



3rd INTERNATIONAL CONFERENCE on FOOD, AGRICULTURE and VETERINARY

19 - 20 JUNE 2021 / IZMIR

CONFERENCE PROCEEDINGS BOOK

EDITORS

Prof. Dr. Behcet KIR

Assoc. Prof. Dr. Seyithan SEYDOSOGLU



**3rd INTERNATIONAL CONFERENCE
on FOOD, AGRICULTURE AND VETERINARY**

PROCEEDINGS BOOK

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Issued: 05/07/2021

ISBN: 978-625-7720-43-4

CONFERENCE ID

CONGRESS TITLE

**3rd INTERNATIONAL CONFERENCE
on FOOD, AGRICULTURE AND VETERINARY**

DATE-PLACE

June 19-20, 2021
Izmir, TURKEY

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Ege University

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TOTAL ACCEPTED ARTICLE

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CONFERENCE PROGRAM



3rd INTERNATIONAL CONFERENCE ON FOOD, AGRICULTURE AND VETERINARY

EGE UNIVERSITY, TURKEY

June 19-20, 2021



www.zoom.us

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- The presentation will have **15 minutes** (including questions and answers).
- The Zoom application is free and no need to create an account.
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- During the session, your camera should be turned on at least %70 of session period
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- Kongremizde Yazım Kurallarına uygun gönderilmiş ve bilim kurulundan geçen bildiriler için online (video konferans sistemi üzerinden) sunum imkanı sağlanmıştır.
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**Zoom'a giriş yaparken önce lütfen adınızı, soyadınızı ve SALON
numaranızı yazınız**

Örnek: Salon-1, Behçet KIR

-Opening Speech-

Date: 19.06.2021

Ankara Time: 09:40 -10:00

Prof. Dr. Behçet KIR

Ege University Department of Field Crops
Chairman of the Organizing Committee

Dr. Mustafa Latif EMEK

Chairman of IKSAD

Prof. Dr. Nedim KOŞUM

Ege University Faculty of Agriculture Dean
President of the Conference

Prof. Dr. Necdet BUDAK

Rector of Ege University

Participating Countries: Turkey, USA, Azerbaijan, Argentina, Brazil, Bulgaria, Algeria, China, Indonesia, Morocco, France, South America, India, Iraq, Iran, Spain, Italy, Kazakhstan, Malaysia, Nepal, Nigeria, Uzbekistan, Pakistan, Romania, Russia

Zoom Meeting ID: 572 394 7582

Zoom Passcode: 030303

19.06.2021
SATURDAY / 10:00-12:30

Zoom Meeting ID: 572 394 7582

Zoom Passcode: 030303

(All speakers required to be connected to the session 15 min before the session starts)

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SESSION-1, HALL-1/OTURUM-1, SALON-1

MODERATOR: Prof. Dr. Hakan GEREN

AUTHOR	AFFILITION	ABSTRACT TITLE
Reza TAMARTASH Fateme MONTAZERI	<i>Faculty Member of Sari Agricultural Sciences and Natural Resources University</i>	A Study of Relief Effect on Grazing in Summer Rangelands of Mazandaran Province, Iran
Hadi Pirasteh-Anosheh Gholamhassan Ranjbar Amir Parnian Nudrat Aisha Akram	<i>National Salinity Research Center</i>	Evaluation of Forage Quantity And Quality of Some Halophytes Species
Fateme Montazeri Reza Tamartash	<i>Faculty Member of Sari Agricultural Sciences and Natural Resources University</i>	The Relationship Between Rainfall and Forage Production in Summer Rangeland of Kiasar, Iran
OYEDIRAN Wasiu Oyeleke	<i>Federal University of Agriculture</i>	Agricultural Extension Training on Youths' Empowerment Opportunities Through Modernized Animal Husbandry In Nigeria
Erdal ÇAÇAN Şerafettin KORTAK	<i>Bingol University</i>	Determination of Yield, Quality and Grazing Capacity of Elazığ Province Karakoçan District Başyurt Village Pasture
Atman ADIBA Jamal CHARAFI Abdelmajid HADDIOUI Hakim OUTGHOULI Inas ZAYANI Anas HAMDANI Rachid RAZOUK	<i>National Agricultural Research Institute</i>	Rooting and vegetative growth of hardwood cuttings of eighteen pomegranate (<i>Punica granatum</i> L.) cultivars
Cevat ÖZBEK Behçet KIR	<i>Ege University</i>	Investigations on The Effects of Nitrogen Fertilizer on Seed Yield with Yield Properties of Second Crop Maize in Aksaray Region
Hakan GEREN Yaşar Tuncer KAVUT	<i>Ege University</i>	The Potential of Triticale Forage as a Source of Animal Feed
Maryam Saffariha	<i>University of Tehran</i>	Forage Quality of <i>Salvia limbata</i> in Rangeland

19.06.2021
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SESSION-1, HALL-2/OTURUM-1, SALON-2

MODERATOR: Prof. Dr. Fatma AYKUT TONK

AUTHOR	AFFILITION	ABSTRACT TITLE
Vesile SEMSEK	<i>Azərbaycan Dövlət İqtisad University</i>	Animal Rights in Islam on the Relationship of The Prophet With Animals
Ahmet Doğan DUMAN Dilara Sena DUMAN Mustafa DİDİN	<i>Hatay Mustafa Kemal University</i>	Mycotoxins and Risk Management in Agricultural Commodities
HAMDAOUI Nora MOUNCIF Mohamed OMARI Abdeloudoude MEZIANE Mustapha	<i>University Mohammed</i>	Lipolytic And Proteolytic Activities Of Two Genera Of Lactic Acid Bacteria (Lactobacillus and Lactococcus)
Meltem AYAZ	<i>Republic of Turkey Ministry of Agriculture and Forestry</i>	An Overview of The Criteria to Be Considered in Silage Corn Variety Breeding Programs
HAMDANI Anas CHARAFI Jamal BOUDA Said Adiba Atman RAZOUK Rachid	<i>Morocco University</i>	Yield and Fruit Quality of Plum Under Deficit Irrigation
Abdurrahim YILMAZ Hakkı Ekrem SOYDEMİR Vahdettin ÇİFTÇİ	<i>Bolu Abant İzzet Baysal University</i>	Land Consolidation Problem in Turkey
Shathar A Imran Alaamer Hussein R. Nayyef Salih K. Alwan Alsharifi	<i>University of Al- Furat Alwsat Technical</i>	Effect of Grain Moisture Contents (MC) and Clearances Between Cylinders (CBC) on Rice Husking
Abdurrahim YILMAZ Hakkı Ekrem SOYDEMİR Vahdettin ÇİFTÇİ	<i>Bolu Abant İzzet Baysal University</i>	Use of Drone Technology in Agricultural Areas
Salih K. Alwan Alsharifi Shathar .A. Imran Alaamer Hussein R. Nayyef	<i>University of Al- Furat Alwsat Technical</i>	Effect of Sowing Methods, Sowing Depth and Sowing Distances on Some Characteristics of Growth and Wheat Yield
Çiğdem YAMANER	<i>Isparta Uygulamalı Bilimler University</i>	Evaluation of Postharvest Cooling Methods on The Microbial Quality and Storage Of Different Fresh Fig

19.06.2021
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SESSION-1, HALL-3/OTURUM-1, SALON-3

MODERATOR: Prof. Dr. Bulent OKUR

AUTHOR	AFFILIATION	ABSTRACT TITLE
Perihan UYSAL ADIGÜZEL Recep Serdar KARA Bülent OKUR Bülent YAĞMUR	<i>Ege University</i>	Soil Salinization and Biochar Applications
Bharti CHAUDHRY	<i>University of Delhi</i>	Pseudocereals and Millets: Gluten-Free, Nutrient-Dense Traditional Grains
Mahmut TEPECİK H. Hüsnü KAYIKÇIOĞLU Ali Rıza ONGUN Sezai DELİBACAK Ömer Lütfü ELMACI Emre İLKER A. Esen ÇELEN	<i>Ege University</i>	The Effect of Treatment Sewage Sludge Applications on The Physical And Chemical Properties of Soil
SALEJ Sood VINAY Bhardwaj SK Kaushik SANJEEV Sharma Dalamu MEHI Lal MANOJ Kumar	<i>ICAR-Central Potato Research Institute</i>	Genetic Gain Enhancement through Estimated Breeding Values using Pedigree BLUP in Potato (<i>Solanum tuberosum</i> L.)
Mehmet KARAMAN	<i>Muş Alparslan University</i>	Comparison of Bread Wheat (<i>Triticum aestivum</i> L.) Lines With Registered Varieties In Terms of Quality Features
Rafika Febriani Mei Meihana Benyamin Lakitan Mery Hasmeda	<i>Universitas Sriwijaya</i>	Depth of Water Table during Early Generative Phase Affected Growth and Yield more than Duration of Its Exposure in Tomato
Mine PAKYÜREK Arzu ÇIĞ	<i>Siirt University</i>	The Effect of Bacterial Application on The Rooting of Zivzik Pomegranate Cuttings
Bozhidar KYOSEV Gergana DESHEVA Evgenia VALCHINOVA	<i>Institute of Plant Genetic Resources</i>	Genetic Diversity of 46 Accessions From <i>Triticum boeoticum</i> Boiss.

19.06.2021
SATURDAY / 10:00-12:30

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SESSION-1, HALL-4/OTURUM-1, SALON-4

MODERATOR : Assoc. Prof. Dr. Ozgur TATAR

AUTHOR	AFFILIATION	ABSTRACT TITLE
Aboukhalaf Abdelghani Moujabbir Sara El Amraoui Belkassem Belahsen Rekia	<i>Ibn Zohr University</i>	Traditional Knowledge and Use of Wild Food and Medicinal Plants in Sidi Bennour Region (Central Morocco)
Soner ÖNDER Özge UÇAR	<i>Siirt University</i>	Effects of Salt Stress on Beans (<i>Phaseolus vulgaris</i> L.) and Applications to Increase Salt Tolerance
Solmaz Ghanbari Reza Farshbaf Pour Abad	<i>University of Tabriz</i>	Investigating the Effect of Several Sensitive and Resistant Wheat Cultivars on the Amount of Protein in Guts, Fat Bodies and Digestive Enzymes Activities in Adults of Sunn Pest, <i>Eurygaster integriceps</i> (Hemiptera: Scutelleridae)
Damla YILMAZ Gul Ebru ORHUN	<i>Canakkale Onsekiz Mart University</i>	Investigation of the Usability of Boron-Removed Geothermal Resources in Wheat Farming
Zhi-Jun Chen Chen Gao Jui-Chin Chen Chi-Hui Tsou	<i>Sichuan University of Science and Engineering</i>	Preparation of Biodegradable Composites With Distiller's Grains as Biomass Filler
Gülizar PINAR Fatih KAHRIMAN	<i>Canakkale Onsekiz Mart University</i>	Morphological, Spectral and Molecular Characterization Of Different Size Of Pollens Obtained From Inducer Maize Line
Yuriy L. ORLOV Arthur I. DERGILEV Nina G. ORLOVA	<i>Novosibirsk State University</i>	Statistical Estimates of Genome Repeats In Plant Gene Regulatory Regions Related To Environment Stress Response
Bülent AYHAN Hasan Hüseyin ÖZTÜRK	<i>Cukurova University</i>	A Research on the Use of Vacuum Tube Collectors For Greenhouse Heating With Solar Energy
Paria Allahverdi beyk Omid Atghia Maryam Fallahi Amir Mirzadi Gohari	<i>University College of Agriculture and Natural Resources</i>	Application of Salicylic Acid As An Organic Elicitor to Manage Green Mold And Black Rot of Lemons Caused by <i>Penicillium Digitatum</i> and <i>Alternaria Alternata</i>

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SESSION-1, HALL-5/OTURUM-1, SALON-5

MODERATOR: Assist. Prof. Dr. Deniz ISTIPLILER

AUTHOR	AFFILIATION	ABSTRACT TITLE
Zhenisbay KABARZHAN Nurbanu SAPANOVA	<i>Al-Farabi Kazakh National University</i>	Stimulation of Plant Root Formation by Rhizosphere Bacteria <i>Pseudomonas putida</i>
Aynur BİLMEZ ÖZÇINAR	<i>Siirt University</i>	The Effect of Different Planting Times on Potato (<i>Solanum tuberosum</i> L.)
Li Xinqian Wang Yuanyuan Zhao Wenjing Li Huanbo Shi Yue Yang Ying	<i>Central South University of Forestry and Technology</i>	Effects of Dietary Fiber From Rice Bran on the Starch Digestive Properties and Postprandial Blood Glucose of Dried Noodles
Tuğçe ÖZDOĞAN ÇAVDAR Hüseyin YILDIZ Özlem ÇEVİK Hakan GEREN	<i>Ege University</i>	A Preliminary Study on The Effect of Different Nitrogen Levels on The Grain Yield and Some Agronomical Components Of Triticale (x <i>Triticosecale</i> Wittmack)
Mukesh Kumar Lokesh Rana Amruta Pattnaik	<i>University of Delhi</i>	Solar Tree – A Sustainable Energy Approach For Farmers
Mohamad Saeid Mohammadi Elias Soltani Fateme Amini Iraj Alahdadi	<i>University of Tehran</i>	Application of Zinc Oxide Nanoparticles on Rapeseed (<i>Brassica napus</i> L.) Seedling Growth and Yield Under Salinity Stress
R. Mary Nancy Floraa S. Palanib M. Chamundeeswaric	<i>Department of Chemical Engineering, Arunai Engineering College</i>	Bionanocomposite for Antimicrobial Activity - A Novel And Green Synthesis Approach
Zeynep DUMANOĞLU Sıdıka EKREN	<i>Ege University</i>	A Research on Determination of Some Physical And Physiological Properties Of Tobacco Seeds (<i>Nicotiana tabacum</i> L.) From Different Years
Xin Zhao Yuanyuan Wang Huanbo Li Ying Yang	<i>Central South University of Forestry and Technology</i>	Effect of Concentration-induced Sodium Alginate Gel on Edible Quality and Digestion Characteristics of Convenient Rice Noodles
Salih K. Alwan Alsharifi Shathar .A. Imran Alaamer Hussein R. Nayyef	<i>University of Al- Furat Alwsat Technical</i>	Effect of sowing methods, sowing depth and sowing distances on some characteristics of growth and wheat yield

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SESSION-1, HALL-6/OTURUM-1, SALON-6

MODERATOR: Assoc. Prof. Dr. Cigdem SONMEZ

AUTHOR	AFFILITON	ABSTRACT TITLE
Hong Zhang	<i>Texas Tech University</i>	Increasing Crop Yield by Improving Abiotic Stress Tolerance
Sipan SOYSAL	<i>Siirt University</i>	An Review of Biostimulant Applications on Wheat Crop
Devpriya Sarkar	<i>Jawaharlal Nehru University</i>	Traditional Agricultural Practice (Jhum-kheti) to Organic Farming in Nagaland: A Transition of Social and Cultural Dimensions
Mehmet Firat BARAN	<i>Siirt University</i>	Analysis of Some Energy Values of Grain Stem Wastes In Batman Province
Firoj A. Tamboli Harinath N. More	<i>Bharati Vidyapeeth College of Pharmacy</i>	Nutraceuticals: Emerging Trends in Healthcare and Medicine
Zeynep NAS Ahmet EŞİTKEN	<i>Selcuk University</i>	Investigation of In Vitro Micro Propagation Properties of 42-01 Zerdali Genotype Indicating Rootstocks Potential
Sofia BRONNIKOVA Anastasia STOINOVA	<i>Peoples' Friendship University of Russia</i>	Analysis of Toxicity Of Nanoparticles Of Different Nature
M. Reşit TAYSI Muammer KIRICI Ersin KARAKAYA	<i>Bingol University</i>	Evaluation of Fish Meat Consumption in Tra1 and Trc3 Regional Provinces
Ayobami Ademola AKANMU Umar Obafemi SALISU Simeon Oluwagbenga FASINA Sekinat Motunrayo SANNI Oluwatobi Maria OLATUNJI Abimbola Simiat OGUNSESAN Ebenezer Tayo ADEDEJI	<i>Federal University of Technology</i>	Rural Travel Pattern and Transport Operation in Lagelu Local Government Area Of Oyo State, Nigeria

19.06.2021
SATURDAY / 13:00-15:30

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SESSION-2, HALL-1/OTURUM-2, SALON-1

MODERATOR: Assoc. Prof. Dr. Oktay YERLIKAYA

AUTHOR	AFFILIATION	ABSTRACT TITLE
Tang Shuang He Lali Wang Yuanyuan Chen Yiting Yang Ying	<i>Central South University of Forestry and Technology</i>	Effect of Aging Process on Edible Quality of Instant Rice Noodles
Mükremin ÖLMEZ Mustafa MAKAV	<i>Kafkas University</i>	Investigation of Antioxidant Effects of Ginger (<i>Zingiber officinale</i>) Essential Oil on Lung and Kidney in Rats
Suman Lata H. K. Verma	<i>Sharda University</i>	Individual Parameter Based Software Monitoring Modules for Greenhouse
Bülent YAĞMUR Nur OKUR Bülent OKUR	<i>Ege University</i>	The Effect of Organomineral And Inorganic Fertilizer Applications on Yield And Mineral Element Uptake Of Corn Plant
Sanda VOÎNEA Cornelia NÎCHÎTA Cornelia DÎAC Paul DOGARU	<i>University of Bucharest</i>	Bioremediation Technology Of Soils Polluted With Hydrocarbons And Heavy Metals Using Natural Biodegradable Absorbent And Organic Accelerators
Recep İrfan NAZLI	<i>Cukurova University</i>	The Effects of Different Dilute Acid and Alkali Pretreatments on Fermentable Sugar and Etanol Production From Switchgrass (<i>Panicum virgatum</i> L.).
Dinnara SILVA Luana CORDEIRO Danilo BRAZ Maria ANDRADE	<i>Universite State of the Piauí</i>	Surface Modifications in Desmanthus Virgatus Seeds Through Low Pressure Plasma Treatment
Esra GÜRSOY	<i>Ağrı İbrahim Çeçen University</i>	Harvest Time and the Effect of Fertilizer Applications in Different Ratios on Mineral Material Content of Different Grain-Legumes Feed Plants
Alexander N. IGNATOV Elena N. PAKINA Anton N. LUZIN Yuriy L. ORLOV	<i>Peoples' Friendship University of Russia</i>	Plant Virus Genome Studies Using Bioinformatics Tools

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SATURDAY / 13:00-15:30

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SESSION-2, HALL-2/OTURUM-2, SALON-2

MODERATOR: Assoc. Prof. Dr. Gulsum OZTURK

AUTHOR	AFFILITION	ABSTRACT TITLE
Stanislava Stateva	<i>Institute of Plant Genetic Resources</i>	Regeneration of Explants of The Species <i>Glycyrrhiza glabra</i> L.
Gülsüm ÖZTÜRK	<i>Ege University</i>	Effect on Potato Mini Tuber Yield Of Different Row Distance
Ibtissame GUIRROU Abdelghani NABLOUSSI Abderraouf EL ANTARI Lahcen HSSAINI Hafida HANINE Abdelhay EL HARRAK	<i>Institut National de la Recherche Agronomique</i>	Effect of Cropping Environment on Some Oil Quality Parameters in Moroccan Rapeseed (<i>Brassica napus</i> L.)
Murat KILIÇ	<i>Ege University</i>	A New Method For Optimum Design Of The Blocked End Furrow System: I. Method
Amir Parnian Hossein Beyrami	<i>National Salinity Research Center, Agricultural Research, Education and Extension Organization</i>	Different Thicknesses of An Organic Mulch Effect on Movement and Accumulation of Some Elements In Soil
Murat KILIÇ	<i>Ege University</i>	A New Method For Optimum Design of The Blocked End Furrow System: Ii. Application
Amir Parnian Amin Parnian Hadi Pirasteh-Anosheh	<i>National Salinity Research Center (NSRC), Agricultural Research Education and Extension Organization</i>	Bioremediation of crude oil contaminated soil, case study: co-composting of 1200 cubic meters of saline soil in Arvandan Oil & Gas Company area, Iran
Murat BİROL Elif GÜNAL	<i>Black Sea Agricultural Research Institute</i>	Agricultural Use of Wood Vinegar
Amir Parnian Amin Parnian Hadi Pirasteh-Anosheh	<i>National Salinity Research Center (NSRC), Agricultural Research Education and Extension Organization</i>	Diesel-Oil-Contaminated Solids Bioremediation Using Reactor Composting

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SESSION-2, HALL-3/OTURUM-2, SALON-3

MODERATOR: Assoc. Prof. Dr. H. Hüsnü KAYIKCIOGLU

AUTHOR	AFFILIATION	ABSTRACT TITLE
Soundharya M T.Blesslin Sheeba A. Vijayalakshmi	<i>RMK Engineering College</i>	Solar Based Mobile Charger For Rural Areas
Mehmet SÜTYEMEZ Betül EKİN	<i>Kahramanmaraş Sütçü İmam University</i>	Evaluation of Turkey Apricots Sapling Production
Snehaa S Meena M Vijayalakshmi A	<i>RMK Engineering College</i>	Role of Sensors In Smart Agriculture
Burcu Demet GÜN Bilal ŞAHİN Ziya MUTLU Öztekin URLA	<i>Çankırı Karatekin University</i>	Floristic Features of Sivas, Ankara, Kayseri Provinces Passages
Maryam Rahimi Jahangirlou Gholam Abbas Akbari Iraq Alahdadi Saeid Soufizadeh David Parsons	<i>University of Tehran</i>	Combined Use of APSIM and Logistic Regression Model to Predict the Quality Characteristics of Maize Grain
Derya ERBAŞ	<i>Isparta Uygulamalı Bilimler University</i>	Preharvest Salicylic Acid Treatment Impact on The Fruit Quality Properties Of Peach cv. Monreo
Sergey ELANSKY Elena CHUDINOVA Stanislav MISLAVSKY Mikhail KURCHAEV Vladislav PLATONOV Alexander ELANSKY	<i>Peoples Friendship University of Russia</i>	New Potato and Tomato Pathogens In Russia
Ahmet CELİK Miraç KILIÇ	<i>Adıyaman University</i>	Determination of Net Primary Production Level in Meadows and Pastures
Elena CHUDINOVA Anastasia KARNIZ Alexander ELANSKY Sergey ELANSKY	<i>Peoples Friendship University of Russia</i>	Chaetomium Globosum as A Promising Biocontrol Agent For The Protection of Potato Tubers

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SESSION-2, HALL-4/OTURUM-2, SALON-4

MODERATOR: Dr. Adem GOKCOL

AUTHOR	AFFILIATION	ABSTRACT TITLE
Kamile ULUKAPI Ayse Gul NASIRCILAR	<i>Akdeniz University</i>	The Role of Silicone Applications in Tolerance to Abiotic Stress Conditions
Al Ameen. M K.S Chandrasekar	<i>University of Kerala</i>	Future Aspects of Solar Farming in Agriculture With Reference To India
Ayşe Gul NASIRCILAR Kamile ULUKAPI	<i>Akdeniz University</i>	Changes In Free Amino Acid Profiles Of Plants Under Drought And Salt Stress Conditions
Asha Devi. J K.S Chandrasekar	<i>University of Kerala</i>	A Study on Agricultural Banks In India
Gülcan KOYUNCU Turgut CABAROĞLU	<i>Kilis 7 Aralık University</i>	The Effect of Storage Time on Volatile Compounds And Sensory Properties Of Table Olives Fermented Using Starter Culture
Sumi A. M. K.S Chandrasekar	<i>University Of Kerala</i>	Responsibilities Of Water Management In Hotel Industries With Reference To Kerala, India
Muhammad Massub TEHSEEN Fatma AYKUT TONK Muzaffer TOSUN Deniz ISTIPLILER Ahmed AMRI Carolina P. SANSALONI Ezgi KURTULUS Muhammad Salman MUBARIK Kumarse NAZARI	<i>Ege University</i>	Genetic Diversity And Population Structure of A Bread Wheat Landrace Population From The Fertile Crescent
Hamida TAIBI Abdelkader BOUDERBALA Sami TOUIL	<i>University of Khemis Miliana</i>	Sustainable Water And Fertilizer Management In A Semi-Arid Climate For The Optimization of Agricultural Production
Hayriye Yıldız DAŞGAN	<i>Cukurova University</i>	Use Of Bio-Fertilizers to Reduce Mineral Nutrients In Soilless Grown Lettuce In Kokopit

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SESSION-2, HALL-5/OTURUM-2, SALON-5

MODERATOR: Assoc. Prof. Dr. Cigdem SONMEZ

AUTHOR	AFFILIATION	ABSTRACT TITLE
Shagufta Saeed Sehrish Firyal	<i>University of Veterinary and Animal sciences</i>	Production of Polyhydroxy Butyrate by Agriculture Waste Using Solid State Fermentation
Arzu KOÇAK MUTLU	<i>Siirt University</i>	Effect of Sound Waves on Biological System
Imane Smatti-Hamza Dounia Keddari Smail Mehennaoui Fatima-Zohra Afri-Mehennaoui	<i>Laboratory Biology and Environment, Frères Mentouri Constantine University</i>	Monitoring of heavy metals content in sediments collected from Koudiet Medouar Dam and its tributary (Batna, Algeria)
Pelin ALABOZ	<i>Isparta Uygulamalı Bilimler University</i>	The Effect of Mycorrhiza and Bacteria Applications on Soil Aggregation
Shulammit Amubieya Luke C. Nwosu Usman Zakka Owolabi M. Azeez Victor C. Okereke Akubuike N. Eluwa Gerald M. Ugagu Godfrey M. Petgrave Christian C. Iwuagwu Uwaoma O. Aguwa Oyinlola A. Ajayi	<i>Department of Crop and Soil Science, University of Port Harcourt</i>	Effect of X-ray Irradiation and Oven- Drying on The Bionomics of Acanthoscelides Obtectus Say (Coleoptera: Chrysomelidae) Infesting Common Bean in Storage: Can X-ray Irradiation Affect Seed Viability After Pest Control Process?
Anirbid Sircar Kriti Yadav	<i>Pandit Deendayal Petroleum University</i>	Honey Extraction using Geothermal Water: Case study from India
Gülen ÖZYAZICI	<i>Siirt University</i>	Effect of sowing dates and nitrogen levels on yield and quality of black cumin (<i>Nigella sativa</i> L.)
Guliang Yang	<i>Central South University</i>	Pterostilbene Plus Physical Exercise Prevented Collagen Induced Rheumatoid Arthritis Via The Maresin-1 NF- κ B/ Autophagy Signal Axis
Alırza Deniz EVREN Hasan Hüseyin ÖZTÜRK	<i>Cukurova University</i>	Determining The Potential of The Plant And Animal Biomass Assessed For Biofuel Production at Beydere Seed Certification Test Directorate

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SESSION-2, HALL-6/OTURUM-2, SALON-6

MODERATOR: Assoc. Prof. Dr. Sıdıka EKREN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Erdal KARADENİZ	<i>Mardin Artuklu University</i>	Determination of Silage Quality of Grasspea (<i>Lathyrus sativus</i> L.) and Oat (<i>Avena sativa</i> L.)
SAGHOURI EL IDRISSE Imane KETTANI Rajae FERRAHI Moha BRHADDA Najiba ZIRI Rabea	<i>National Institute of Agronomic Research</i>	Comparative Study Of Biochemical Mechanisms Of Resistance To Water Stress In Sixteen Advanced Lines Of Durum Wheat (<i>Triticum durum</i> Desf.)
Sezgi ARMAN	<i>Sakarya University</i>	Histopathological Effects Of Triclosan Exposure On Zebrafish (<i>Danio rerio</i>) Kidney Tissue
Alexander N. IGNATOV Maya V. VORONINA Fevzi S. DZHALILOV Konstantin A. MIROSHNIKOV	<i>Peoples' Friendship University of Russia</i>	Biocontrol Of Bacterial Plant Diseases By Bactriophage Application
Sıdıka EKREN	<i>Ege University</i>	General Situation of Tobacco Production In Turkey
Sodir MELIEV Saidmurad BABOEV Xolliev OYBEK	<i>Institute of Genetics and Plants Experimental Biology</i>	Adaptation To Climate Change Of Wheat Bread In Conditions Uzbekistan
Burak YILDIRIM Mehmet HAMURCU	<i>Selçuk University</i>	Investigation Of Biochemical Changes Caused By Trehalose Applications In Wheat Under Boron Stress Conditions
Dilfuza JABBOROVA Mohina FAYZULLAEVA	<i>Institute of Genetics and Plants Experimental Biology</i>	Identification And Characterization Of Endophytic Bacteria Isolated From Ginger (<i>Zingiber officinale</i>) Grown In Tashkent Region, Uzbekistan
Müge KİRMİKİL Bilge TERZİOĞLU Aleyna DURGUT	<i>Bursa Uludağ University</i>	The Importance Of Interview On The Land Consolidation Projects The Case Study In Kesik Village

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SESSION-3, HALL-1/OTURUM-3, SALON-1

MODERATOR: Prof. Dr. Ferit TURANLI

AUTHOR	AFFILIATION	ABSTRACT TITLE
Umudjon BAKHODIROV	<i>Institute of Genetics and Plants Experimental Biology</i>	Determination Of Dn Genes Of Soft Wheat (<i>T. aestivum</i> L) Resistant To Russian Wheat Aphids In The Condition Of Uzbekistan
Umut SUZAN Hatice GÜRGÜLÜ	<i>Ege University</i>	Estimation Of Reference Plant Water Consumption (Eto) For Izmir With Multiple Linear Regression Models
Khurshid SULAYMANOV Alimjon MATCHANOV Farrukh TASHPULATOV Dilfuza JABBOROVA	<i>Institute of Genetics and Plants Experimental Biology</i>	Phytochemical Evaluation, Curcumin, Flavonoid And Total Proteins Contents Of Turmeric (<i>Curcuma longa</i> L.) Rhizomes Grown In Different Regions Of Uzbekistan
Ahmet DİNÇ Yeşim TOĞAY	<i>Muğla S.K. University</i>	The Effects Of Vermicompost and Microbiological Manures On The Yield And Yield Components In Chickpea (<i>Cicer arietinum</i> L.)
Ruqayyah S. Y. Hassan A. J. Busari, M. B	<i>Bauchi State University</i>	Acute toxicological effects, In vitro and In vivo Antimalarial Activities of Aqueous Root Bark Extract of <i>Calotropis procera</i>
Deniz AYDOĞAN Gülcan DEMİROĞLU TOPÇU	<i>Ege University</i>	Agriculture In The Covid-19 Process
Hassan Aliyu Corrienna Abdul Talib Faruku Aliyu Bilkisu Umar Mani	<i>Sokoto State University</i>	Inclusion of Sustainable Progress STEM in Education for Renewable Energy into Nigeria's Secondary School Curriculum
Arda SÖZCÜ Aydın İPEK Merve GÜNDÜZ	<i>Bursa Uludağ University</i>	Intestinal Histomorphology And Cecal Microflora Of Broilers Supplemented With Liquid Garlic (<i>Allium sativum</i> L.) Extract
Sona S Dev Chikku Santhosh Greeshma James	<i>St. Peter's College</i>	Characterization, Antibacterial and Dye Degrading Activity of Silver Nanoparticle Synthesized From Methanolic Leaf Extract of <i>Ayapana triplinervis</i>

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SESSION-3, HALL-2/OTURUM-3, SALON-2

MODERATOR: Assoc. Prof. Dr. Mahmut TEPECİK

AUTHOR	AFFILIATION	ABSTRACT TITLE
Sellami Wafae Bendidi Abderrazzak Daoui Khalid Ibriz Mohammed	<i>University Ibn Tofail Kenitra</i>	Effect of Cropping Practices (no-till, minimum till, chisel plough and deep plough) on Agronomic Parameters on the Production of Bread Wheat (<i>Triticum aestivum</i>)
Büşra ALTINTAŞ Mustafa BAYRAM	<i>Tokat Gaziosmanpaşa University</i>	Antiviral Effects Of Bioactive Compounds
Sanjaya Kumar Sahoo Sukanta Chandra Swain	<i>KIIT Deemed to be University</i>	Role of Repatriated Migrants in Strengthening Supply Chain of Agricultural Produce of Rural Odisha
Firdevs ERSİN	<i>Ege University</i>	Predation Potential Of Typlodromus Recki (Acari: Phytoseiidae) In Biological Control Of Frankliniella Occidentalis (Thysanoptera: Thripidae)
Dzhumadil CHILDIBAEV Nurbanu SAPANOVA Zhenisbay KABARZHAN	<i>Abay Kazakh National Pedagogical University</i>	Formation Of Ecological Education And Ecological Culture Among Students Of The Agricultural Area
Emine AYDIN	<i>Düzce University</i>	Forest Fruits As A Healthy Snack: Dried Cornelian CherrY (<i>Cornus mas L.</i>) And Dried Arbutus Berry (<i>Arbutus unedo</i>)
Siti Nor Akmar ABDULLAH	<i>Universiti Putra Malaysia</i>	Unraveling Early Defence Response Of Oil Palm Against The Hemibiotrophic Fungal Pathogen, Ganoderma Boninense Towards Development Of Effective Control Measures
Arzu MUTLU	<i>Harran University</i>	The Importance Of Nitrogen Fertilization In Malting Barley
Bucur SORİNEL – İONEL	<i>Romanian Academy</i>	Reources And Uses Of The Forest Sector In Romania

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SESSION-3, HALL-3/OTURUM-3, SALON-3

MODERATOR: Assist. Prof. Dr. Deniz ISTIPLILER

AUTHOR	AFFILIATION	ABSTRACT TITLE
Boryana DULGEROVA Nikolay DULGEROV	<i>Institute of Agriculture</i>	Agronomic Characteristics Of Winter Barley Mutant Lines
Fadime CANBULAT Levent ÜNLÜ	<i>Selçuk University</i>	Determination Of Adult Population Development And Infestation Rates Of Olive Fly [Bactrocera Oleae (Gmel.) (Diptera: Tephritidae)] in Olive Orchards in Ermenek (Karaman)
Boryana DULGEROVA Nikolay DULGEROV	<i>Institute of Agriculture</i>	Variation Of Morphological And Agronomic Traits Of Hulless Barley Accessions
Gafur GÖZÜKARA	<i>Eskişehir Osmangazi University</i>	Determination Of Weathering Rate Of Surface Soil Using Pxrif
A. Biryukova A. Petrov E. Kharlitskaya M. Bolshakova	<i>RUDN University</i>	Effect Of Pesticides On Soil Biocenosis
Sıla BARUT GÖK	<i>Tekirdağ Namık Kemal University</i>	Chemical constituents of essential oil and water extract of Mentha longifolia (L.) Huds. growing in Turkey
Seydedeh Mohadeseh Ehsani	<i>Gorgan university</i>	The Impact of Soil Communities on Biodiversity in North of Iran
Tuba ŞERBETÇİ Sabriye AYDINOĞLU	<i>Çukurova University</i>	Elemental Analysis Of Hypericum Triquetrifolium By Inductively Coupled Plasma-Mass Spectrometry
Sundaresha, S Neha Salaria Vinay Bhardwaj Salej Sood Kajol Thakur Ashwani Kumar Neha Sharma Umesh Goutam	<i>Lovely Professional University</i>	Overexpression of CDF1.2 allele mediates early maturity and tuberisation in late maturing potato cultivar

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SESSION-3, HALL-4/OTURUM-3, SALON-4

MODERATOR: Assoc. Prof. Dr. Ozgur TATAR

AUTHOR	AFFILIATION	ABSTRACT TITLE
Deepa Biswal	<i>Fakir Mohan University</i>	The Impact of Sources of Credit on Farmer's Distress – A Study in Balasore District
Serap GÖNCÜ Gökhan GÖKÇE Bilge Nur GÖKÇE	<i>Çukurova University</i>	Milk Consumption Habits of Elementary School Students in Rural Families of Adana Province
Horiya Gadoum Valentim Coelho Abdallah Noui Lurdes Jorge Eugénia Gouveia	<i>Hassiba Benbouali University of Chlef</i>	Evaluation of virulence and the oxalic acid production on <i>Cryphonectria parasitica</i> virulent and converted strains by CHV1 hypovirus
Taha HIJAZI Salih KARASU Zeynep Hazal TEKIN-CAKMAK Fatih BOZKURT	<i>Yıldız Teknik University</i>	Modeling Of Thixotropic Behavior Of The Gum Solution Obtained From Oil Industry By-Products: Chia Seed Oil By-Product Gum, Flaxseed Oil By-Product Gum And, Rocket Seed Oil By-Product Gum
Aditya	<i>Aligarh Muslim University</i>	Rural Development
İlkay YAVAŞ H. İlker ÖZDEMİR Burcu KESER	<i>Aydın Adnan Menderes University</i>	Phytochemical Profiles And Antifitoviral Activities Of Some Medicinal Plant Essential Oils
Tokede A.M. Ahmed A.O	<i>Department of Forest Economics and Extension Forestry Research Institute of Nigeria</i>	Urbanites Awareness, Perception And Attitudes Towards Urban Forestry As A Panacea For A Sustainable Environment In Ogun State, Nigeria: A Survey Of Covid-19 Era
Hasan KARAOSMANOĞLU	<i>Giresun University</i>	Packaging Materials in Hazelnut and Hazelnut Products
Sushil Kumar Singh	<i>Vivekananda College of Technology & Management Aligarh</i>	Natural Fiber-Reinforced Composite Properties And Application In Beam Design: A Review

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SESSION-3, HALL-5/OTURUM-3, SALON-5

MODERATOR: Assoc. Prof. Dr. Hakan GEREN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Elsevar Farzaliyev	<i>Azerbaijan State Economic University</i>	Innovative Potential Of Pectin Substances In The Structure Of Functional Food Products
Saliha DİNÇ Meryem KARA	<i>Selçuk University</i>	Carbon Dot Based Biosensors And Food Safety
Muhammad Kamran Khan	<i>Government College University</i>	Application Of Ultrasound In Extraction Of Polyphenols From Food By-Products
Hayrullah Bora ÜNLÜ Ramazan ERKEK	<i>Ege University</i>	Effects Of Using Phytase Enzyme In Broiler Diets On Feed's Phosphorus Utilization And Performance
Hardi D. JOSHI Navin SHETH Nasir VADIA Sanjay CHAUHAN	<i>Gujarat Technological University</i>	Development and validation of LC-MS method for the determination of selected Pesticide residues from Vegetables in the Rajkot region
Onur KETENOĞLU	<i>Eskişehir Osmangazi University</i>	Infrared-Assisted Extraction And Its Applications In Food Products
Muhammad Nadeem Muhammad Imran Awais Khan	<i>University of Veterinary and Animal Sciences Lahore</i>	Impact Of Fractionation On Fatty Acids Profile And Oxidative Stability Of High Oleic Acid Butter
Nur CEYHAN GÜVENSEN	<i>Ege University</i>	The Impact Of Food Additives On The Human Gut Microbiota
Favour C. Uroko	<i>University of Nigeria</i>	Joseph's Agricultural Policy (Genesis 41:46-57) and Food Insecurity in Nigeria

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SESSION-3, HALL-6/OTURUM-3, SALON-6

MODERATOR: Assoc. Prof. Dr. Sıdıka EKREN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Grozi DELCHEV	<i>Trakia University</i>	Productivity Of Express Sun Oil-Bearing Sunflower (<i>Helianthus annuus</i> L.) By Influence Of Some Herbicides, Herbicide Tank Mixtures And Herbicide Combinations
Yakup Onur KOCA	<i>Aydın Adnan Menderes University</i>	The Changes Of Oil Content and Fatty Acid Composition In Corn Seed During The Grain Filling Period
Hossein Beyrami Hossein Rezaei Amir Parnian Hossein Parvizi	<i>National Salinity Research Center</i>	Effect of different mulches on salinity changes and evaporation reduction in soils with different texture
Nesrin Yumak ALNIAK Muhammed YUCEER Cengiz CANER	<i>Çanakkale Onsekiz Mart University</i>	Effectiveness Of Chitosan Coating And Electrolyzed Water Application On Fresh Strawberry Storage Stability
R. Yazdani-Biouki H. Beyrami M. Karimi M.H. Banakar V. Soltani-Gerdfaramarzi	<i>National Salinity Research Center</i>	Estimation of salinity tolerance threshold and some growth characteristics of Purslane (<i>Portulaca oleracea</i> L)
Funda ÖZÜSOY Fatma KOYUNCU	<i>Isparta Uygulamalı Bilimler University</i>	The Effects Of Pre-Harvest Salicylic Acid, Acetylsalicylic Acid And Methyl Salicylate Applications On The Quality Of Sour Cherry (<i>Prunus cerasus</i> L.) Fruit
Subhashini E P. Anusha P A. Vijayalakshmi	<i>RMK Engineering College</i>	Solar Based Cool Cap
Işıl Lavkor F. Bihter ONAT	<i>Çukurova University</i>	Determination Of Charcoal Rot [Macrophomina phaseolina (Tassi) Goid] Resistant Varieties In Soybean
Seydeh Mohadeseh Ehsani Reza Tamartash	<i>Gorgan University Of Agriculture Science And Natural Resource</i>	The effect of altitude and soil surface parameters on plant diversity in north of Iran

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SESSION-1, HALL-1/OTURUM-1, SALON-1

MODERATOR: Prof. Dr. Hatice KALKAN YILDIRIM

AUTHOR	AFFILIATION	ABSTRACT TITLE
Chilakala Likhith Reddy M. Meena P. Suganthi	<i>RMK Engineering College</i>	Applications Of Nanomaterials In Food Adulteration
Cengiz CANER Çiğdem Uysal PALA Muhammed YUCEER Kübra TİRYAKİ	<i>Çanakkale Onsekiz Mart University</i>	The Effect Of Electrolyzed Water And Ultrasonication With Modified Atmosphere Packaging On Storage Stability Of Fresh Strawberry (<i>Fragariaananassa</i>)
Shrinidhi M Meena M Vijayalakshmi A	<i>RMK Engineering College</i>	Sensor Technology In Food Industry
Sipan SOYSAL Özge UÇAR	<i>Siirt University</i>	Response of Lentil (<i>Lens culinaris</i> Medik.) to Abiotic Stres Factors: Deficiency and Toxicity of Micronutrients
V. N. Lad	<i>Sardar Vallabhbhai National Institute of Technology</i>	Improvement Of Rheological Properties Of Food Products
Pınar ŞENGÜN Fadime Begüm TEPE Tolga Kağan TEPE	<i>Pamukkale University</i>	Novel Methods And Pretreatments On The Drying Of Foods
Zhenglu Ma Yuan Lin Tao Yang Chi-Hui Tsou	<i>Sichuan University of Science and Engineering</i>	Application of clam shell recycling in preparation of high-density polyethylene antibacterial bio-composites
Ayşe Burcu AKTAŞ Zelal ARDIÇ	<i>Sivas Cumhuriyet University</i>	Enrichment Of Table Green Olives By Anthocyanins
Rui Zeng Tao Yang Jui-Chin Chen Gao Chen Chi-Hui Tsou	<i>Sichuan University of Science and Engineering</i>	Preparation Of Modified Oyster Shell And Its Application In Polyphenylene Sulfide

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SESSION-1, HALL-2/OTURUM-1, SALON-2

MODERATOR: Prof. Dr. Ferit TURANLI

AUTHOR	AFFILIATION	ABSTRACT TITLE
Rosa P. TIIS Elvira R. GALIEVA Yuriy L. ORLOV Ludmila P. OSIPOVA	<i>Novosibirsk State University</i>	Genetic Adaptation To Metabolism Of Xenobiotics In Relation To Food Safety
Adnan Fatih DAĞDELEN Fatma Tuba PİRİNÇ Özgür KÜÇÜKÇAKIR Büşra Nur KAHRAMAN	<i>Bursa Teknik University</i>	Investigation Of The Use Of Deep Eutectic Solvents As Plasticizers In Flexible Food Films
Khemissi GAIDI Meriem ZIANE	<i>University of Bordj Bou Arreridj</i>	Presentation and evaluation of the agricultural policies for food security in Algeria, Morocco and Tunisia
Kübra AKTAŞ Zeynep ÇINAR	<i>Karamanoğlu Mehmetbey University</i>	The Effects Of The Using Of Lime (<i>Citrus aurantifolia</i>) And Lemon (<i>Citrus Limon</i>) Powders On The Quality Characteristics Of Cookie
Shri Abijith M Meena M Vijayalakshmi A	<i>RMK Engineering College</i>	An Eminent Role Of Nanotechnology In Agriculture And Food Industry
Mustafa Özgür YAYLI	<i>Bursa Uludağ University</i>	Torsional Vibration Analysis Of Protein Microtubules With Elastic Boundary Conditions
R. Harshini A. Vijayalakshmi R. Thinesh Kumar	<i>RMK Engineering College</i>	Role Of Nanotechnology In Food Safety
Abdullah Köse Muhammed Özgölet Muhammed Zeki Durak	<i>Yıldız Teknik University</i>	The Effects of Utilization of Chia, Pumpkin Seed and Flaxseed Flour Mixture Substituted with Gums on Bread Quality Parameters
Simona Rodat	<i>Adventus University</i>	Sustainability Of Food Production In Press Articles On Nutrition: The Case Of The German Online Media

20.06.2021
SUNDAY / 10:00-12:30

Zoom Meeting ID: 572 394 7582
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SESSION-1, HALL-3/OTURUM-1, SALON-3

MODERATOR: Prof. Dr. Mustafa GÜMÜS

AUTHOR	AFFILIATION	ABSTRACT TITLE
Meryem GÖKSEL SARAÇ Tuğba DEDEBAŞ	<i>Sivas Cumhuriyet University</i>	The Use Of Acoustic Method In Determining The Textural Properties Of Foods
Busari M. B. Yusuf R. S Hamzah R. U. Ibrahim Y. O. Muhammad H.N Yahayah A. S	<i>Federal University of Technology Minna</i>	Effects of Cold and Hot Extraction Processes on Phytochemical Constituents and Antioxidant Activities of Methanol Extract of Taminalia catappa Leaves
Ebru DENİZ Çiğdem MUŞTU Candan VARLIK Kamil BOSTAN	<i>İstanbul Aydın University</i>	Edible Insect-Based Food Products And Production Methods
Hui Zhao Zihan Gong Song Zhang Pengxin Lu Meng Shu Xinru Cai Jie Bai Qinlu Lin Jun Liu	<i>Central South University of Forestry and Technology</i>	Production of water-soluble yellow monascus pigments via atmospheric and room temperature plasma and heavy ion beam irradiation of <i>M. purpureus</i> in submerged fermentation
Gülten TIRYAKİ GÜNDÜZ Ayça KORKMAZ VURMAZ	<i>Ege University</i>	Determination Of Antimicrobial And Antiquorum Sensing Activities Of Strawberry Tree (<i>Arbutus unedo</i> L.) And St. John's Wort (<i>Hypericum perforatum</i> L.) Plant Materials
Stephen Ajagbe Dominic Odulate Yemi Akegbejo-Samsons Israel Arabambi	<i>Federal University of Agriculture</i>	Exploitation of <i>Tylochromis jentinki</i> , Steindachner, (1894) and its contribution to food security in Ikeregorge, Iseyin, Oyo State, Nigeria
Seda YILMAZ Cemal KAYA	<i>Tokat Gaziosmanpaşa University</i>	Usage Areas of Collagen in Food Industry, Its Importance in Terms of Human Nutrition and Health
Fathi Masoud S.M. Sapuan Mohd Khairol Anuar Mohd Ariffin Y. Nukman Emin Bayraktar	<i>University Putra Malaysia</i>	Experimental Analysis of Heat-Affected Zone (HAZ) in Laser Cutting of Sugar Palm Fiber Reinforced Unsaturated Polyester Composites
Müge URGU ÖZTÜRK Burcu ÖZTÜRK KERİMOĞLU	<i>Ege University</i>	Utilization Of Dairy-Based Ingredients In Further Processed Meat Products

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SESSION-1, HALL-4/OTURUM-1, SALON-4

MODERATOR: Prof. Dr. Behcet KIR

AUTHOR	AFFILIATION	ABSTRACT TITLE
Muskan Syed Tanmay Arora	<i>School of Chemical and Life Sciences</i>	Isolation and Extraction of Surface Layer proteins from Lactobacillus species of Fermented Foodstuffs like Kefir Milk
Elif Tuğçe AKSUN TÜMERKAN	<i>Ankara Yıldırım Beyazıt Üniversitesi</i>	The Investigation Of The Impact Of Smoking Process On The Dna Degredation In Different Fish Species
Sarita Barik B.B. Mishra	<i>KIIT University</i>	Role Of Dairy Industry In Rural Development - A Case Of Omfed In Odisha
Sibel KARAKAYA Esra HASSAS	<i>Ege University</i>	The Use Of Legumes In Infant Formulations And The Determination Of The Protein Digestibility In The Infant Static In Vitro Digestion Model
Carmen Matilde SALERNO Gonzalo SAVY Hebe Tania FERNÁNDEZ Rocio TORRACA ARGÜELLES Mauro BARTOLOMÉ	<i>Universidad Nacional del Sur</i>	Chia Meal, Hydroxytyrosol And Enzymes In Broiler Diet Impact On The Microbial Ecobiota Of Excreta
Neslihan KALKAN Gamze İZZETOĞLU TURGAY Servet YALÇIN	<i>Ege University</i>	Effect Of Incubation Temperature On Intestine Development Of Broiler Chicks
Rocio TORRACA ARGÜELLES Hebe Tania FERNÁNDEZ Verónica Ana PIÑEIRO	<i>Universidad Nacional del Sur</i>	Products and by-products of the olive industry in broiler diet. A bibliometric approach on their evolution over time
Aysun DEMİRDÖĞEN Safiye Nur DİRİM	<i>Ege University</i>	Integration Of Digital Twin' Models For Production Into Plm Processes In The Food And Beverage Industry
Filippo SEVI Gianfranco DIRETTO Sarah FRUSCIANTE Chiara LICO Diego ORZAEZ Antonio GRANELL Alessia FIORE	<i>University of Naples</i>	Nutritional Improvment Of Tomato Fruits Using A Crispr/Cas9 System.

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SESSION-1, HALL-5/OTURUM-1, SALON-5

MODERATOR: Prof. Dr. Golgen Bahar OZTEKIN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Benginur BAŞTABAK Beril GÜNDOĞAN Ahmet ERYAŞAR Şefik ARICI Aşiye Gül BAYRAKÇI ÖZDİNGİŞ Günnur KOÇAR	<i>Ege University</i>	Sustainable Nutrient Solution In Soilless Culture: A Biogas Slurry
Kayode Kunle Oyediran Laoye Oluwafemi Oyediran	<i>Umaru Federal Polytechnic</i>	Public Participation And Sustainable Urban Food Systems Planning: The Narrative On Ibadan Region, Oyo State, Nigeria
Fahriye Şeyma ÖZCAN Osman SAGDIÇ	<i>Yıldız Teknik Üniversitesi</i>	Production Of Functional Powder Beverage From Licorice (Glycyrrhiza glabra) By Spray Drying Method
Esmail Banibugari Mohammad Sedghi	<i>Isfahan University</i>	Effect Of Supplementing Acidifier And Arbucl To The Diet At Rearing On Performance And Gastrointestinal Changes Of Broiler Chickens
Meltem UZUNHİSARCIKLI Yusuf KALENDER	<i>Gazi University</i>	Fipronil-Induced Oxidative Stress In Spleen Tissues Of Rats: The Effects Of Curcumin And Quercetin
Nemati amin Tabatabaei sn Foruzandeh Shahraki am Eghbal saied	<i>University of Tehran</i>	Comparison The Effect Two Strain Of Saccharomyces, Cerevisia & Elipsideus On Performance, Bio-Chemical And Immuno Blood Factors In Dairy Calves
Ersin DEMİR Hülya SİLAH Nida AYDOĞDU Cengiz SARIKÜRKCÜ M. Burak AÇIKGÜL	<i>Afyonkarahisar Sağlık Bilimleri University</i>	Investigation Of The Electrochemical Behavior Of Rafoxanide By Modified Electrode
José Manuel, AGUILAR Manuel, FÉLIX Yolanda, LÓPEZ-GONZÁLEZ Felipe, CORDOBÉS Antonio, GUERRERO	<i>Departamento de Ingeniería Química. Universidad de Sevilla</i>	Effect Of Ph On The Heat-Induced Gelation Of Egg Yolk Acidulated With Citric Acid
Merve YURTTAŞ	<i>Amasya University</i>	The Role Of Sourdough Lactic Acid Bacteria In Gluten-Free Bread Production

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SESSION-1, HALL-6/OTURUM-1, SALON-6

MODERATOR: Assoc. Prof. Dr. Mahmut TEPECİK

AUTHOR	AFFILIATION	ABSTRACT TITLE
Mehriban Rauf qızı Yusifova Günəş Məzahir qızı Nəsrullayeva Mehriban Həmid qızı Məhərrəmovə	<i>Azərbaycan Dövlət İqtisad Universiteti</i>	Environmental And Biological Characteristics And Use Of Medicinal Plants The Mikoloji Security Policies
Ali KOZLU Yeşim ELMACI	<i>Ege University</i>	Use Of Fruit And Vegetable Wastes In Meat Products
Leila Kebal Noureddine Djebli	<i>Pharmacognosy and Api- Phytotherapy laboratory Mostaganem University</i>	Phytochemical study of hydro-ethanolic extract of Algerian Ficus carica.L fruit and evaluation of his anti-inflammatory activity in vivo
Derya BULUTDAĞ Abdulvahit SAYASLAN	<i>Karamanoğlu Mehmetbey University</i>	Various Properties Of Chickpea Flours Applied With Different Pretreatment
Ceyda DADALI Yeşim ELMACI	<i>Ege University</i>	Fat Substitutes Used In Cake Production
Soumya S. Mini S.	<i>University of Kerala</i>	Menthol Affords Cardioprotection By Alleviating Oxidative Stress And Apoptosis In Streptozotocin Induced Diabetic Rats
Abdulkerim HATİPOĞLU	<i>Mardin Artuklu University</i>	Current Nanotechnology Applications In Food Packaging
Enver KENDAL	<i>Mardin Artuklu University</i>	The Effects Of Environmental Factors On Barley Cultivation

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SESSION-2, HALL-1/OTURUM-2, SALON-1

MODERATOR: Assit. Prof. Dr. Deniz ISTIPLILER

AUTHOR	AFFILIATION	ABSTRACT TITLE
Selvinaz YAKAN Cafer Tayer İŞLER	<i>Ağrı İbrahim Çeçen Üniversitesi</i>	Effects Of Sex, Eye-Side, Diurnal Variation On Intraocular Pressure In Romanov Sheep
Djalel Eddine GHERİSSİ Ramzi LAMRAOUI Faycel CHACHA	<i>University of Souk-Ahras</i>	Infundibular cyst in Algerian dromedary camel population: cross sectional study and histopathologic description
Rahşan KOÇ AKPINAR	<i>Samsun Veterinary Control Institute Directorate</i>	The Role Of American Foulbrood Disease In Bees Affected By Colony Losses In The Black Sea Region
Touba Nadri	<i>Tehran University</i>	Application Of Encapsulated Antioxidants In Cryopreservation Of Sperm
Abdullah DÖKÜMCÜ Özlem DURNA AYDIN	<i>Kafkas University</i>	Boron Mineral And Its Effects On Metabolism
Вернуст Виктория Михайловна Куликов Евгений Владимирович Петров Александр Константинович	<i>People's Friendship University of Russia</i>	Pathological Changes Of The Blood System At Babesiosis In Animals
Bilge Kaan TEKELİOĞLU	<i>Cukurova University</i>	Infectious Pancreatic Necrosis Virus (Ipnv) Infection And Its Impacts On The Aquaculture Industry
Mozgova Anastasia	<i>RUDN University</i>	Dental Anatomy Of Rabbits And Its Block Anesthesia
Sinan KÖSE Bekir TUFAN	<i>Tarsus University</i>	Design A Mobile Fish Meal And Oil Production Unit For Utilizing Fish By-Products/Waste

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SESSION-2, HALL-2/OTURUM-2, SALON-2

MODERATOR: Prof. Dr. Fatma AYKUT TONK

AUTHOR	AFFILIATION	ABSTRACT TITLE
Eda ALTAN	<i>Vitalant Research Institute, San Francisco</i>	Animal Viral Metagenomics: Discovery Of Novel Viruses
Murat ÇELEBİ Çağla ÇELEBİ Elif AKSÖZ	<i>Bahkesir University</i>	Evaluation Of Potential Treatments To Prevent Gentamicin-Induced Nephrotoxicity
Евгения РУЗМЕТОВА	<i>People's Friendship University of Russia</i>	World Experience In Application Of Brachytherapy In The Treatment Of Small Animals' Oncological Diseases: A Review
Betül BARDAKCI ŞENER Eyüp Mümtaz TIRAŞIN	<i>Dokuz Eylül University</i>	In Situ Dialysis Culture System For Natural Phytoplankton Communities
Faïcel CHACHA Djalel Eddine GHERİSSİ Ramzi LAMRAOUİ	<i>University of Souk-Ahras</i>	Evolution Of Body Condition, Milk Production Metabolic Profiling During The Postpartum Period In Dairy Cows
Nuray Gamze YÖRÜK	<i>Kocaeli Food Control Laboratory Directorate</i>	Foodborne Infections In Milk And Dairy Products Caused By Campylobacter Spp. And Toxins
Pramod K Singh	<i>Sharda University</i>	Ionic Liquid Doped Polymer Electrolyte (Ildpe): A Novel Electrolyte For Electrochemical Devices
Elvan TALAY Meltem UZUNHİSARCIKLI Yusuf KALENDER	<i>Gazi University</i>	Toxic Effects Of Lead Nitrate And Cadmium Chloride On Rat Lung Tissues And Protective Role Of Sesamol
Muhammad Imran Muhammad Kamran Khan Muhammad Haseeb Ahmad Rabia Shabir Ahmad Muhammad Nadeem Haseeb Anwar	<i>Government College University</i>	Modern And Conventional Approaches For Flax Lignan Extraction

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SESSION-2, HALL-3/OTURUM-2, SALON-3

MODERATOR: Assoc. Prof. Dr. Gulsum OZTURK

AUTHOR	AFFILIATION	ABSTRACT TITLE
Niran Nur AKALIN Sami GÖKPINAR	<i>Kırıkkale University</i>	Investigation Of Toxoplasma Gondii And Sarcocystis spp. Tissue Cysts In Meat And Meat Products Available To The Market By Percoll Gradient Method
Morakeng Edward Kenneth Lebaka	<i>University of Zululand</i>	The Use Of Farm And Garden Plants By Traditional Healers As Traditional Medicines To Cure Different Health-Related Problems Or Ailments, In Greater Sekhukhune District Municipality, Limpopo Province In South Africa
Zahide BİLGİN	<i>İstanbul University</i>	Resistance To Anthelmintics Used In The Treatment Of Sheep Gastrointestinal Nematodes And Alternative Treatments
Meena M Vijayalakshmi A	<i>Tamil Nadu</i>	Nightmare of Locust Attack in India
Çağrı Melikşah SAKAR	<i>International Livestock Research and Training Center Directorate</i>	Record Keeping In Livestock
Seyed Keramat Hashemi Ana	<i>Yasouj University</i>	Simulation Longest The Length of Dry Spells With Approach of Climate Change in Iran
Ramazan Ülkü ÇETİN	<i>Bandırma On Yedi Eylül University</i>	Current Physicchemical Analysis Methods Used In Ice Cream Analysis
Jun Lu Zhenyu Yang Qi Liu Feijun Luo Jiali Ren	<i>Central South University of Forestry and Technology</i>	Antioxidant and Hypoglycemic Activities of Cryptotaenia Japonica Hassk. After in Vitro Simulated Digestion
Merve ÖZCAN Selda BULCA	<i>Aydın Adnan Menderes University</i>	Use Of Ultrafiltration Technique In Milk And Milk Products

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SESSION-2, HALL-4/OTURUM-2, SALON-4

MODERATOR: Assoc. Prof. Sıdıka EKREN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Cansu ÇELİK	<i>Istanbul University- Cerrahpaşa</i>	The Core Microbiome And Antimicrobial Resistant Microorganisms In Horses
Anisha GS	<i>Post-graduate and Research Department of Zoology</i>	Transglycosylation Potential Of A-Galactosidase From Streptomyces Griseoloalbus For Probiotic Applications
Behlül SEVİM Yusuf CUFADAR	<i>Aksaray University</i>	Effects of Natural Color Substances on Egg Yolk Color
Tarique Jamal Mohd Sapuan Bin Salit Khalina Abdan Shah Faisal Khan Sherwani	<i>Advanced Engineering Materials and composites Research Centre</i>	Water Barrier Properties of Sugar Palm Fiber-Reinforced Polymer Composites – A review
Şeniz ÖZİŞ ALTINÇEKİÇ Funda ERDOĞAN ATAÇ	<i>Bursa Uludağ University</i>	A General Overview On Mastitis In Small Ruminants
Tariq Jameel Rohayah Che Amat Mohd. Khalid Hasan	<i>Universiti Teknologi Malaysia Kuala Lumpur</i>	Landscaping Visual Arts and its Transition over the Ages of Muslim Era
Maksut IŞIK Zabit YENER İsmail KELEŞ Ufuk KÖMÜROĞLU Ömer Faruk KELEŞ	<i>Van Yüzüncü Yıl University</i>	Histopathological And Biochemical Investigation Of The Preventive Effect Of Nigella sativa On The Formation Of Obesity Induced By High-Fat Diet In Rats
Eldelita A. P. FRANCO Lilane de Araújo M. BRANDÃO Irenilza de Alencar NÄÄS	<i>Paulista University</i>	Forecasting The World Broiler Meat Demand And Production To Meet Un 2030 Agenda
Artun YIBAR Oğuz YILDIZ Sefa Can KÜÇÜK	<i>Bursa Uludağ University</i>	Enumeration and Identification Of Bifidobacterium spp. and Lactobacillus spp. in Probiotic Dairy Products Sold in Supermarkets in Bursa Province, Turkey

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SESSION-2, HALL-5/OTURUM-2, SALON-5

MODERATOR: Dr. Adem GOKCOL

AUTHOR	AFFILIATION	ABSTRACT TITLE
Özlem İSTANBULLU PAKSOY Tuba BÜYÜKSİRİT BEDİR	<i>Kocaeli Food Control Laboratory Directorate</i>	Investigation Of Biofilm Forming Characteristics Of Brucella Spp. Pathogenes
Mojtaba Emami Amir Mirzadi Gohari Amin Ebrahimi Mohammad Javan-Nikkhah Mohsen Farzaneh	<i>University of Tehran</i>	Activities of Antioxidant Enzymes in Compatible and Incompatible Interactions in Zymoseptoria Tritici-wheat Pathosystem
Sezen HARMANKAYA	<i>Kafkas University</i>	Silent Hazard Arising From Food Packaging "Migration"
Cornelia NICHITA	<i>University of Bucharest</i>	Free Radical Scavenging Properties Of Selective Polyphenolic Extracts Obtained From Salvia Officinalis L.
Ufuk EROL	<i>Sivas Cumhuriyet University</i>	Determination Of The Prevalence Of Eimera Species In Water Buffalo In Balikesir
Simeon Oluwagbenga FASINA Umar Obafemi SALISU Ayobami Ademola AKANMU Motunrayo Sekinat SANNI	<i>Olabisi Onabanjo University</i>	Logistics Of Agricultural Freight In A Peri-Urban Area Of Ibadan, Nigeria
Hilal TOZLU ÇELİK	<i>Ordu University</i>	Current Situation of Small Ruminant In The World And In Turkey, Milking Practices And The Importance Of Milk
Nikolaya Velcheva Katya Uzundzhaliyeva Simona Cheperigova	<i>Institute of Plant Genetic Resources</i>	Documentation Of Plant Genetic Resources In Bulgaria – Current Status And New Approaches
Meltem KIZIL Abdullah GAZİOĞLU Ömer KIZIL Murat UZTİMUR	<i>Firat University</i>	The Effect Of Vitamin C On Liver And Kidney Functions In Beef Cattle Vaccinated Against Theileria Annulata

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SESSION-2, HALL-6/OTURUM-2, SALON-6

MODERATOR: Prof. Dr. Behcet KIR

AUTHOR	AFFILIATION	ABSTRACT TITLE
Hakan YILDIZ Emre İLKER	<i>Ege University</i>	Preliminary Evaluation Of The Adaptation Ability Of Canola (<i>Brassica napus</i>) Genotypes Of Different Origins Under Mediterranean Climate Conditions
Vahid Ahmadi Saadi Biglari Gholdare Seyed Pouya Hosseini	<i>Shahid Beheshti University</i>	Monitoring Temporal And Spatial Scale Changes In Shoreline Using Landsat Satellite Time Series (Case Study: Jask Port To Chabahar Port)
Alper Kürşat DEMİRKAYA	<i>Bilecik Şeyh Edebali University</i>	Investigation Of Various Physical And Chemical Properties Of Various Canned Foods Consumed In Bilecik
OJO Oluwadamilola Mary	<i>Ladoke Akintola University</i>	Training Needs Of Cassava Processors In Iwo Local Government Area Of Osun State.Nigeria
Aytül MENEVŞE Erdoğan Eşref HAKKI Sait GEZGİN Makbule Rumeysa OMAV Hatice SÜSLÜ Merve ÖZBEK Ayşe Hümeysra OMAV	<i>Selçuk University</i>	Determination Of Responses Of Back Hybrid 4 Lines Containing Nax1 And Nax2 Genes Under High Dose Salt Administration
Ashwani Kumar Salej Sood Sundaresha S. Baljeet Singh Vinay Bhardwaj Umesh Goutam	<i>Central Potato Research Institute (CPRI)/Lovely Professional University</i>	Progress towards development of non-recombinant gametes in potato using RNAi technology
Senem FİLİZ DOKSÖZ İ. Adem BOZKURT	<i>Olive Research Institute-Hatay</i>	Biological Control of <i>Pseudomonas savastanoi</i> pv. <i>savastanoi</i> Causing The Olive Knot Disease With Epiphytic And Endophytic Bacteria
K.R. Preethy M. Chamundeeswari	<i>Department of Biotechnology, St. Joseph's College Of Engineering, Sholinganallur</i>	Green synthesis of reduced graphene oxide under Muffle atmosphere from an Agro waste for Wastewater Management
Hayriye Yıldız DAŞGAN Çiğdem KARA	<i>Çukurova University</i>	Effects Of Humic Acid, Amino Acid And Sea Algae Application On Arugula (<i>Eruca sativa</i>) Culture

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SESSION-3, HALL-1/OTURUM-3, SALON-1

MODERATOR: Prof. Dr. Hatice KALKAN YILDIRIM

AUTHOR	AFFILIATION	ABSTRACT TITLE
Hayriye Yıldız DAŞGAN Mürsiye KANAL	<i>Çukurova University</i>	Comparison Of F1 Hybrid Melon (<i>Cucumis melo</i> L.) And Its Parents In Terms Of Yield And Some Fruit Properties
George H M RODOLFO David L NELSON Marcelino S LEONEL Luciana B RODOLFO Juan P B ROA	<i>Universidade Federal dos Vales do Jequitinhonha e Mucuri</i>	A Financial Viability Approach Of Macaúba Palm (<i>A. aculeata</i>) To Brazilian Savanna
Burcu DÜNDAR KIRIT Erdal AĞÇAM Asiye AKYILDIZ	<i>Çukurova University</i>	The Effects Of Ultrasound Application And Ascorbic Acid Addition On Quality Properties Of Loquat Nectar
Yuvvaranni Sathyamoorthy Amritta Balaji Chamundeeswari Munusami	<i>Department of Biotechnology, St. Joseph's College of Engineering, Chennai, Tamil Nadu</i>	Green Synthesis and Characterization of Iron Nanoparticles from combined Herbal extracts for Biomedical Applications
Şebnem KUŞVURAN Serpil HAVADAR	<i>Çankırı Karatekin University</i>	The Effects Of Salicylic Acid Treatment On Salt Tolerance in Tomato
Samiran Bisai Sarnali Dutta	<i>Sidho-Kanho-Birsha University, Purulia</i>	Traditional food practices of Lodha: A gathering-hunting indigenous community of West Bengal, India
Elif ÖZER Nayil DİNKÇİ Gülfem ÜNAL A. Sibel AKALIN	<i>Ege University</i>	Influence Of Whey Protein Concentrate And Bifidobacterium lactis Addition On Microbiological And Sensory Properties Of Kefir
Akshra Rana	<i>Aligarh Muslim University</i>	Gender Equality: Against The Contradictions Of Inequality In India
Eda KAZANCI Salih KARASU Alican AKÇIÇEK	<i>Yildiz Technical University</i>	The Process Optimization Of Ultrasound Assisted Extraction Of Bioactive Compounds From Chokeberries (<i>Aronia melanocarpa</i>)

20.06.2021
SUNDAY / 16:00-18:30

Zoom Meeting ID: 572 394 7582

Zoom Passcode: 030303

(All speakers required to be connected to the session 15 min before the session starts)

Moderator is responsible for ensuring the smooth running of the presentation, managing the group discussion and dynamics.

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exp. Hall 1, Cesme-Alacati

SESSION-3, HALL-2/OTURUM-3, SALON-2

MODERATOR: Assist. Prof. Dr. Yakup Onur KOCA

AUTHOR	AFFILIATION	ABSTRACT TITLE
Şehnaz Yasemin TOSUN Didem ÜÇOK ALAKAVUK	<i>Istanbul University</i>	Effect Of Treatment With Orange And Lemon Juice On The Microbial Quality Of Marine Trout (<i>Oncorhynchus Mykiss</i> , Walbaum 1792)
Andrezza K. O. Silva Rocio Santiago Nicácio H. da Silva Elvis Joacir de França Eugênia C. Pereira	<i>Universidade Federal de Pernambuco</i>	Bioremediation of salinized soils of desertification area in the Brazilian Northeast using <i>Cladonia substellata</i> (lichen) and their compounds: a compilation of results
Enver KENDAL	<i>Mardin Artuklu University</i>	The Effects Of Different Locations On Triticale Genotypes Cultivation
Srikanth B Sneha Joseph A. Vijayalakshmi	<i>RMK Engineering College</i>	Smart Irrigation System Using Soil Moisture Sensor
Rahime YAYGINGÜL Yalçın Alper ÖZTURAN İbrahim AKIN	<i>Aydın Adnan Menderes University</i>	Determination of Schirmer Test I, Intraocular Pressure, And Central Corneal Thickness Measurements In Broiler's (<i>Gallus Gallus Domesticus</i>)
Rizwan Rasheed	<i>Department of Botany, Government College University Faisalabad</i>	Effect of exogenous niacin on growth and physiochemical attributes of spinach under cadmium stress
Hatice Ahu KAHRAMAN Hidayet TUTUN	<i>Burdur Mehmet Akif Ersoy University</i>	Identifying Food Safety Problems In Bee Products With The Rasff Database
Muhammad Arslan Ashraf	<i>Department of Botany, Government College University Faisalabad</i>	Phytoremediation: a green approach to clean up metal contaminated soils
Esra ATEŞ Kübra ÜNAL	<i>Selçuk University</i>	Determination Of Some Characteristics Of Chicken Nuggets Coated With Chia Mucilage And Corn Flour

20.06.2021
SUNDAY / 16:00-18:30

Zoom Meeting ID: 572 394 7582

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SESSION-3, HALL-3/OTURUM-3, SALON-3

MODERATOR: Prof. Dr. Golgen Bahar OZTEKIN

AUTHOR	AFFILIATION	ABSTRACT TITLE
M. Zeki KARİPÇİN	<i>Siirt University</i>	Collecting Vegetable Gene Research
Gözdenur ÇAKAR Işıl SARAÇ SİVRİKAYA Ersin KARAKAYA Abdullah GÜLLER	<i>Bingöl University</i>	Evaluation Of The Fungicidal Activity Of Summer Savory And Lavender Essential Oils Against Fusarium Solani
Saide Selin ERAY	<i>Agri Ibrahim Cecen University</i>	A Review on The Types and Use of Trees and Plants in Iranian Garden Art
Nizamettin TURAN Seyithan SEYDOŞOĞLU	<i>Siirt University</i>	Drought Tolerant Cool Season Forage Grass Species to Combat Desertification
Mahmut YARDIMCI Zabit YENER Zübeyir HUYUT Ömer Faruk KELEŞ	<i>Muş Alparslan University</i>	Histopathologic and Immunohistochemical Investigation of The Therapeutic Effect Of Stinging Nettle Seed (Urtica dioica Seed) In Ethanol-Induced Liver Fibrosis In Rats
Nazire MİKAİL Arzu ÇIĞ	<i>Siirt University</i>	Path and Correlation Analyses Between Plant Nutrient Content and Some Morphological Features of Hyacinth (<i>Hyacinthus orientalis</i> L.) Cultivars
Hasan Hüseyin ÖZTÜRK Hasan Kaan KÜÇÜKERDEM	<i>Çukurova University</i>	Energy Use For Cow Milk Production
Fatih ÇIĞ Arzu ÇIĞ	<i>Siirt University</i>	The Effect of ACCD Bacterial Strains on Seedling of Sesbania spp. Under Drought Stress
Kemal TOKUÇ	<i>İstanbul Rumeli University</i>	New Trends And Risks In The Food Industry
Fatih ÇIĞ Arzu ÇIĞ	<i>Siirt University</i>	The Effect of Bacteria Applications Showing ACCD Activity on the Seedling of Sesbania spp. Seeds Under Salt Stress

20.06.2021
SUNDAY / 16:00-18:30

Zoom Meeting ID: 572 394 7582

Zoom Passcode: 030303

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SESSION-3, HALL-4/OTURUM-3, SALON-4

MODERATOR: Assoc. Prof. Dr. H. Hüsnü KAYIKCIOGLU

AUTHOR	AFFILIATION	ABSTRACT TITLE
Aygül ÇİÇEKDEN Feran AŞUR	<i>Van Yüzcüncü Yıl University</i>	Primary School Gardens And Children
Evgeniya Igorevna Simonova Rystsova Ekaterina Olegovna	<i>Peoples' Friendship University of Russia</i>	Prevention Of Chronic Mycotoxicosis In Sows And Piglets
Yusuf Jameel Mohd Sapuan Bin Salit Shah Faisal Khan Sherwani Zulkiflile b Leman	<i>Universiti Putra Malaysia</i>	Natural Fiber Composites Application Constraints, Their Remedies and Challenges In The Automotive Sector: A Holistic Review
Ayobami Ademola AKANMU Umar Obafemi SALISU Simeon Oluwagbenga FASINA Sekinat Motunrayo SANNI Oluwatobi Maria OLATUNJI Adesoji Olugbenga ADESANYA Abimbola Simiat OGUNSESAN Jacob Ayorinde ADEJARE	<i>Federal University of Technology</i>	Food Security And Agricultural Produce Transportation In Sakı Region Of Oyo State, Nigeria
Moujabbir Sara Aboukhalaf Abdelghani João Miguel Ferreira da Rocha EL AMRAOUI Belkasssem Rekia Belahsen	<i>Chouaib Doukkali University</i>	Diversity Of Practices In Making Bread With Traditional Sourdough In Moroccan Berber Area "Figuig"
Caihong Lan Xiangyang Tang Liping Wu Dongcai Zhu Zhilong Yang Tao Yang	<i>Central South University of Forestry</i>	Effect of the flavor of Sweet rice wine fermented by <i>Saccharomycopsis fibuligera</i> and <i>Rhizopus</i>
P. Rudenko S. Drukovsky N. Troshina A. Rudenko E. Krotova	<i>RUDN University</i>	Criteria Of Biological Safety In The Formation Of A Strategy For Combating Intra-Farm Infections Of Cattle
P. Rudenko Yu. Vatnikov Ev. Kulikov V. Semenova	<i>RUDN University</i>	Analysis Of Biochemical And Immunological Parameters Of Blood During Probiotic Therapy Of Purulent Wounds In Cats
Devran DEMİR Mehmet Şükrü GÜLAY Özlem YILDIZ GÜLAY	<i>Burdur Mehmet Akif Ersoy University</i>	The Key For The Youth: Collagens

20.06.2021
SUNDAY / 16:00-18:30

Zoom Meeting ID: 572 394 7582

Zoom Passcode: 030303

(All speakers required to be connected to the session 15 min before the session starts)

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SESSION-3, HALL-5/OTURUM-3, SALON-5

MODERATOR: Assoc. Prof. Dr. Cigdem SONMEZ

AUTHOR	AFFILIATION	ABSTRACT TITLE
Mohammad Sedghi Zahra Sarrami Mojtaba Abbasi	<i>Isfahan University</i>	Effect of Different Levels of Mineral and Vitamin Supplements on Broilers Performance
Deepamol Thomas	<i>Mar Ivanios College</i>	Environmental Protection: CSR Initiatives of Media Organisations in Kerala
Shah Faisal Khan Sherwani Mohd Sapuan Bin Salit Zulkifile b Leman Edisyam Zainudin Khalina Abdan	<i>Universiti Putra Malaysia</i>	Tensile Stress-strain Curve For Treated Sugar Palm Fibre/ Glass Fibre Reinforced Poly (lactic acid) Hybrid Composite
Horiya Gadoum Valentim Coelho Abdallah Noui Lurdes Jorge Eugénia Gouveia	<i>Hassiba Benbouali University</i>	Evaluation Of Virulence And The Oxalic Acid Production On Cryphonectria Parasitica Virulent And Converted Strains By CHV1 Hypovirus
Peyman Sharifi Fatemeh Benakashani Iraj Allahdadi Gholam Abbas Akbari	<i>University of Tehran</i>	Living Mulch Performance In Black Caraway (<i>Nigella sativa</i> L.) Field And Impact
Vikrant PATEL Kapila MANOJ Ankit CHAUDHARI	<i>Veer Narmad South Gujarat University</i>	Use Of The Vegetable Wastes As An Alternative Nutritional Source For The Growth And Survival Of Indian Major Carps (Catla catla, Labeo rohita and Cirrhinus mrigala)
Alpa Varsani Kapila Manoj	<i>Veer Narmad South Gujarat University</i>	Water quality assessment of effluent-dominated Creeks of Surat city, Gujarat
Silviya IVANOVA Tanya IVANOVA Eli KOSTADINOVA	<i>Institute of Cryobiology and Food Technology</i>	Trans Fatty Acids, Biological Active Substances And Assessment Of Fatty Acid Composition In Sheep Milk From Two Breeds
Sanjaya Kumar Sahoo Sukanta Chandra Swain	<i>KIIT Deemed to be University</i>	Causes and Well-Being of Women In-Migrants of Gajapati District of Odisha

20.06.2021
SUNDAY / 16:00-18:30

Zoom Meeting ID: 572 394 7582

Zoom Passcode: 030303

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SESSION-3, HALL-5/OTURUM-3, SALON-5

MODERATOR: Assoc. Prof. Dr. Sıdıka EKREN

AUTHOR	AFFILITION	ABSTRACT TITLE
Bülent BUDAK Ali SALMAN Behçet KIR Gülcan DEMİROĞLU TOPÇU Sükrü Sezgi ÖZKAN Özgün IŞIK	<i>Ege University</i>	Effects of Mixture Rates on the Some Silage Quality Characteristics of Different Legume Mixtures With Annual Ryegrass (<i>Lolium italicum</i>)
Shimsa.S Mini.S	<i>University of Kerala</i>	Syringic Acid Alleviates Hyperglycemia By Regulating Key Enzymes Of Carbohydrate Metabolism In Streptozotocin Induced Diabetic Rats
Mehmet Fırat BARAN	<i>Siirt University</i>	Projection Of Agricultural Tools And Machinery Usage In Agriculture In Van
Saeideh Alipoor Elias Soltani Iraq Allahdadi Majid Ghorbani Javid Gholam Abbas Akbari	<i>University of Tehran</i>	Comparison of physiological responses of two halophyte species to fine dust stress
Fusun GÜLER Arzu ÇİĞ	<i>Van Yüzüncü Yıl University</i>	Relationships Between Potassium Nutrition And Flower Quality In Ornamental Plants
P. Kowsalya S. Uma Bharathi S. Sivasankar M. Chamundeeswari	<i>St. Joseph's College of Engineering, Sholinganallur, Chennai</i>	Optimization of Organic, Reactive And Textile Effluent Dye Degradation By Photo Catalyst From Micro Algae – A Cost Effective And Chemical Free Approach
Shamim Ramezani Azghandi Azita Farashi Mohsen Najjari	<i>Ferdowsi University of Mashhad</i>	Preliminary Study Of Leishmaniasis In Iran And Neighboring Countries
Feran AŞUR	<i>Van Yüzüncü Yıl University</i>	Basic Visual Concept In Landscape; Ephemera
Imtiaz Mustafa Haseeb Anwar Shahzad Irfan Humaira Muzaffar Muhammad Imran Muhammad Umar Ijaz	<i>Government College University</i>	Efficacy Of <i>Bellis perennis</i> As Antioxidant And Antidiabetic Activities: A Comparative Study Of Its Different Extracts

CONFERENCE GALLERY

Zoom Meeting

Participants (45)

Q Find a participant

SS Seythan SEYDOŞ... (Co-host, me) [Mute] [Video]

IKSAD Nurlan (Host) [Mute] [Video]

A Atabek (Co-host) [Mute] [Video]

ML MUSTAFA LATİF EMEK (Co-host) [Mute] [Video]

BB Bülent BUDAK [Mute] [Video]

Prof. Dr. Behçet KIR [Mute] [Video]

BO Bülent Okur [Mute] [Video]

Hall 3 - Benyamin Lakitan [Mute] [Video]

HM HALL-4,Amir Mirzadi Gohari [Mute] [Video]

NB Necdet Budak [Mute] [Video]

PD Prof. Dr. Morakeng Edward Ken... [Mute] [Video]

ÇÇ Cansu Çelik [Mute] [Video]

Çağlar Karaca OMU -SAMSUN [Mute] [Video]

Dr. Bharti Chaudhry [Mute] [Video]

Invite Mute All ...

Aramak için buraya yazın

Adres

09:40
19.06.2021

Zoom Meeting

Recording

Participants (57)

Q Find a participant

SS Seythan SEYDOŞ... (Co-host, me) [Mute] [Video]

IKSAD Nurlan (Host) [Mute] [Video]

ML MUSTAFA LATİF EMEK (Co-host) [Mute] [Video]

A Atabek (Co-host) [Mute] [Video]

OH Observer-Aygul H-4 (Co-host) [Mute] [Video]

Prof. Dr. Behçet KIR [Mute] [Video]

Hulusi Yılmaz [Mute] [Video]

MK Murat KILIÇ [Mute] [Video]

NB Necdet Budak [Mute] [Video]

Prof. Dr. Nedim KOŞUM [Mute] [Video]

AK Ayca Korkmaz Vurmaz [Mute] [Video]

BB Bülent BUDAK [Mute] [Video]

BO Bülent Okur [Mute] [Video]

ÇÇ Cansu Çelik [Mute] [Video]

hall 6, Striker Sid

HALL-4,Amir Mirzadi Gohari

DEVPRIVA

H-2, Ahmet Doğ...

HALL-4 Amir Mir...

Hall 5, Solmaz G...

Hall 5 Tugre OZ...

H2-Soydemir Ha...

Invite Mute All ...

CONFERENCE GALLERY

Zoom Meeting

Recording

Participants (59)

Q Find a participant

SS Seyithan SEYDOŞ... (Co-host, me) [Mute] [Video]

IKSAD Nurlan (Host) [Mute] [Video]

A Atabek (Co-host) [Mute] [Video]

ML MUSTAFA LÂTİF EMEK (Co-host) [Mute] [Video]

OH Observer-Aygul H-4 (Co-host) [Mute] [Video]

Prof. Dr. Behçet KIR [Mute] [Video]

Prof. Dr. Nedim KOŞUM [Mute] [Video]

SS Salon 5, Zeynep Dumanoglu [Mute] [Video]

MK Murat KILIÇ [Mute] [Video]

NB Necdet Budak [Mute] [Video]

AK Ayca Korkmaz Vurmaz [Mute] [Video]

BB Bülent BUDAK [Mute] [Video]

BO Bülent Okur [Mute] [Video]

CC Cansu Çelik [Mute] [Video]

Invite Mute All ...

Zoom Meeting - Hall-1

Recording

Remaining : 09:52:29 View

Hakan GEREN Hall-1

Sejithan SEYDOŞOĞLU

salon-1, Bülent BUDAK

Hall-1, Gülcan DEMİROĞLU TOPÇU

Hall 1, A.Burcu...

Hall 1 - Umut Suzan

Prof. Dr. Nedim KOŞUM

session 1 hall 1 Behçet KIR

H-1 observer

hall 1, ATMAN A...

8 unassigned participants

Mute Stop Video

Participants 10 Chat Share Screen Record Breakout Rooms Reactions

Leave Room

CONFERENCE GALLERY

You are viewing H-6, MEHMET FIRAT BARAN's screen View Options

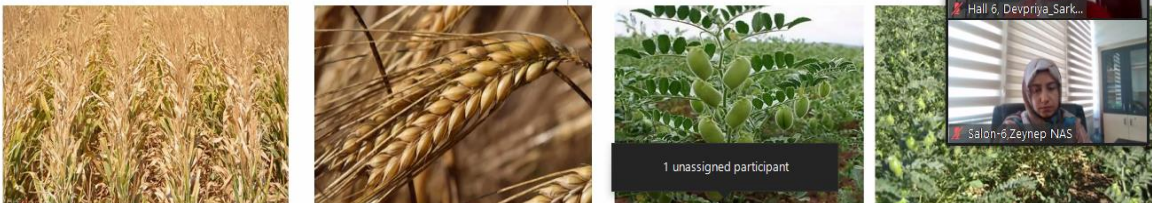
View Remaining: 09:20:57

Bazı Tahıl Ürünlerinin Ekim Alanı ve Üretim Miktarları

Ürün	Ekilen Alan (da)	Verim (kg/da)	Üretim (ton)
Mısır (Dane)	54,070	1.560,8	84.393
Buğday	555,134	501.27	219.068
Arpa	50,795	296	15.037
Kırmızı Mercimek	133,250	191,3	25.500
Nohut	2,813	162,1	456

Cultivation Area and Production Quantities of Some Cereal Products

Product	Cultivated Area (decare)	Yield (kg/decare)
Corn	54,070	1.560,8
Wheat	555,134	501.27
Barley	50,795	296
Red lentil	133,250	191,3
Chickpea	2,813	162,1



1 unassigned participant

Unmute Stop Video Participants Chat Share Screen Record Breakout Rooms Reactions Leave Room

Recording

3rd INTERNATIONAL CONFERENCE ON FOOD, AGRICULTURE AND VETERINARY

June 19-20, 2021



Comparison the Effect Two strain of Saccharomyces, Cerevisia & Elipsideus on Performance, Bio-Chemical and immune Blood Factors in Dairy Calves

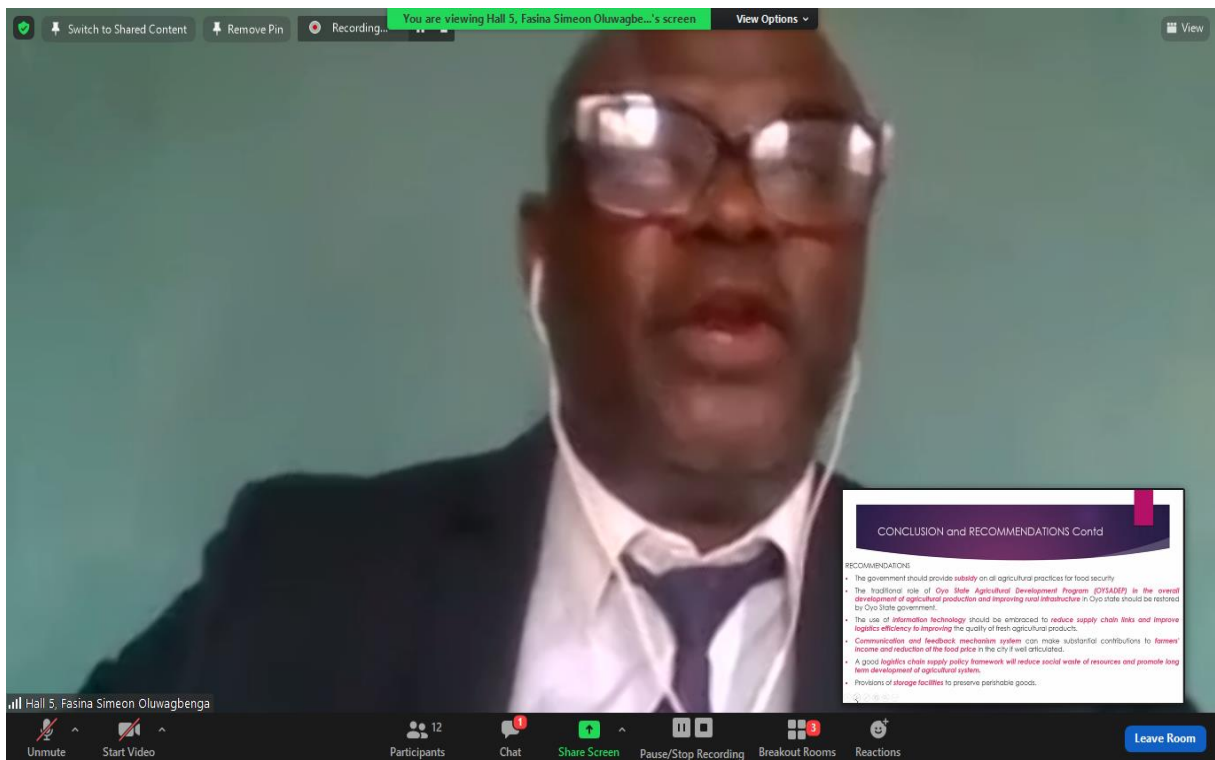
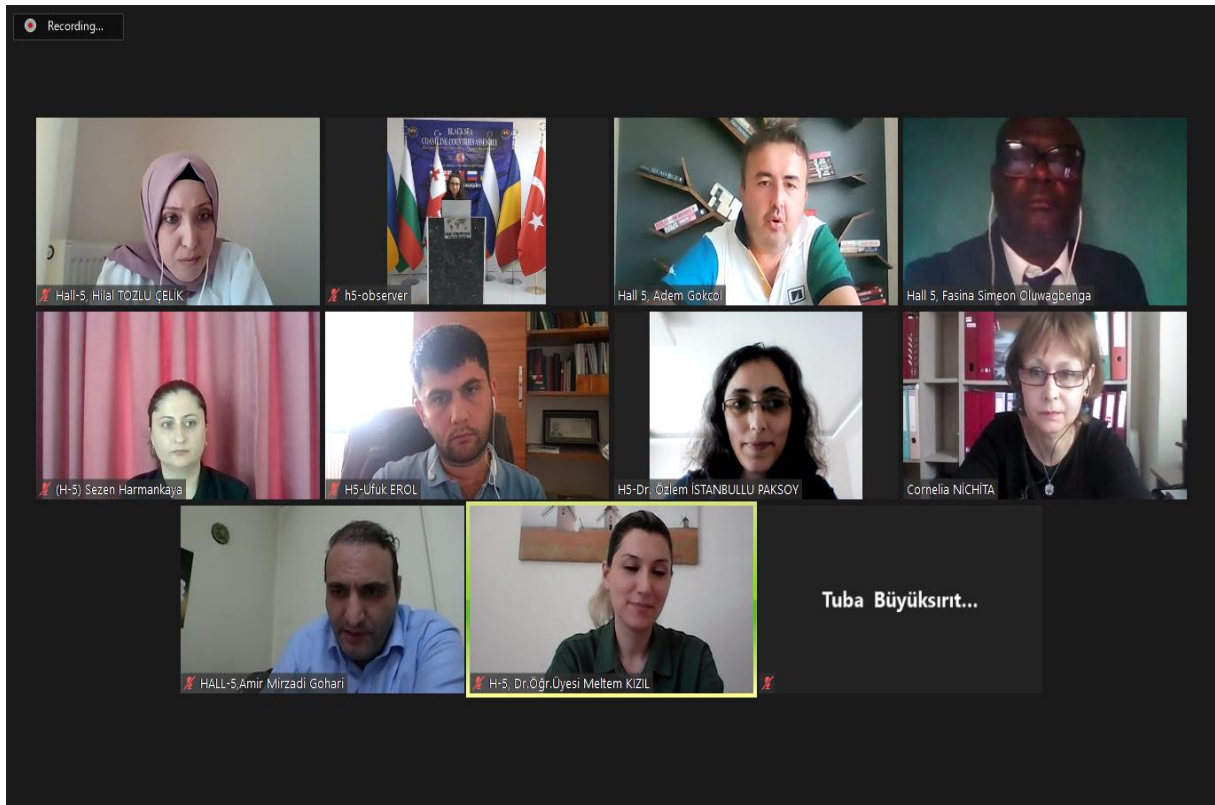


Nemati Amin, Tabatabaei Seyed Norodin, Foruzandeh Shahraki Amin Davari,

Eghbal saied Shahin

Islamic Azad University, Isfahan (khorasgan) Branch, Department of Animal Sciences

CONFERENCE GALLERY



CONFERENCE GALLERY

A screenshot of a Zoom conference gallery. The interface shows a grid of six video feeds. The top row includes a participant named 'Hall-5, horiya.gadoum', a shared screen titled 'BLACK SEA CASPIAN COUNTRIES ENERGY' with flags of Bulgaria, Romania, Hungary, and Turkey, and a participant 'Cigdem Sonmez'. The middle row shows 'H-5, Siliya Ivanova', 'Hall-5, S.F.K. Sherwani', and 'Zahra Sarrami'. Below the grid, there are three large black boxes with white text: 'H-5, user', 'H5 Tuğba Dede...', and 'S-3,H-5 SANJAY...'. A status bar at the bottom indicates '4 unassigned participants' and provides controls for Unmute, Start Video, Participants, Chat, Share Screen, Pause/Stop Recording, Breakout Rooms, Reactions, and a Leave Room button.

A screenshot of a Zoom conference gallery. The main focus is a shared presentation slide with a background of a pink cherry blossom tree. The slide contains the following text:

- Logos for: **IPB INSTITUTO POLITÉCNICO DE BRAGANÇA**, **CIMO Centro de Investigação de Montanha**, **BioChestnut-IPM**, and **EGE UNIVERSITY**.
- Evaluation of virulence and the oxalic acid production on *Cryphonectria parasitica* virulent and converted strains by CHV1 hypovirus**
- Horiya Gadoum, Valentim Coelho, Abdallah Noui, Lurdes Jorge, Eugénia Gouveia*
- 3rd INTERNATIONAL CONFERENCE on FOOD, AGRICULTURE AND VETERINARY**
19 - 20 June 2021 - EGE UNIVERSITY, TURKEY
- Date: **20/06/2021**

A small video feed of 'Hall-5, horiya.gadoum' is overlaid on the slide. The Zoom interface at the top shows 'Recording...' and a 'View' button.

CONFERENCE GALLERY

Recording...

Remaining: 09:19:33

Environmental effect Seed Oil Content Quality analysis

جامعة مؤمنان اسماعيل
UNIVERSITY MOUENAN ISMAEL
جامعة العلوم
UNIVERSITY OF SCIENCES

المعهد الوطني للبحوث الزراعي
National Institute of Agricultural Research

The content (%) of seed oil rapeseed varieties contains, significantly different amounts of oil ranging between 35% and 41% which are in agreement with those found in the literature (Iqbal et al., 2008; Rabiee et al., 2004; Sharafi et al., 2015; Chennaoui et al., 2020).

Seed Oil Content (%)

Variety	Sidi Allal Tazi (%)	Douyet (%)
Alia	39.5	38.0
Adila	39.0	36.5
Baraka	38.5	36.5
Lila	39.5	37.8
Mofida	40.5	39.0
Narjisse	37.5	35.8

Moderator Hall-2

H2: Gülsüm ÖZTÜRK

Hall 2-session 2, Ibtissa...

S2H2: Murat KILIÇ

Recording...

You are viewing H-2, Ahmet Doğan DUMAN's screen

View Options

Remaining: 09:44:43

Oluşumdan etkilenen tarımsal ürünler

- Tahıllar
- Kurutulmuş meyveler (incir, kayısı, üzüm vb)
- Mısır
- Sorghum
- Çavdar
- Yulaf
- Baharatlar (özellikle kırmızı biber, zencefil, safran, kişniş vb)
- Hayvan yemleri
- Süt ve süt ürünleri
- Balıklar
- Fındık
- Yer fıstığı
- Antep fıstığı
- Kavun çekirdeği
- Badem, ceviz, pıkan cevizi
- Pamuk tohumu
- Bira
- Zeytin
- Pirinç
- Kahve çekirdeği
- Susam
- Ayçiçeği
- Soya fasulyesi
- Fasulye
- Şarap

TAHILLAR
KURUTULMUŞ MEYVELER
YAĞLI TOHUMLAR
SEBZELER
BAHARATLAR
YEMLER
HAYVANLAR
SÜT ve SÜT ÜRÜNLERİ

Observer Hall-2

Hall-2, Fatma Aykut T...

H-2, Ahmet Doğan DU...

H2-Firdevs Ersin


Unmute Start Video Participants Chat Share Screen Pause/Stop Recording Breakout Rooms Reactions Leave Room

CONFERENCE GALLERY

You are viewing HALL-2, Anas HAMDANI's screen View Options

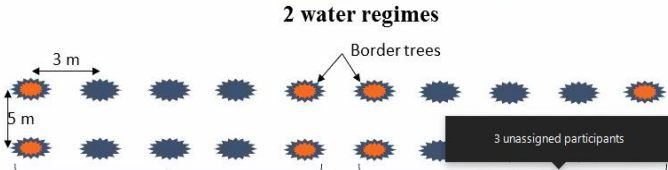
Plant material and water treatments

11 clones



Experimental field of INRA
Ain Taoujdate
Age of trees: 12 years old

2 water regimes



3 unassigned participants

Unmute Start Video Participants Chat Share Screen Pause/Stop Recording Breakout Rooms Reactions Leave Room

Remaining: 09:19:55

HALL-2, Anas HAMDANI

Salon 2-Merye...

H2-Soydemir Hakkı E...

S2H2 Murat KILIÇ

Recording... Figs Yeast and molds count (log cfu/g) Remaining: 08:39:34

Figs	Before storage	I.week	II.weeks	III.weeks
Siyah Kış (2/3)	2,986816445	2,737403637	3,062458783	5,994055
Siyah Kış (olgun)	3,450246891	3,428790791	4,137656536	6,057754
Beyaz Orak (yarı olgun)	3,141667911	3,571350328	3,686001572	3,984648
Beyaz Orak (olgun)	2,661294965	4,595756025	3,950103642	4,984355
1100 (2/3)	2,176143217	3,5800763	4,227019377	5,809192
1100 (olgun)	2,66276373	4,020605604	4,352748169	5,880151
Siyah Orak (2/3)	2,506975273	3,828493012	4,05094701	5,991757
Siyah Orak (olgun)	2,780065458	5,014650898	4,086105376	5,894045
Yediveren (2/3)	2,983040155	3,989233005	4,07422464	4,716009
Yediveren (olgun)	3,077078012	3,844037621	4,490341082	5,347281
Bursa Siyahı (2/3)	2,692259848	3,677918804	3,165732428	5,365135
Bursa Siyahı (olgun)	2,939069646	3,346694942	3,431829453	5,728614
Gök lop (yarı olgun)	3,031803043	2,851778668	3,657884634	4,050585
Gök lop (olgun)	2,751390572	3,653852222	4,213609429	4,254705
Yeşil güz (yarı olgun)	3,136790845	2,342441477	2,712971273	3,170300
Yeşil güz (olgun)	2,671121276	3,023291633	3,903843676	4,745049059
208 (2/3)	3,046885552	2,686854789	2,823470602	5,315272337
208 (olgun)	2,330677697	3,320650685	3,307784024	5,314388844
Morgüz (2/3)	2,685881679	2,461108812	3,801444256	4,763313253
Morgüz (olgun)	3,875386232	2,767481291	4,601259827	5,606382293

Observer Hall-2,

H2-Soydemir Hakkı E...

Hall-2, Fatma Aykut T...

Cigdem Yamaner

CONFERENCE GALLERY

Zoom Meeting

H-1 observer

ESRA GURSO... Hall-1 Oktay Yer... H1-Mukremi... Hall1 Shuang Ta... Salon-1, Ahmet...

Recording

Effect of Retrogradation Process on Edible Quality of Instant Rice Noodles.pptx - Microsoft PowerPoint

Remaining: 09:51:34

Effect of Retrogradation Process on Edible Quality of Instant Rice Noodles

Reporter : Shuang Tang
Instructor: Ying Yang
Report date : 19 June 2021

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Hall1 - Umut Suzan

Prof. Dr. Nedim KOŞUM

Hall-1 Gülcan DEMİROĞLU TOPÇU

session:1 hall 1 Behçet KIR

Seyithan SEYDOĞOĞLU

7 unassigned participants

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3rd INTERNATIONAL CONFERENCE
on FOOD, AGRICULTURE and VETERINARY
19-20 June, Izmir-TURKEY



ABSTRACTS



EVALUATION OF FORAGE QUANTITY AND QUALITY OF SOME HALOPHYTES SPECIES

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ABSTRACT

Due to the severe limitation of fresh water resources for plant production, growers are forced to use highly saline soil and water resources in the form of haloculture or biosaline agriculture systems. In these systems, common plants can not tolerate high salinity, so halophytes should be used. The use of halophytes requires further research into their potential use. The aim of this study was to identify the quantity and quality of forage in some halophytes species in saline areas at Yazd, Iran. In this research, the quantity and quality of 13 halophytes species grown in saline areas of Yazd province were investigated. The results showed that species had significant variations in terms of quantity (fresh weight) and forage quality (ash, crude protein, acid detergent fibers, neutral detergent fibers, and metabolizable energy). The highest fresh weights, as an index for forage production, were obtained in *Noaea mucronata* and *Suaeda fruticosa*. The range of changes in ash, crude protein, acid detergent insoluble fibers, neutral detergent insoluble fibers and metabolizable energy for all salinity species are 8-33%, 6-16%, 30-30%, 56-33%, and 5.6-8.7 MJ/kg, respectively. Among the 13 species studied, it seems that *Alhagi maurorum*, *Bassia scoparia*, *Noaea mucronata* and *Halostachys belangeriana* species can be introduced as new forage sources for further study due to the good quantity and quality of forage.

Keywords: Biosaline agriculture, haloculture, rangeland, salinity, tolerance



AGRICULTURAL EXTENSION TRAINING ON YOUTHS' EMPOWERMENT OPPORTUNITIES THROUGH MODERNIZED ANIMAL HUSBANDRY IN NIGERIA

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ABSTRACT

Youth empowerment (YE) is a mechanism that enables children and young people are encouraged to take control of their lives through discussing their condition and then taken action to strengthen their access to opportunities and change their consciousness through their beliefs, values, and attitudes. Agricultural extension delivery (AED) is the engine that powers all agricultural policies and research; without it, no policy or research would be possible. It is in view of this that this paper presents the extension training on youths' empowerment opportunities through modernized animal husbandry in Nigeria. Animal Husbandry (AH) plays an important role in the Nigerian economy not only in terms of its contribution to Gross Domestic Product (GDP) but it also provides very nutritious protein consumption in the human diet and good earnings for the pastoralists. Skins, fibre, fertilizer, and fuel, as well as capital accumulation, are derived from animal husbandry. Oyediran *et al.* (2018) reported that about 74.1% of the youths engaged in animal husbandry and related activities particularly in the poultry and abattoirs instead of roaming about the street after graduation. Though it was reported that animal husbandry is a profitable venture yet traditional methods of handling are predominant. Consequently, Extension Service Providers (ESP) have identified the training needs in AH to include good site selection, construction of a good animal house, selection of high-quality breeds, artificial insemination, supplying of safe and nutritious feed, provision of clean and sustainable water, consulting Veterinary and Animal Care Experts for drugs, and hygiene and good waste disposal. This paper concludes that AH can be transformed to provide jobs for millions of youths in Nigeria considering the series of potentials in the value chain if there is a paradigm shift from the traditional ways of handling animals to modern methods.

Keywords: Agriculture, animal husbandry, empowerment, extension service, youth, Nigeria



ROOTING AND VEGETATIVE GROWTH OF HARDWOOD CUTTINGS OF EIGHTEEN POMEGRANATE (*Punica granatum* L.) CULTIVARS

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ABSTRACT

The experiment on the response of eighteen pomegranate (*Punica granatum* L.) cultivars was carried out at a green house in Saiss Plain (NW Morocco) on 2020. This research included two experiments. Experiment 1 evaluated rooting percentage and vegetative growth attributes of hardwood cuttings of eighteen cultivars. Experiment 2 evaluated indole-3-butyric acid (IBA) treatments which consisted of basal dip in water only (control) or a gel formulation of indole-3-butyric acid (1000 mg.L⁻¹, 2000 mg.L⁻¹ and 3000 mg.L⁻¹) for hardwood cuttings of the same cultivars used in experiment 1. The measurements concerned rooting success percentages, dry root mass, leaf area, plant height, number of shoots, apical shoot growth, total shoot length, branching, stem diameter, and relative chlorophyll content. Results showed clear differences among pomegranate cultivars in response to hardwood cuttings. Differences in plant height and branching between all cultivars tested could be detected early in production. The rooting percentage in Zheri Precoce Grenade Rouge and Djebali cultivars is 100% in experiment 1. The effect of IBA concentration on rooting percentage and growth attributes varied among cultivars. Cuttings of Grenade Jaune and Gordo de Jativa rooted best with 2000 mg. L⁻¹ IBA versus control, 1000 and 3000 g L⁻¹ IBA, whereas rooting of cuttings of Mollar Osin Huesso was similar among IBA rates. Stem diameter had no effect on rooting on Gjeibi, Grenade Jaune, Chelfi and Sefri 2 cultivars in either experiment. There were significant differences among cultivars in terms of leaves chlorophyll content, with Zheri Automne, Djebali and Mollar Osin Huesso having greener leaves in this collection.

Keywords: *Punica granatum* L., auxinindole-3-butyric acid, vegetative propagation, rooting



AKSARAY YÖRESİNDE AZOTLU GÜBRE UYGULAMALARININ 2. ÜRÜN MISIRDA DANE VERİMİ İLE VERİM ÖZELLİKLERİNE ETKİSİ ÜZERİNDE ARAŞTIRMALAR

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ÖZET

Bu araştırma, 2013 yılında Aksaray ilinde 2. Ürün olarak yetiştirilen mısıra üst ve taban gübresi şeklinde uygulanan farklı azotlu gübrelemenin, mısırdaki silajlık hasıl ve dane verimi ile verim özelliklerine etkisini belirlemek amacıyla Sultanhanı ilçesi Osman kuyusu mevkiinde yürütülmüştür. Değişik formda azotlu gübre uygulamaları ile verim ve verim özelliklerinden elde edilen değerler arasında istatistiki olarak önemli farklılıklar bulunmuştur. Eşit miktarda uygulanan saf azot miktarı ile birlikte en yüksek dane verimini taban gübresi olarak Eurotim Plus, üst gübresi olarak Timazot 25 uygulamasından elde edilmiştir.

Anahtar Kelimeler: Saf azot miktarı, tane verimi, II. Ürün



INVESTIGATIONS ON THE EFFECTS OF NITROGEN FERTILIZER ON SEED YIELD WITH YIELD PROPERTIES OF SECOND CROP MAIZE IN AKSARAY REGION

ABSTRACT

This research was carried on to define the efficiency of different fertilizing with nitrogen which is applied as top and base manure to the corn that is grown as second crop to herbage and seed yield in Osmankuyu locality in the Sultanhanı in Aksaray in 2013, in the Sultanhanı and its Osmankuyu location. Statistically significant differences between the values obtained with different nitrogenous fertilizer application form has been found. The highest amount of product applied with equal amounts of pure nitrogen and grain yield as the base of fertilizer Eurotim Plus, obtained from Timazot-25 as the upper fertilizer application.

Keywords: The amount of pure nitrogen, seed yield, second crop



FORAGE QUALITY of *Salvia limbata* IN RANGELAND

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ABSTRACT

Salvia is a genus native to the Mediterranean regions and belongs to Lamiaceae family. This family is known as that has flowering plants which are called mint or sage family. Forage quality of *Salvia limbata* at two growth stages (vegetative, seed production) at different altitudes (1500, and 2500 m above sea level) has been studied in Taleghan rangeland in Alborz province. Aerial parts of the plant were sampled with five replications. Then samples were dried and milled. Five forage quality traits, including DMD (Dry matter digestibility), ADF (Acid detergent fibre), ME (Metabolizable energy), CP (Crude protein), and N were measured. Data were analysed in completely randomized design analysis of variance and means were compared by Duncan's test at 1% level. The results indicated that the forage quality of *Salvia limbata* was affected by phenological stages and altitudes. N (2.5%), CP (15.7%), ME (9.69%), and DMD (68.8%) have been obtained in higher amount in vegetative stage and ADF (55.60%) was achieved in the seed ripening. Due to the high percentage of CP, N, ME, and DMD, the vegetative stage at 2500 m was determined for animals to graze this plant. Based on the results, it is clear that *Salvia limbata* can be used both for production of essential oil and also can be effective for grazing in its vegetative stage. According to our results the grazing time of *Salvia limbata* was from June to August so it should be noted that in other areas what would be the best time to graze *Salvia limbata*. This research could be conducted in other areas with the same conditions. If other factors including human activities were studied carefully, the results would be more trustworthy.

Keywords: *Salvia*, growth stages, livestock, rangeland



ПРАВА ЖИВОТНЫХ В ИСЛАМЕ. ОБ ОТНОШЕНИИ ПРОРОКА К ЖИВОТНЫМ

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РЕЗЮМЕ

Известно, что людям нужно многое, чтобы выжить на протяжении всей жизни. Одно из самых важных из них - животные. Фактически, животные были созданы для людей, от удовлетворения основных потребностей, таких как еда, одежда и транспорт, до обращения к декоративным материалам и даже к эстетическим удовольствиям. В Коране на эту ситуацию обращено внимание следующим образом: «Аллах создал животных. Есть согревающие вещи (шерсть) и много пользы от них для вас. Вы оба едите от них (и их доход). Когда они приносят их вечером и отпускают утром, они доставляют вам (удовольствие и) красоту. Он также создал лошадей, мулов и ослов, чтобы вы могли ездить на них и быть украшением (в жизни этого мира), и он создает много вещей, о которых вы еще не узнаете. В другом стихе говорится, что в молочных животных есть знаки для людей, и утверждается, что они являются чудом искусства: «У молочных животных определенно есть знак для вас. Ведь мы заставляем вас пить чистое молоко, которое легко проходит через глотку пьющих, между приливом живота и кровью. С другой стороны, некоторые главы Корана названы разными именами животных, кроме того, животные описаны как умма, как люди: «Нет на земле живого существа, которое борется, и нет птиц, летающих на двух крыльях, которые бы там были. Это не умма, как ты. Мы не оставили ничего пропавшего в книге (Лоух аль-Махфуз), тогда все они соберутся в присутствии своего Господа ». Поразительно, что термин «умма», занимающий важное место в исламской традиции и литературе, также используется для обозначения животных. Потому что животные играют очень важную роль в поддержании экологического порядка и равновесия. Кроме того, как и любое благословение в жизни, животные - это реликвии, принесенные на службу человечеству. Поэтому, используя эти реликвии, необходимо не выдавать их и всегда бережно относиться к ним. Гц. Мы ясно видим это в советах, приказах и действиях Пророка. Например, он запретил бесполезное и произвольное убийство животных, за исключением некоторых вредителей. Гц. Пророк покинул Медину в ихраме, чтобы отправиться в Мекку. Усайе нам подошел к позиции. Это было где-то между Ruvise и Aгс. Он увидел газель, свернувшуюся клубочком и спящую в тени. Аллах повелел посланнику Аллаха не беспокоить животное и не беспокоить его газелью, пока все не пройдут мимо. По пути к завоеванию Мекки была выставлена великолепная картина, посвященная обращению с животными. Такое отношение было результатом того, как Бог смотрел на создания. Когда Повелитель Миров покинул Арку и направился к Талубу со своей великолепной десятитысячной армией, он увидел собаку, растянувшуюся над его щенками и кормившую их. Он немедленно подозвал к себе одного из своих товарищей, Куайла бин Сурака, и поставил его охранять этого кельба и его потомков. Мать сообщила, что кельбин и ее потомство не будут напуганы исламской армией. Еще раз, Гц. Пророк предупредил Аишу, которая едет на боевом верблюде и водит его назад и вперед, чтобы успокоить животное, говоря: «- Относитесь к животному мягко! Потому



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19-20 June, Izmir-TURKEY**



что мягкость делает его красивым, где бы он ни находился. Любое поведение без мягкости некрасиво ». Гц. Мухаммад неоднократно заявлял, что сострадание, милосердие или милосердие, проявляемые к животным, могут быть средством вечного счастья или разочарования для людей: «Для каждого живого существа есть добрые дела». В другом замечательном хадисе говорится следующее: «Женщину мучил кот, которого она заточила в тюрьму до самой смерти, и поэтому она попала в ад. Когда он заключил животное в тюрьму, он ничем его не кормил, не давал пить и даже позволял или позволял ему есть вредителей на земле ». Иногда может потребоваться ввести определенные ограничения для боевых животных только для их дрессировки. Однако здесь следует проявлять осторожность, чтобы не переборщить. Мучение животного из-за его уязвимости - это действие, противоречащее духу ислама. Эту жестокость попросят объяснить в мире или в загробной жизни. Также важно, чтобы животные хорошо кормились, чтобы их возили столько, сколько они могут унести, и чтобы они уделяли должное внимание своему отдыху. Это один из вопросов, который Пророк тщательно подчеркивал. В хадисе он сказал: «Путешествуя по местам, где много травы, дайте верблюдам возможность воспользоваться травой. Если вы путешествуете по бесплодным местам и местам без травы, быстро ползайте на верблюдах, чтобы они могли добраться до места назначения, не теряя силы. Когда вы делаете перерыв и ложитесь спать ночью, сверните с дороги и стойте в стороне. Потому что дорога будет проходить мимо животных, а насекомые останутся на ночь.

Ключевые слова: Пророк, права животных, Коран, милосердие



TARIMSAL ÜRÜNLERDE MİKOTOKSİNLER ve RİSK YÖNETİMİ

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ÖZET

Mikotoksinler; öncelikli olarak *Alternaria*, *Fusarium*, *Aspergillus*, *Penicillium* gibi küf kaynaklı toksik bulaşılarda gıdalarda ve yemlerde yaygın olarak bulunurlar ve günlük beslenmeye bağlı olarak insanlarda ve hayvanlarda çeşitli sağlık sorunlarına neden olabilirler. İkincil metabolit olarak 400'den fazla toksin tanımlanmasına karşın; gıda riski, sağlık kaygıları ve ekonomik kayıplarla olan ilişkileri nedeniyle aflatoksinler, okratoksin A, *fusarium* toksinleri, patulin, deoksinivalenol ve trikoteşenler ön plana çıkmaktadır. Dünya nüfusunun 2050 yılında 9 milyar 800 milyon kişi olması beklenmektedir. Mikotoksinlere maruz kalma; tüketme, solunma ve deri temasıyla meydana gelebilir ve bu durum rastgele meydana gelmektedir. Mikotoksikoz vakalarının çoğu (insan ve hayvan) kontamine yiyeceklerin tüketilmesi ile sonuçlanır. İnsan maruziyeti tahıllar yoluyla doğrudan veya bulaşmış hayvansal ürünlerle (yumurta, süt, et vb) olur. Küresel gıda ve yem üretiminin %25'i mikotoksinlerle bulaşık hale gelmektedir. İklim değişikliği toksijenik küf gelişiminin aşamalarını, oranlarını ve konakçı-patojen etkileşimlerini değiştirebilir, ayrıca her bir patojen için değişen mikotoksin üretimi koşullarını da etkileyebilir. Tarımsal üretim zincirinde mikotoksinlerin tüketiciler için oluşturduğu tehlike, hem de paydaşlar için maliyetler konusunda uluslararası düzeyde farkındalık ve bilgi yaymak, dünya çapında bu tür bulaşmaları kontrol etmeyi amaçlayan risk yönetimi ve değerlendirilmesi kilit önemdedir.

Anahtar Kelimeler: Gıda güvenliği, risk değerlendirme, bulaşılarda, kalite



MYCOTOXINS and RISK MANAGEMENT in AGRICULTURAL COMMODITIES

ABSTRACT

Mycotoxins are commonly found in foods and feeds, primarily with mold-borne toxic contamination such as *Alternaria*, *Fusarium*, *Aspergillus*, *Penicillium*, and can various health problems in humans and animals depending on daily nutrition and feeding. Although more than 400 toxins are defined secondary metabolites; aflatoxins, ochratoxin A, fusarium toxins, patulin, deoxynivalenol and trichothecenes come to the fore due to their association with food risk, health concerns and economic losses. The world population is expected to be 9 billion 800 million people in 2050. Exposure to mycotoxins; it can occur through ingestion, inhalation, and skin contact, and this happens randomly. Most cases of mycotoxicosis (for human and animal) result in the consumption of contaminated food. Human exposure occurs directly through cereals or contaminated animal products (eggs, milk, meat, etc.). 25% of global food and feed production becomes contaminated with mycotoxins. Climate change can alter the stages, rates and host-pathogen interactions of toxigenic mold development, as well as affect the varying mycotoxin production conditions for each pathogen. Spreading awareness and knowledge at international level about the danger posed by mycotoxins to consumers in the agricultural production chain, as well as costs for stakeholders, and risk management and assessment aimed at controlling such contamination worldwide are key.

Keywords: Food safety, risk assessment, contaminants, quality



LIPOLYTIC AND PROTEOLYTIC ACTIVITIES OF TWO GENERA OF LACTIC ACID BACTERIA (*Lactobacillus* and *Lactococcus*)

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ABSTRACT

Lactic acid bacteria play a role in the fermentation of animal and plant raw materials. They are widely used in the food industry. Lactic acid bacteria have an important role in the preparation, preservation and processing of many fermented foods. They also play an important role in the manufacture of cheese and various fermented dairy products, and contribute to texture, flavor and the production of aromatic compounds. The objective of this work is to study certain characteristics of technological interest such as the lipolytic and proteolytic abilities of lactic acid bacteria isolated from raw cow milk in eastern Morocco, namely *Lactobacillus* and *Lactococcus*. Proteolytic activity is an important technological property of lactic acid bacteria since it gives them the capacity to grow efficiently in milk. The lipolytic activities of microorganisms are important during the maturation stages of certain food products, and these activities generally contribute to the development of different flavors. Proteolytic activity is demonstrated on MRS/M17 agar medium supplemented with 5% skimmed milk. Lipolysis is demonstrated on PCA medium supplemented with 1% sterile glycerol. The results obtained for this test show that the species of the *Lactobacillus* genus are strongly proteolytic, their clear zone diameter varies between 2 to 10 mm compared to the species of the *Lactococcus* genus. *Lactococci* expressed an average lipolytic activity and *Lactobacillus* were only slightly lipolytic. This study allowed the detection of the proteolytic and lipolytic activities of the two studied strains, and shows that the proteolytic and lipolytic activities differ from one strain to another, confirming the strain effect.

Keywords: Lactic acid bacteria, *Lactobacillus*, *Lactococcus*, proteolytic activity, lipolytic activity



YIELD AND FRUIT QUALITY OF PLUM UNDER DEFICIT IRRIGATION

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ABSTRACT

The effects of water stress (CDI) on the performance of plums (*Prunus domestica* L.) were evaluated in the Saiss plain (NW of Morocco), during the fruit development period. However, there are no established studies on the drought stress tolerance of the cultivars used. In this study, eleven plum cultivars, growing in the Ain Taoujdate experimental station of INRA Morocco, were examined for their tolerance to water stress of 50% ETc, applied during the fruit growing season, compared to control trees sprayed at 100% ETc. Measurements focused on yield, fruit weight, chemical quality (Brix, pH) and biochemical quality of the fruits (total polyphenol content, total soluble sugars, total amino acids and antioxidant capacity). All analyses revealed significant variations among cultivars in response to water stress. However, the cluster analysis based on mean ratios between CDI and FI treatments of all traits highlighted three distinct clusters within the studied cultivars with regard to drought tolerance. PCA analysis using mean trait ratios revealed that the effects of water stress on fruit weight, brix degree and antioxidant activity had the greatest impact on cultivar discrimination for drought tolerance.

Keywords: *Prunus domestica*, drought conditions, fruit quality



PSEUDOCEREALS AND MILLETS: GLUTEN-FREE, NUTRIENT-DENSE TRADITIONAL GRAINS

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ABSTRACT

An increasing incidence of gluten intolerance in both children and adults is resulting in Celiac disease, a chronic, autoimmune disorder of the small intestine, non-celiac gluten sensitivity and wheat allergy. Gluten is a complex mixture of proteins, prolamines and glutenins in cereals like wheat, barley and rye. Ingestion of dietary gluten is associated with mucosal inflammation, villous atrophy in celiac patients, resulting in malabsorption of nutrients, chronic diarrhoea, abdominal bloating and pain, fatigue, weight loss, anaemia, liver and biliary tract disorders, osteoporosis, intestinal lymphomas and other complications like cardiomyopathy and neuropathy. Traditional grains like Pseudocereals and Millets are gluten-free and offer a healthy alternative for gluten-sensitive people, being good sources of essential amino acids, complex carbohydrates, antioxidants, minerals, vitamins and dietary fibre. Pseudocereals are herbaceous dicotyledonous plants (non-grasses) with small, edible starchy grains similar to true cereals (grasses, family Poaceae), but with starch reserves stored in the perisperm. Pseudocereals like *Fagopyrum esculentum* (buckwheat), *Chenopodium quinoa* (Quinoa) and various *Amaranthus* species (Redroot Amaranths) are rich in proteins with high biological value due to the presence of high essential amino acids content, particularly lysine, methionine and tryptophan. Pseudocereals exhibit high nutraceutical potential with several bioactive compounds like polyphenols, phytosterols, flavonoids like rutin, and fagopyritols that can play a role in prevention of lifestyle disorders including hypertension, obesity, insulin resistance, dyslipidaemia and hyperglycaemia. Millets are small seed grains of Poaceae, that are resilient to drought, salinity and extreme temperatures, and can grow easily in marginal and degraded lands of Africa and Asia. Millets like *Eleusine coracana* (Finger millet), *Pennisetum typhoides* (Pearl millet), *Setaria italica* (Foxtail millet) are rich in minerals like iron, calcium, magnesium, zinc, phosphorus and potassium, B-vitamins, antioxidants, essential amino acids and fibre. Millets support healthy gut flora as prebiotics, reduce the risk of colon cancer, control blood sugar and cholesterol levels, provide protection against cardiovascular diseases, diabetes and Celiac disease. The review intends to highlight the potential of these sustainable, nutrient-dense grains in the development of Gluten-free functional food.

Keywords: Gluten intolerance, celiac disease, pseudocereals, millets, nutraceuticals, lifestyle disorders



**GENETIC GAIN ENHANCEMENT THROUGH ESTIMATED BREEDING VALUES
USING PEDIGREE BLUP IN POTATO (*Solanum tuberosum* L.)**

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ABSTRACT

Identification of superior parental lines require phenotypic or genotypic characterization of the germplasm, which is time consuming and laborious. Here we demonstrate the identification of suitable parental lines for tuber yield, late blight and specific gravity based on estimated breeding values using historical data as training population. The advanced potato breeding clones including control varieties evaluated in RCBD from 2008-09 to 2019-20 at Central Potato Research Institute, Regional Station, Modipuram, India were included in the study. The pedigree of all the clones was searched to a depth of 5-6 generations. The mixed model fitting using REML was true. The minimum and maximum values for total tuber yield, late blight AUDPC and specific gravity were 28.33-732.2, 0-1846.25, 1.043-1.087, respectively. Pedigree had 161 founders out of total 759 individuals and the pedigree matrix showed relationship in 1,09,057 pairs. Heritability estimate was highest for specific gravity (0.77), followed by late blight AUDPC (0.49) and total tuber yield (0.24). The EBVs for total tuber yield were highest for Kufri Mohan, Kufri Pukhraj, Kufri Khyati, SM/14-342 and Kufri Pushkar while SM/10-05, SM/09-99, Kufri Girdhari, SM/11-120 and Kufri Karan for late blight resistance, and Kufri Chipsona-1, SM/14-225, SM/14-229, SM/10-220 and SM/09-153 for specific gravity were the best genotypes. The prediction accuracy measured as correlation between EBV and observed phenotype score for specific gravity (0.97) was near perfect, very high for late blight AUDPC



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(0.75), and high for total tuber yield (0.55). The prediction bias measured as regression coefficient and scatter plots of observed phenotype values on EBVs was nil to low for specific gravity and late blight AUDPC, while underestimation was observed for total tuber yield. Overall, the prediction accuracies for all the three traits were very good and selection of parental lines using BLUP breeding values could result in enhanced genetic gain in potato breeding.

Keywords: pedigree BLUP, estimated breeding values, tuber yield, late blight, specific gravity



**DEPTH OF WATER TABLE DURING EARLY GENERATIVE PHASE AFFECTED
GROWTH AND YIELD MORE THAN DURATION OF ITS EXPOSURE IN
TOMATO**

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ABSTRACT

Tomato (*Solanum lycopersicum* L.) is rarely grown at riparian wetlands in Indonesia since most of local farmers considered tomato as sensitive plant to excessive water condition. This research was designed to evaluate ability of tomato plant to tolerate shallow water table and duration of its exposure. Results of this study disclosed that tomato could tolerate water table at depth of 10 cm below substrate surface or deeper, regardless of duration of its exposure. Despite significantly reduced root length in plants exposed to shallow water table, root dry weight was not significantly affected. Most of vegetative and reproductive traits were insignificantly reduced by shallow water table condition, including total harvested and fresh weight of tomato fruits. Based on results of this study, tomato plant has promising prospect for cultivation at riparian wetlands during transition from rainy to dry season and vice versa as long as soil water table could be constantly managed at position deeper than 10 cm beneath soil surface.

Keywords: Waterlogging, oxygen deficiency, flowering stage, tropical vegetable, yield loss



TRADITIONAL KNOWLEDGE AND USE OF WILD FOOD AND MEDICINAL PLANTS IN SIDI BENNOUR REGION (Central Morocco)

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ABSTRACT

We report the first ethnobotanical study of wild food and medicinal plants used by the inhabitants of the Sidi Bennour province. Considering the urgent need to avoid the loss of this traditional knowledge. An ethnobotanical survey was conducted between February And October 2019, using a questionnaire, The sample size surveyed was 200 people. The surveys were based on the Semi-Structured Interview method. The approach of the interviewed population was based on dialogue in the local language. The results showed that a total of 71 plant species representing 66 genera and 33 families were used to make different food dishes and in the treatment of various diseases. The most cited WEP (Wild edible plants) families were *Asteraceae* (16%), followed by *Apiaceae* (13%) and *fabaceae* (8%). The leaves (36%) and stems (30%) were the most parts commonly used in food. Four utilization categories were cited, as vegetables, for seasoning, as drink and Other (plants used to decorate or flavor traditional dishes). The use of these WEPs as vegetables was the most cited mode of consumption (35%) by the local population. The leaves were the most commonly used part (34%) for medicinal uses of WEPs, and decoction (30.5%) and powder (23.3%) were the most common methods of preparing traditional medicines. The majority of preparations were administered orally (72.5%) followed by cutaneous applications (23.8%). The study results showed also that local people have sufficient information on the safe use of WEPs. Moreover, the study population underlined the sharp decline in the consumption of most of the species recorded, especially among the young generation. This study data draw attention to the urgent need to document in order to protect the knowledge related to the traditional uses of wild plant resources which constituted untapped potential as dietary supplements and therapeutic products.

Keywords: Beqoula, relative frequency index of citation, phytotherapy, Morocco



**INVESTIGATING THE EFFECT OF SEVERAL SENSITIVE AND RESISTANT
WHEAT CULTIVARS ON THE AMOUNT OF PROTEIN IN GUTS, FAT BODIES
AND DIGESTIVE ENZYMES ACTIVITIES IN ADULTS OF SUNN PEST,
EURYGASTER INTEGRICEPS (Hemiptera: Scutelleridae)**

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ABSTRACT

Sunn Pest *Eurygaster integriceps* (Hemiptera: Scutelleridae) is an important pest of wheat, which is known as a major economic pest today. Wheat is one of the strategic and valuable products of the world, which is known as one of the most people needed food in world. Sunn pest damage to wheat is seen in the various stages of wheat growth such as reducing the quantitative and qualitative properties of the product. In the first nymph stage to mid-age of second nymph stage no feeding is observed and the main stage of damage is from the 4th nymph stage to the adult insects. Improper use of insecticides against this pest has led to resistance in the majority of wheat cultivars. Therefore, the tremendous use of chemical pesticides is not a good way to prevent the sunn pest damage. Due to the importance of controlling this pest, this study contains the effect of six different wheat cultivars, including Antanious, Noodel, Germez, Sabalan, Sardari and Azar 2 cultivars, on the changes in the amount of protein in the gut and fat bodies of adult Sunn pest insects. Fat bodies play a major role in the insects' storage and release insect protein that takes place in this area and increases the resistance of this insect to adverse environmental conditions. Therefore, the protein of Sunn pest adult insect fat bodies was evaluated in this study. moreover, the effect of different wheat cultivars on the activity of alpha-amylase, protease and Pectinase of the Sunn pest adult insects were studied. The weight of adult insects that fed from different wheat cultivars were measured. Protein patterns of samples prepared from gut and fat bodies of adult Sunn pest insects on different wheat cultivars were also compared using Polyacrylamide gel electrophoresis. Determination of protein amount from bradford's colorimetric assay and images of polyacrylamide gels were consistent and the protein content of the samples was clearly visible in the gels. Therefore, it can be said that the amount of protein in the gut and fat bodies of whole insects feeding on different cultivars were significantly different. The lowest amount of gut and fat bodies protein was observed in insects that fed from Germez cultivar and the highest amount of the protein in gut and fat bodies were observed in insects that fed on Sardari cultivar. The effect of Azar2 cultivars culture on protein in gut and fat bodies of whole insects was investigated and it was observed that insects that fed on wetland farmed Azar2 had less protein than insects that fed on dryland farmed Azar2. Alpha-amylase enzyme activity in Germez cultivar was much lower than Sabalan cultivar and the highest alpha-amylase activity was observed in fed insects on Sabalan cultivars. Gut protease activity was not significantly different in three cultivars of Germez, wetland farmed Azar2 and



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Noodel and the highest gut protease activity of whole insects was observed in fed insects on Sardari cultivar. Pectinase enzyme activity in Germez cultivar was much lower than Sardari cultivar and the highest Pectinase activity was observed in fed insects on Sardari cultivars. Therefore, we conclude that the type of wheat cultivar affects the damage caused by this pest in different regions and the selection of cultivars resistant to insect damage can be suitable, cost-effective and a valuable method to replace the chemical control method.

Keywords: Sunn pest, fat bodies, protein, gut, alpha-amylase, protease, pectinase, SDS-PAGE



BOR GIDERİLMİŞ JEOTERMAL KAYNAKLARIN BUĞDAY TARIMINDA KULLANILABİLİRLİĞİNİN ARAŞTIRILMASI

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ÖZET

Su canlıların yaşaması için gerekli olan bir doğal kaynaktır. Dünyamızın %70'ini oluşturan su, vücudumuzun da önemli bir kısmını oluşturmaktadır. Ancak yeryüzündeki su kaynaklarının yaklaşık %0.3'ü kullanılabilir ve içilebilir özelliktedir. Artan nüfusun etkisiyle birlikte su tüketiminin artması, suya olan ihtiyacı da beraberinde getirmektedir. Küresel iklim değişikliği ve çevreye verilen zarar ile birlikte su kaynakları azalmaya başlamış, bu durum suya olan ihtiyacımızı daha çok arttırmıştır. Bu sebeple bütün dünyada her türlü su kaynağının tarımsal amaçlı sulamada kullanılmasını zorunlu hale getirmektedir. Termal sular çeşitli mineraller bakımından zengin ve sıcaklığı yüksek oldukları için doğrudan değerlendirilememektedir. Jeotermal kaynağının tarımsal amaçlı sulamada kullanılabilir hale getirmek önem kazanmaktadır. Jeotermal kaynaklar çok zengin element içeriğine sahip ve yüksek miktarda bor, ağır metal vb. elementlerden meydana gelmektedir. Bor, bitkilere toksik etki yapan elementlerin başında gelmektedir. Bu sebeple doğrudan sulama amaçlı kullanıldıklarında bitkilere toksik etki yapacak ve çevre sorunlarına sebep olacaktır. Buğday bitkisi, çeşitli topraklarda kolay uyum sağlama yeteneğine sahiptir. Bu sebeple dünyamızda her geçen gün buğday verimi artış göstermektedir. Bu çalışmada bor minerali giderilmiş jeotermal kaynakların, besin kaynağı olarak kullanılan buğday yetiştirilecektir. Bu amaçla ilk adımda Tuzla jeotermal kaynaklarında bulunan yüksek oranda bor minerali içeren termal suda bor giderimi yapılacaktır. Elde edilen artırılmış sudan iki farklı buğday çeşidi yetiştirilerek gelişimleri izlenecek. Çalışmada bitki materyali olarak farklı tahıl tohumu kullanılacaktır. Çalışmada fidelerde fiziksel ve bitkisel özellikleri değerlendirilecektir.

Anahtar Kelimeler: Buğday, Jeotermal kaynak, bor

Teşekkür: Bu çalışma Çanakkale Onsekiz Mart Üniversitesi Bilimsel Araştırma Projeleri Koordinasyon (BAP) Birimince Desteklenmiştir. Proje Numarası: .FYL2020: 3277.



INVESTIGATION OF THE USABILITY OF BORON-REMOVED GEOTHERMAL RESOURCES IN WHEAT FARMING

ABSTRACT

Water is a natural resource necessary for living creatures to survive. Water, which makes up 70% of our world, also constitutes an important part of our body. However, approximately 0.3% of the water resources on earth are usable and potable. The increase in water consumption with the effect of the increasing population brings along the need for water. With the global climate change and the damage to the environment, water resources have started to decrease, and this situation has increased our need for water more. For this reason, it makes it mandatory to use all kinds of water resources in irrigation for agricultural purposes all over the world. Since thermal waters are rich in various minerals and their temperature is high, they cannot be evaluated directly. It is important to make the geothermal resource usable in irrigation for agricultural purposes. Geothermal resources have very rich element content and high amounts of boron, heavy metals, etc. It consists of the elements. Boron is one of the elements that have toxic effects on plants. For this reason, when used for direct irrigation, it will have a toxic effect on plants and cause environmental problems. Wheat plant has the ability to adapt easily to various soils. For this reason, wheat yield is increasing day by day in our world. In this study, wheat will be grown, which is used as a food source of geothermal resources that have demineralised boron. For this purpose, in the first step, boron removal in thermal water containing high boron minerals found in Tuzla geothermal resources will be made. Two different types of wheat will be grown from the purified water, and their development will be monitored. Different cereal seeds will be used as plant material in the study. Physical and vegetative properties of seedlings will be evaluated in the study.

Keywords: Wheat, geothermal resource, boron



PREPARATION OF BIODEGRADABLE COMPOSITES WITH DISTILLER'S GRAINS AS BIOMASS FILLER

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ABSTRACT

It is an effective way to change the properties of PLA (poly (lactic acid)) by adding natural biomass as reinforcing filler. The main content of this paper is to get PLA / biomass composites by physical melt blending of distiller's grains (DG) biomass and PLA, and then use MPLA (modified poly (lactic acid)) to modify PLA / biomass composites, in order to try to improve the properties of PLA / biomass composites. The morphology, thermal properties, mechanical properties and barrier properties of the composites were studied. PLA / DG was prepared by melt blending of PLA and DG, and then MPLA was added to obtain MPLA / DG composite. Through XRD analysis, the characteristic peak of PLA / DG has no obvious change. DTG images show that the thermal stability of the composite is improved after adding MPLA. DSC analysis showed that MPLA improved the molecular bond cooperation between DG and PLA and the uniform dispersion of DG in PLA. Compared with PLA / DG, the water resistance of MPLA / DG composites is improved obviously, but it is still in the overall upward trend. At the same time, compared with PLA / DG, the degradation performance of MPLA / DG has no obvious change. The addition of MPLA can improve the mechanical strength of the composite, but the increase is not significant compared with pure PLA. However, when the addition of DG reaches 20%, the mechanical strength of MPLA can be close to that of pure PLA. Through this ratio, the cost can be effectively reduced.

Keywords: Grains, preparation, composites



İNDİRGEYİCİ MISIR HATTINDAN ALINAN FARKLI İRİLİKTEKİ POLENLERİN MORFOLOJİK, SPEKTRAL VE MOLEKÜLER KARAKTERİZASYONU

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ÖZET

Tüm bitkilerde olduğu gibi mısırdaki da polen genetik çalışmalarının önemli vektörlerinden birisidir. *In vivo* maternal katlanmış haploid tekniğinde kullanılan indirgeyici hatlar polen kaynağı olarak kullanılan nitelikli materyallerdir. Bu materyallerden toplanan polenlerin özelliklerinin araştırılmasına yönelik çalışmalar sınırlıdır. Bu araştırma CIMGTAIL-P2 indirgeyici hattının 50 mikron ve 100 mikron büyüklüklerinde filtrelenmiş örneklerin morfolojik, moleküler ve spektral özelliklerinin incelenmesi amacıyla yürütülmüştür. Çalışmada, Çanakkale Onsekiz Mart Üniversitesi, Ziraat Fakültesi Çiftliği Bitkisel Üretim Araştırma ve Uygulama Birimindeki kontrollü sera şartlarında 2020 yılı kış döneminde yetiştirilen indirgeyici hattan toplanan ve filtrelenen polen örnekleri kullanılmıştır. Toplanan polenler vakum altında 50 mikron ve 100 mikronluk filtrelerden geçirilmiş ve bu örneklerde morfolojik ölçümler ışık mikroskobu altında 10X büyütme altında incelenmiştir. Polen örneklerinden Raman ve Yakın Kızıl Ötesi Spektroskopisi (NIR) spektrumları alınarak karşılaştırılmıştır. Ayrıca polen örneklerinden toplam protein izolasyonu gerçekleştirilmiş ve Sodyum Dodesil Sülfat-Poliakrilamid Jel Elektroferez (SDS-PAGE) yöntemi ile protein bant fraksiyonları ayrıştırılmıştır. Çalışma sonucunda 50 mikron ve 100 mikron örneklerde polen canlılığının önemli benzer olduğu gözlemlenmiştir. Filtreleme ile ayrıştırılan örneklerin ortalama polen çapları 50 mikron grubunda 87.4 mikron, 100 mikronluk örneklerde 101.2 mikron olarak hesaplanmıştır. Spektral veriler bakımından polen örnekleri kıyaslandığında, polen iriliklerine ait örneklerde önemli farklar olduğu görülmüştür. Moleküler bant analizlerinde 100 mikronluk çaptaki örneklerde tespit edilen bant sayısı 50 mikronluk örneklerden daha fazla olmuştur. Sonuç olarak polen ayrıştırma işleminin moleküler ve spektral farklılıklara neden olduğu görülmüştür.

Anahtar Kelimeler: Polen analizleri, haploid, *Zea mays*

Not: Bu çalışma Gülizar Pınar'ın Yüksek Lisans tezi kapsamında elde edilen sonuçlar kullanılarak hazırlanmış olup, Çanakkale Onsekiz Mart Üniversitesi Bilimsel Araştırma Projeleri Koordinasyon Birimi tarafından desteklenmiştir (Proje No:FYL-2020-3396).



MORPHOLOGICAL, SPECTRAL AND MOLECULAR CHARACTERIZATION OF DIFFERENT SIZE OF POLLENS OBTAINED FROM INDUCER MAIZE LINE

ABSTRACT

As in all plants, pollen in maize is one of the important vectors of genetic studies. Inducer lines used in *in-vivo* maternal double haploid technique are qualified materials used as a sources of pollen. Studies on the properties of pollen collected from these materials are limited. This research was carried out to investigate the morphological, molecular and spectral properties of the 50 micron and 100 micron filtered samples of the CIMGTAIL-P2 inducer line. In the current study, pollen samples collected from the inducer line grown in the winter of 2020 and under controlled greenhouse conditions in the Agricultural Production Research and Application Unit of Çanakkale Onsekiz Mart University, Faculty of Agriculture, were used. The collected pollen was passed through 50 micron and 100 micron filters under vacuum and morphological measurements in these samples were examined under 10X magnification under light microscope. Raman and Near Infrared Spectroscopy (NIR) spectra were taken from pollen samples and compared. In addition, total protein extraction was performed from pollen samples and protein band fractions were separated by Sodium Dodecyl Sulphate-Polyacrylamide Gel Electrophoresis (SDS-PAGE) method. As a result of the study, it was observed that pollen viability was similar in 50 micron and 100 micron samples. The average pollen diameters of the samples separated by filtering were calculated as 87.4 microns in the 50 micron group and 101.2 microns in the 100 micron samples. When the pollen samples were compared in terms of spectral data, it was seen that there were significant differences in the samples belonging to the pollen size. In molecular band analysis, the number of bands detected in 100 micron diameter samples was higher than 50 micron samples. As a result, it was seen that the pollen filtration caused molecular and spectral differences.

Keywords: Pollen analyses, haploid, *Zea mays*



**STATISTICAL ESTIMATES OF GENOME REPEATS IN PLANT GENE
REGULATORY REGIONS RELATED TO ENVIRONMENT STRESS RESPONSE**

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ABSTRACT

Challenge of plant selection research is in deciphering genome regulation mechanisms for stress responses to drought, cold, changing temperature and other varying environment conditions. Development of high-throughput sequencing technologies allow to study the transcription factors binding in genome scale. The clusters of transcription factor binding sites determine regulatory gene regions in plants. New data on the experimentally found binding sites by ChIP-seq technologies may help analyze gene expression in model plant genomes. Plants have complex molecular regulatory mechanisms of gene expression and response to the environmental stresses important for biotechnology. We develop software tools for the analysis of the transcription factor binding sites location, their clustering in a model genome, visualization, and statistical estimates for such clusters. The statistics of clusters of the binding sites for several (3 and more) different transcription factors predicted and identified by ChIP-seq is shown. We used such transcription regulation clusters for analysis of text repeats, tandem repeats and entropy estimates aiming for specific gene enhancer prediction. An application for the analysis of transcription factor binding sites in several evolutionarily distant model plant organisms is discussed. We developed computer program for analysis of ChIP-seq data, detection and visualization clusters. We applied it to model genome study in three plants, including Arabidopsis. We discuss statistical estimates of the binding sites clustering. The clusters of binding sites in the plant genomes were predicted and annotated. The regulatory clusters in Arabidopsis were considered in more details using gene ontology analysis tools.

Keywords: Biology, plant genome, next-gen sequencing, gene expression, statistics



**APPLICATION OF SALICYLIC ACID AS AN ORGANIC ELICITOR TO MANAGE
GREEN MOLD AND BLACK ROT OF LEMONS CAUSED BY *PENICILLIUM
DIGITATUM* AND *ALTERNARIA ALTERNATA***

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ABSTRACT

Lemons are among the most commonly consumed citrus worldwide since this fruit contains high levels of vitamin C, antioxidants, and flavonoids, which are beneficial for human health. Lemons are susceptible to the postharvest decay caused by *Penicillium digitatum* and *Alternaria alternata*, causing the green mold and black rot disease, respectively. Therefore, the current study aimed to investigate the potential of salicylic acid (SA) as a natural defense inducer to control lemon postharvest diseases. Antifungal activities of SA were determined in vitro by plating fungal cultures on medium supplemented to various SA concentrations (0, 1, 2, 4, 6, 8, and 16 mM). Our in vitro experiments demonstrated that SA significantly reduced the radial growth and conidial germination of the *P. digitatum* and *A. alternata* in a dependent-dose manner where the minimum measured factors obtained seven days post-inoculation at 16 mM SA. Interestingly, we observed that SA triggered the conidial germination of *P. digitatum* at low concentrations (1 and 2 mM). Nevertheless, the conidial germination of both examined fungal pathogens remarkably reduced at high concentrations of SA (6 and 8 mM). Our in vivo assays demonstrated that SA remarkably reduced lesion diameter on the lemon fruits treated by 8 and 16 mM SA before inoculated by *P. digitatum* and *A. alternata*. Based on our knowledge, it is the first report showing the fungitoxic impacts of SA to manage the green mold and black rot of lemons. To sum up, we suggested a potential implication of SA as a preharvest treatment to control lemon green mold and black rot diseases at commercial scales.

Keywords: Lemons, postharvest diseases, organic elicitor, salicylic acid



STIMULATION OF PLANT ROOT FORMATION BY RHIZOSPHERE BACTERIA *PSEUDOMONAS PUTIDA*

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ABSTRACT

The rhizosphere of plants is a complex ecological structure densely populated with both useful, neutral and harmful microorganisms for plants. The ratio of species in the rhizosphere largely determines the resistance of plants to diseases, the intensity of their growth and development, and productivity. In this regard, in modern agrobiotechnology, biological products based on natural soil bacteria are increasingly used, which can stimulate the growth and development of plants, while reducing the incidence of the latter. The most promising bacteria from a practical point of view are representatives of the so-called PGPR-group (Plant Growth-Promoting Rhizobacteria), which have a set of properties useful for plants. One of the most important mechanisms of interaction in plant-bacterial associations is the production of phytohormones, vitamins and other biologically active substances (BAS) by bacteria. At the same time, it is known that it is quite difficult to stimulate root formation in many plants, and sometimes it is impossible without the use of special preparations - root formation stimulants. Taking into account the above, the aim of this work was to study the antagonistic and root-growth-stimulating activities of the bacteria *Pseudomonas putida* C11. These bacteria are rhizospheric antagonists of phytopathogens capable of stimulating plant growth; however, the ability to activate seedling root formation in these bacteria has not been previously studied. To study the effect of treatment with bacteria, plants were grown according to the standard. The seeds were pretreated with an aqueous solution of KMnO_4 (0.1%) for 20 minutes and washed with sterile water, after which they were treated with a culture liquid of bacteria for 4 hours. The bacteria were grown in a liquid nutrient medium for 48 h with aeration at 28 °C. To determine the effect of bacteria on plant growth, the following formula was used:

$$\text{Effect, \%} = \frac{D_t}{D_c}$$

where D_t is the growth parameter of plants treated with bacteria;

D_c is the parameter of plant growth in the control, without treatment with bacteria. For the experiment to study the effect of plant metabolites on root growth, M9 medium with molasses and medium A were used. Before use, the bacterial culture was diluted 100 and 1000 times with sterile water and the seeds were treated for 4 hours. The results were evaluated by changes in the growth parameters of 10-day-old seedlings. The length of the stem of plants, the seeds of which were treated with a suspension of bacteria, differed insignificantly; fluctuations were observed within the measurement error. When treated with a culture medium without bacteria, an increase in stem growth was noted. The observed effect can be explained by the fact that in both environments there are additional sources of micro- and macroelements. The growth of



green mass of seedlings when treated with M9 medium with molasses did not differ from that when treated with medium A. Changes in the length of plant roots as a result of treatment with bacteria; allow us to conclude that succinic acid at a concentration of 40 mg / l without bacteria stimulates the growth of roots of rape seedlings to a greater extent than M9 medium with molasses. Treatment with a bacterial culture stimulates the growth of rapeseed roots in all experiments. The increase in the length of the roots of plants treated with bacteria in relation to those treated with water. The length of plant roots increased in all treatment options by 1.4 - 1.8 times. Succinic acid activates root growth, and a comparison was made between the length of the roots of plants treated with bacteria and plants treated with an appropriate culture medium without bacteria. The positive effect of bacteria on the growth of plant roots, with the best results being detected when processing large dilutions of the bacterial culture in all studied samples. Thus, it was found that the treatment of plant seeds with bacteria *P. putida C11* - antagonists of phytopathogens can stimulate root formation, while the increase in root length reaches 25% compared to treatment with a culture medium without bacteria. It was found that seed treatment with a suspension of *P. Putida C11* bacteria has a stimulating effect on the root system of seedlings. The acceleration of plant shoot development after treatment is apparently caused by additional food sources contained in the culture medium of bacteria.

Keywords: Rhizosphere bacteria, phytopathogens, *P. putida C11*, PGPR, bacterial culture



EFFECTS OF DIETARY FIBER FROM RICE BRAN ON THE STARCH DIGSTIVE PROPERTIES AND POSTPRANDIAL BLOOD GLUCOSE OF DRIED NOODLES

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ABSTRACT

In order to explore the effects of dried noodles containing dietary fiber from rice bran on human health, the effects of the adding amounts of dietary fiber from rice bran on the starch digestive properties and postprandial blood glucose of dried noodles were investigated by in vitro digestion and human blood glucose tests, respectively, in this paper. As shown in the results, the addition of dietary fiber from rice bran had significant effects on the digestion rate and digestion degree of dried noodles starch and postprandial blood glucose. The addition of rice bran dietary fiber reduced the digestibility of dried noodles starch by up to 24.9%, and increased the resistant starch content of dried noodles by up to 100.2 %, the slow-digested starch and content increased by 8.9%, the fast-digested starch content decreased by 67.8%; The addition of rice bran dietary fiber reduced the postprandial blood glucose fluctuations decreased by 41.2%, the postprandial blood glucose peak decreased by 12.8%, and peak arrival time is delayed up to 90 minutes after human consumption and the delay rate is 200%; The addition of rice bran dietary fiber reduced the GI value of the noodles by up to 36.4%.

Keywords: Dried noodles, dietary fiber of rice bran, starch, digestion characteristics



SOLAR TREE – A SUSTAINABLE ENERGY APPROACH FOR FARMERS

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ABSTRACT

The energy-producing similarity between the photoelectric effect and photosynthesis makes them more important for humans and has a large environmental impact potential. Sunlight is common in both and its longevity makes them an important solution tool for many human issues. The energy need is one of the important ones. The various researches are going on such sunlight energy conversions, various techniques like Photo Voltaic (PV), Solar Thermal (ST), Solar Photovoltaic-thermal (PV/T) conversion are proposed. Researchers are also not able to achieve 100% accuracy due to optical loss, thermal loss Recombination, Spectrum losses, and Impedance matching. Despite all these, it is found solar energy is a sustainable energy solution with the highest input capital, but with long durability, lower operational cost, and maintenance. The idea of the solar flexible trees is fit for meeting farmers' energy demands as well as makes them energy producers. This not only creates another source of income for them but also helps in farming. Besides suggesting, this work also addresses the difficulties engaged with this design model and also proposes future research scope. The tighter coupling of land use and management and energy generator ensure us for farmer's sustainable energy solution.

Keywords: Solar energy, energy, farmer income, agriculture sustainability



APPLICATION OF ZINC OXIDE NANOPARTICLES ON RAPESEED (*BRASSICA NAPUS* L.) SEEDLING GROWTH AND YIELD UNDER SALINITY STRESS

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ABSTRACT

In this study, the methods of application of zinc oxide nanoparticles on seedling growth and Rapeseed yield under salinity stress were investigated. This factorial experiment was conducted in a randomized complete block design in the greenhouse of Abureihan Campus of the University of Tehran in 2019. Salinity stress was applied at three levels of 2.5 (control), 4 and 6 dS m⁻¹. Seed coating treatment were zinc oxide nanoparticles at three levels (control, 25 and 50 mg) and foliar application of zinc oxide nanoparticles applied two weeks after planting in seedling stage including three levels of foliar application with distilled water (control), 200 and 500 mg in 4 replications. The evaluated traits were emergence, seedling growth in two stages (2 to 3 leaves and 4 to 5 leaves), chlorophyll fluorescence, relative leaf water content and yield. The results of this study showed that seed coat treatment with zinc oxide nanoparticles had a significant effect on leaf area index, stem dry weight, leaf fresh weight, and emergence percentage. The treatment of 50 mg seed coat with zinc oxide nanoparticles had the greatest effect on leaf area, stem dry weight and leaf fresh weight, stem weight and seedling emergence percentage. Salinity stress had a significant effect on leaf dry weight, stem dry weight, emergence rate, FO, F_v / F_M, F_M / F_O, F_v / F_O and yield. Leaf dry weight and stem dry weight had the highest values at salinity of 4 dS m⁻¹ and emergence rate and yield at salinity of 2.5 dS m⁻¹ (control). Foliar application of 200 mg l⁻¹ for leaf area index and foliar distillation (control) for shoot dry weight had the highest values. The interaction effect of seed coating × salinity had a significant effect on emergence rate. At the salinity of 2.5 dS m⁻¹ and seed coating with 25 mg nanoparticles, oxide nanoparticles had the highest emergence rate. For the relative content of leaf water content, the interaction effect of seed coat × foliar application with nano-oxide had a significant effect. Zinc oxide nanoparticles had the highest amount in 50 mg seed coat and 200 mg l⁻¹ foliar application. The results of this study showed that the use of zinc oxide nanoparticles could partially compensate for the destructive effects of salinity stress on leaf area index, stem dry weight, leaf fresh weight, and stem weight.

Keywords: Yield, emergence, seed coating, emergence rate, seedling growth



BIONANOCOMPOSITE FOR ANTIMICROBIAL ACTIVITY - A NOVEL AND GREEN SYNTHESIS APPROACH

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ABSTRACT

The present work, depicts the synthesis of Zinc oxide nanoparticles (ZnO NPs) using aqueous leaf extract of *Azadirachta indica* and fabrication using neem oil and *Aloe vera* gel by precipitation strategy to form Bionanocomposite (BC) with improved properties. The aim of the study is to evaluate the antimicrobial activity of ZnO Nps based Bionanocomposite (ZnO-BC) on some bacterial and fungal strains. The ZnO- BC was synthesized using natural agents and was characterized by Scanning Electron Microscope - Energy-dispersive X-ray spectroscopy (SEM- EDX), X- ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FT-IR) analysis. The antimicrobial activity was determined using *Escherichia coli* and *Aspergillus niger* through well diffusion method. ZnO-BC may act as lead for discovering new bioactive natural products that may serve as potential vehicle by surface modification in antibiotic delivery that can be explored in the on-going new biomedical research activities based on green synthesis.

Keywords: Bionanocomposite, green synthesis, *Aloevera* gel, Antibacterial activity, antifungal activity



EFFECT OF CONCENTRATION-INDUCED SODIUM ALGINATE GEL ON EDIBLE QUALITY AND DIGESTION CHARACTERISTICS OF CONVENIENT RICE NOODLES

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ABSTRACT

In order to improve the edible quality of convenient rice noodles and improve its digestive properties, this paper studied the rehydration characteristics, texture characteristics and sensory quality of concentrated rice flour by concentration-induced sodium alginate gel by convenient food quality determination experiment and in vitro simulated digestion experiment. And the effects of digestion characteristics. The results showed that the concentrated inducing sodium alginate gel not only improved the rehydration characteristics of the convenient rice noodles (reduced water time decreased by 15%, the broken strip rate decreased by 94.1%, the rehydration loss rate decreased by 86.1), and the texture characteristics (elasticity increased by 11.8%).) and sensory quality (19.8% increase in sensory total score) and effectively reduced the digestibility of convenient rice flour (maximum reduction of 10.77%) and increased the content of resistant starch in the digestion process (increased by 9.55%). Therefore, the concentrated inducible sodium alginate gel can improve the eating quality of the convenient rice noodles and contribute to the beneficial effect of the convenient rice noodles on the digestive health of the human body.

Keywords: Convenient rice noodles, concentration-induced sodium alginate gel, edible quality, digestion characteristics



INCREASING CROP YIELD BY IMPROVING ABIOTIC STRESS TOLERANCE

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ABSTRACT

As world population increases and cropland decreases (due to urban development, soil erosion and salinization), food security becomes a serious issue that we must face in the future. To keep people well fed and clothed, we must keep food/fiber production in line with population growth. The biggest challenge in the future will be producing more food and fiber with less cropland and less input (i.e. less irrigation and less fertilizers). Climate change will make agricultural production more difficult in the future as many countries in Africa, South and Central Asia, Australia, and Latin America will become hotter and drier in the summer, other nations may become hotter and flooded frequently, which will cause huge losses in crop yields, leading to food shortage in the most vulnerable countries in the world. As abiotic stresses such as drought, heat, and salt are the main reasons that cause huge losses in agricultural productivity worldwide, improving plant abiotic stress tolerance will likely increase crop yield as it will avoid the losses that would be caused by abiotic stresses. We tested this idea by co-overexpressing genes that confer increased drought, heat, and salt tolerance in transgenic plants and we demonstrated that we could double fiber yield for cotton grown in dryland production system. If this strategy is adopted in countries where agricultural production is in dryland regions, crop yield will likely increase substantially.

Keywords: Crop, yield, stress



TRADITIONAL AGRICULTURAL PRACTICE (*Jhum-kheti*) TO ORGANIC FARMING IN NAGALAND: A TRANSITION OF SOCIAL AND CULTURAL DIMENSIONS

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ABSTRACT

Shifting Cultivation is commonly known as *Jhum-kheti* in Nagaland, particularly and commonly in North-East India. It is the oldest and traditional form of agricultural practice present in Nagaland. During the Colonial period in India, many initiatives have been taken to eradicate the practice of *Jhum-kheti* by the various settled form of agriculture and allowance systems. However, this traditional practice has maintained its space in the state among diverse tribal communities because of their cultural and social beliefs. In this paper, I have studied this particular form of agricultural practice among the Ao community of Nagaland; for the same, a field survey was carried out in two villages of Mokokchung district, namely Mongsenyimti and Chuchuyimlang. *Jhum-kheti* is regarded as subsistence in nature, and due to the rising population, it is not sufficient to meet the increasing needs and demands. Thus, the government of Nagaland took up organic farming techniques to increase the productivity of crops and provide monetary benefits to the farmers. Organic Farming has gained due attention in the latest era, and organic products fetch better economic returns than other conventional products. In this context, the villages of Mokokchung district have seen some phase of transition in land use and agricultural practices in the recent decade. This has affected their existing traditional, social, cultural and economic lives. Thus, Nagaland is experiencing a social and cultural transition phase, where agricultural innovations play a significant role.

Keywords: *Jhum-kheti* or shifting cultivation, organic farming, socio-cultural transition, agricultural innovation, state initiatives



NUTRACEUTICALS: EMERGING TRENDS IN HEALTHCARE AND MEDICINE

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ABSTRACT

Hippocrates, the great Greek physician, once said, "Let food be your medicine and medicine is your food." Consumers are deeply concerned about how their health care is managed, administered and priced. They are frustrated with the expensive, high-tech, disease-treatment approach predominant in modern medicine; the consumer is seeking complementary or alternative beneficial products and the red tape of managed care makes nutraceuticals particularly appealing. Nutraceuticals are natural bioactive, chemical compounds that have health promoting, disease preventing or medicinal properties. Nutrients can range from isolated nutrients, food bases, nutritional supplements and foods to genetically modified foods and processed products, including cereals, sauces and beverages. In addition, these products can have physiological functions and biological effects. The lifestyles of people around the world have changed over the past century due to increased incomes, declining exercise and preferences for unhealthy foods. Nutraceuticals are very popular because of their safety, nutritional value and treatment. They are used in the treatment and prevention of heart disease, Alzheimer's disease, cancer, diabetes, and Parkinson's disease, as well as obesity. Nutraceuticals are constantly evolving and have spread rapidly throughout the world. Therefore, it has become led to in a new era of medicine and health, which has made the food and pharmaceutical industry a business of research interest.

Keywords: Nutraceutical, balanced foods, lifestyle, cancer, diabetes, alzheimer's disease



ANAÇLIK POTANSİYEL GÖSTEREN 42-01 ZERDALİ GENOTİPİNİN *IN VITRO* MİKROÇOĞALTIM ÖZELLİKLERİNİN ARAŞTIRILMASI

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ÖZET

Meyvecilikte anaç kullanımı yüksek verim ve kalite için vazgeçilmez bir unsurdur. Kayısıda *Prunus armeniaca* türü içerisinde klon anaçı geliştirmeye yönelik yapılan çalışmalardan sonuç alınamaması nedeniyle çöğür anaçları kullanılmaktadır. Kayısıda anaç olarak kullanılacak genotiplerin köklenmesinin zor olması dolayısıyla gerek çelikle çoğaltma gerekse mikroçoğaltma çalışmalarından istenen sonuçlar alınamamıştır. *In vitro* şartlarda klonal olarak çoğaltılabilecek bir *P. armeniaca* anacının geliştirilmesi bu çalışmanın en önemli amacıdır. Elde edeceğimiz zerdali klon anaçı, kayısının kendi türü içerisinde ilk klon anaçı olmasının yanı sıra erik, şeftali ve badem türleri için de anaç olarak kullanılabilir. Bu çalışmamızda, materyal olarak Konya'da yaptığımız arazi çalışması sırasında belirlediğimiz, anaçlık özellikleri üstün olan 42-01 zerdali genotipinin *in vitro* mikro çoğaltım özellikleri araştırılmıştır. Ana bitkiden alınan çelikler laboratuvar ortamında yüzey sterilizasyona tabi tutulmuş ve eksplantlar 0,5 mg/l BA+0,01 mg/l IBA+0,5 mg/l GA içeren NRM (Nas ve Read, 2004) ortamında kültür tüplerinde kültüre alınmıştır. Eksplantlar, sürgün kültür ortamında rejenerasyon denemelerinde kullanılabilir sayıya sürgün elde edilinceye kadar 3'er haftalık aralıklarla aynı sürgün kültür ortamında alt kültüre alınmıştır (Başlangıç safhası). Başlangıç safhasında yeterli sayıda 1-1,5 cm uzunluğunda sürgün elde edildikten sonra, kültürlerin *in vitro*'da sürdürülebilirliğini, stabilizasyonunu ve en iyi mikro çoğaltım katsayısını sağlayacak kültür ortamını belirlemek amacıyla, başlangıç aşamasından alınacak eksplantlar farklı kombinasyonlarda BA (0, 0,5, 1.0 mg l⁻¹) ve IBA (0, 0.01, 0.025 mg l⁻¹) içeren NRM ve MS ortamları üzerinde alt kültüre alınmıştır. Daha sonra tekrar bir alt kültür yapılmadan farklı konsantrasyonlarda (0.0, 1.0 ve 2.0 mg l⁻¹) IBA içeren 1/1 ve ½ yoğunluktaki MS ve NRM ortamlarına köklendirmeye alınmıştır. Köklenmiş ve sağlıklı bitkicikler kademeli bir şekilde dış ortama alıştırılmıştır. Çalışmada, ortalama bitki canlılığı oranı, 0,0 mg/l BA + 0,01 mg/l IBA+ 0,5 mg/l GA içeren MS (%38,90) ve 0,0 mg/l BA + 0,025 mg/l IBA + 0,5 mg/l GA içeren NRM (%30,56) dışında, diğer tüm uygulamalarda %69,44-100,00 arasında değişmiştir. Eksplant başına ortalama en yüksek sürgün sayısı 1,0 mg/l BA + 0,00 mg/l IBA + 0,5 mg/l GA içeren MS ortamında kaydedilmiştir (5,97 adet/eksplant). Sürgün uzunluğu bakımından en uzun sürgünler 0,5 mg/l BA + 0,01 mg/l IBA + 0,5 mg/l GA içeren MS ortamından elde edilmiştir (2,77 cm). En yüksek köklenme oranı, 2,0 mg/l IBA içeren ½ MS ortamında (%61) kaydedilmiştir. 2,0 mg/l IBA içeren ½ NRM ortamında eksplant başına 6,33 kök sayısı not edilmiştir. Kök uzunluğu bakımından en iyi sonucu 2,0 mg/l IBA içeren ½ NRM uygulamasında kaydedilmiştir (2,46 cm).

Anahtar Kelimeler: anaç, *in vitro*, kayısı, NRM



INVESTIGATION OF *IN VITRO* MICRO PROPAGATION PROPERTIES OF 42-01 ZERDALI GENOTYPE INDICATING ROOTSTOCKS POTENTIAL

ABSTRACT

The use of rootstocks in fruit growing is an indispensable factor for high yield and quality. In apricot, in *Prunus armeniaca* specie, seedling rootstocks are used due to the lack of results from the studies realized to develop clone rootstocks. Due to the difficulty in rooting the genotypes to be used as rootstock in apricot, the desired results could not be obtained from either with cutting propagation or with micropropagation. Development of a *P. armeniaca* rootstock that can will be reproduced clonally in conditions in vitro is the most important aim of this study. The zerdali clone rootstock we will obtain, in addition to being the first clone rootstock in own specie of apricot, also can be used as rootstock for plum, peach and almond species. In this our study, as a material, the in vitro micro-propagation properties of the 42-01 zerdali genotype, which we determined during the field study we realized in Konya, with superior rootstock features were investigated. Cuttings taken from the mother plant were subject to surface sterilize under laboratory conditions and explants were cultured in culture tubes in NRM (Nas and Read, 2004) medium containing 0,5 mg/l BA + 0,01 mg/l IBA + 0,5 mg/l GA. Explants were taken subcultured in the same shoot culture medium at 3-week intervals until the number of shoots that will could be used in regeneration experiments in the shoot culture medium was obtained. After obtaining a sufficient number of shoots of 1-1,5 cm lenght in the initial stage, in order to determine the culture medium that will provide the sustainability, stabilization and the best micro propagation coefficient of the cultures on in vitro, explants will taken from the initial stage were taken to subculture on NRM and MS media containing different combinations of BA (0, 0.5, 1.0 mg/l) and IBA (0, 0.01, 0.025 mg/l). Later, it was be rooted in 1/1 and 1/2 density MS and NRM media containing IBA at different concentrations (0.0, 1.0 and 2.0 mg/l) without subculturing again. Rooted and healthy plantlets was gradually acclimated to the external environment. In the study, mean plant survival rate was ranged from 69,44% to 100% in all other applications, except MS (38,90%) containing 0,0 mg/l BA + 0,01 mg/l IBA + 0,5 mg/l GA and NRM (30,56%) containing 0,0 mg/l BA + 0,025 mg/l IBA + 0,5 mg/l GA. The average hightest number of shoots per explant was recorded in MS medium containing 1,0 mg/l BA + 0,00 mg/l IBA + 0,5 mg/l GA. (5,97 number/ explant). The longest shoots in terms of shoot length were obtained from MS medium containing 0,5 mg/l BA + 0,01 mg/l IBA + 0,5 mg/l GA (2.77 cm). Optimum rooting rate was recorded in MS medium containing 2.0 mg/l IBA (%61). Numbers of root per explant in 1/2 NRM medium containing 2.0 mg/l IBA were noted as 6.33.

Keywords: Apricot, *in vitro*, NRM, rootstock



ANALYSIS OF TOXICITY OF NANOPARTICLES OF DIFFERENT NATURE

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ABSTRACT

The rapid development of nanotechnology has raised serious concerns about its impact on environmental health and safety. Due to their new physicochemical properties, metal nanoparticles are the most widely used engineering metal nanomaterials [1,2]. Some promising nanoscale candidates are gold and silver nanoparticles, which are used in industrial production, environmental management and commercial products. In addition, gold and silver nanoparticles can be used for food packaging as a nanoscale film [3-5]. Therefore, the study of the toxicity of gold and silver nanoparticles is of great interest due to their unique structural and functional properties, as well as their use in a wide range of applications. The aim of the research was to carry out a comparative analysis of the toxicity of gold and silver nanoparticles obtained by chemical and microbiological methods. Silver and gold hydrosols were prepared at room temperature by the method of tannin reduction of precursors (AgNO_3 – Ag sol and HAuCl_4 – Au sol) in the presence of a buffer solution of sodium tetraborate with $\text{pH} = 9$. In addition, gold and silver nanoparticles were also obtained by the microbiological method using baker's yeast *Saccharomyces boulardii*. The toxicity of the obtained nanoparticles of gold and silver was determined by the bioluminescence method on a "Biotox-10M" device using an "Ecolum" biosensor. The toxic effect of the test sample on the test object is determined by the decrease in the intensity of bioluminescence over a 30 minute (in the express version - 5 minutes) exposure period. Quantitative assessments of the test reaction are expressed as a dimensionless value - the toxicity index "T", equal to the ratio:

$$T = 100(I_0 - I) / I_0$$

Based on the results obtained, all samples were highly toxic. However, research shows that using baker's yeast, gold and silver nanoparticles are less toxic than chemical reduction nanoparticles. In the course of the work, silver and gold nanoparticles were obtained. These results are confirmed by spectrophotometric analysis data. The absorption maximum of the spectrum of Ag hydrosols was in the range $\lambda_m = 405 - 420$ nm, and that of Au hydrosols $\lambda_m = 520 - 530$ nm, which corresponds to the literature data. Thus, it can be argued that it is the nanoparticles obtained by the microbiological method that can be used in the food industry.

Keywords: Nanoparticle toxicity, silver, gold, Biotox, toxicology



**RURAL TRAVEL PATTERN AND TRANSPORT OPERATION IN LAGELU LOCAL
GOVERNMENT AREA OF OYO STATE, NIGERIA**

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ABSTRACT

Rural areas have remained most important part of human settlement since ancient periods. Likewise, Nigeria is blessed with numerous rural areas which are sources of food supplies and other agricultural produce to the cities. However, the trend at which rural parts are being neglected is highly worrisome in many developing parts of the world. Countries in the South, including Nigeria have not been according rural areas her due recognition and attention most especially, in terms of mobility and accessibility of essentials that can ease their livelihood and livability. This study therefore, appraised rural travel pattern and transport operations in three rural settlements consisting of Lagun, Oyedeji and Akitibo in Lagelu Local Government Area of Oyo State, Nigeria. Using systematic random sampling, 120 copies of questionnaires were administered to rural residents and the results of data analysed descriptively revealed that over 60% of the residents engaged in agricultural related activities; rely on para-transit means; most bituminous linking roads are in extremely deplorable condition (62.5%), while rickety vehicles (63.3%) being used as the rural travel pattern is confined to less than 5km daily movement. The results of Regression analysis shows significant relationship between the quality of rural



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on FOOD, AGRICULTURE and VETERINARY
19-20 June, Izmir-TURKEY**



transport operation and socio-economic variable (income) ($p=0.000 < 0.05$). The study concludes that the deplorable transportation infrastructure and deteriorating transport operation are twin issues that are adversely impacting rural travel pattern, and at the same time retrogressing the pace of development in the study area. It is recommended among others, improvement in rural-urban linkage road networks; improved government attention to rural transport infrastructure and operation; regularization of the use of motorcycle for rural-urban commuting and introduction of three-wheeler vehicles in order to improve rural transport operation and travel pattern.

Keywords: Rural area, travel pattern, rural transport operation, transport infrastructure and Oyo State



EFFECT OF AGING PROCESS ON EDIBLE QUALITY OF INSTANT RICE NOODLES

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ABSTRACT

In this paper, five kinds of early indica rice were selected to make instant rice flour under laboratory conditions, and the influence of low temperature aging process on the rehydration, texture characteristics and sensory quality of convenient rice flour was studied. The experimental results show that, under the same experimental conditions, the rice noodles after low temperature aging process (temperature 4 °C, humidity 70-80%, time 3h) have significant effects on rehydration characteristics, texture TPA index and sensory quality. The aging process can improve the rehydration of the round rice noodles of Yuanzao, Zhongzao 25, and Zhengui varieties, and reduce their breakage rate, water loss rate, and iodine blue value. The aging significantly improves the rehydration time of Pearl No. 3 convenient rice noodles. The iodine blue value and the three or two dwarf varieties facilitate the strip breaking rate and rehydration loss rate of rice flour. The texture indexes such as the aged round rice noodles and pearl No. 3 rice noodles are better, while the texture characteristics of the rice noodles of the middle and early 25 years are worsened; aging improves the sensory quality of the three and two short rice noodles, while the pearl three The sensory quality of No., Yuanzao, Zhongzao25 and Zhengui rice noodles decreased slightly, and the sensory quality of Zhengui had no significant effect.

Keywords: Aging; quality; instant noodles



INDIVIDUAL PARAMETER BASED SOFTWARE MONITORING MODULES FOR GREENHOUSE

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ABSTRACT

For proper growth of the plants inside greenhouse, environmental parameters, like temperature, relative humidity, luminosity and carbon dioxide etc. are to be monitored. These parameters need to be maintained within desired limits and thus continuous monitoring of such parameters is required. This paper chapter wireless sensor network-based software modules for monitoring of temperature, humidity and luminosity considering these to be the most important parameters for the growth of the plants. While developing these software modules the considered greenhouse has been considered a complex one with multiple zones of variable dimensions. Also, different number of wireless sensor nodes have been placed inside these zones. Readings from the individual sensors are assumed to be taken after every 5 minutes. Moving average is taken over 30 minutes. The software modules take decision on the basis of average value of a parameter in a zone i.e., zonal value of a parameter which is calculated by taking mean of the moving average values for all the sensors located within that zone. On the basis of the comparison of zonal average of the selected parameter with its desired upper and lower levels required for the selected crop appropriate alert/alarm signals are generated.

Keywords: Intelligent green house , moving average ,wireless sensor network , wireless sensor node



**BIOREMEDIATION TECHNOLOGY OF SOILS POLLUTED WITH
HYDROCARBONS AND HEAVY METALS USING NATURAL BIODEGRADABLE
ABSORBENT AND ORGANIC ACCELERATORS**

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ABSTRACT

Pollution is a complex phenomenon and oil accidents are one of the major challenges facing environmental organizations. In this context, this paper aims to apply an innovative process of bioremediation of soils polluted with hydrocarbons, by using mainly the natural biodegradable absorbent *Sphagnum mosses*, in combination with a series of non-toxic ecological products such as environmentally friendly biodegradable detergent (based on coconut oil) and Petrolsynth (based on degradation enzymes and microorganisms). The bioremediation treatment of the contaminated soil with natural biodegradable absorbent based on *Sphagnum mosses*, biodegradable detergent and Petrolsynth, generates rapid decomposition and removal of the contaminants (petroleum oils and heavy metals), after the apply of the treatment. Bioremediation of soils, was investigated by kinetic monitoring of the process of removal of petroleum hydrocarbons using UV-VIS spectroscopy (spectra of the samples were acquired in the range of 200-800 nm) which highlighted decreasing of the absorbance values at the wavelengths corresponding to the analyzed pollutants. Monitoring of heavy metals was investigated by Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES) to determine concentration of the metals As, Cd, Cu, Fe, Pb, Co, Cr, Mn, Zn, Se, Co. The soil polluted with hydrocarbons and heavy metals treated with natural absorbent and organic accelerators was bio-remedied and restored to its original type of use. The conclusions of this study highlighted the biodegradation ability of the analysed materials, in case of hydrocarbons and heavy metals spilled on the soil in accidental pollution. The results emphasized that this material can be used with good efficiency, given that the costs are low and the use is easy. In the case of accidents that can affect soil quality and lead to the destruction of the ecosystem, people can use alternative ecological variants that implicitly lead to energy savings.

Keywords: Bioremediation, hydrocarbons, heavy metals, biodegradable absorbent, petrolsynth



SURFACE MODIFICATIONS IN *DESMANTHUS VIRGATUS* SEEDS THROUGH LOW PRESSURE PLASMA TREATMENT

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ABSTRACT

In agriculture, plasma technology has been widespread, due to important characteristics such as superficially changing the chemical character of seed coatings. The objective of this work was to investigate the low pressure plasma effects on the germinative process *Desmanthus virgatus* seeds. The seeds were placed in a sample holder containing 19 holes of 9 mm in diameter, with 5 seeds being placed in each hole. The atmosphere used was Argon in a 10 sccm flow and with a continuous voltage source with maximum voltage and current of 1500 V and 2 A. The temperature was controlled at 30°C, in the times of 1, 3 and 5 minutes. Germination, imbibition, pH control and electrical conductivity tests and apparent contact angle were performed. The apparent contact angle was carried out using the sessile drop method. This test indicates an increase in the wettable surface with the treatment time, proving the hydrophilic character modification in the seed by the plasma. Seeds treated for 3 and 5 minutes germination generation superior to treatment for 1 minutes and to seeds without treatment. The leachate solution, in the imbibition test, has a lower conductivity than the treated sample, indicating less loss of nutrients to the solution. The pH remained within the neutral range for those treated. As superficial changes in the seeds caused gains obtained in the germinative parameters, promoting improvement in the indexes and percentage of germination. Thus contributing, to an efficient increase in overcoming dormancy and seed lot uniformity with the use of low pressure plasma as a tool for breaking dormancy.

Keywords: Native forests, low pressure plasma, seed technology



PLANT VIRUS GENOME STUDIES USING BIOINFORMATICS TOOLS

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ABSTRACT

Studying plant defense from biotic stress for better and sustainable crops assume complex interdisciplinary approaches. Development of high-throughput sequencing technologies and acquisition of genome data for plant viruses allow complex analysis of biological interactions of plant cells and pathogen at molecular level. Systems biology approach for analysis of the relationship of plants and phytopathogens and is a challenging task. We used bioinformatics tools for the analysis of genome structure of plant viruses. We analyzed text repeats, tandem repeats and entropy estimates aiming for specific gene expression regulatory region analysis. Important bioinformatics problems of plant virus genome organization could be solved using set of novel databases on plant virus data such as PVsiRNAdb (Plant Virus-derived small interfering RNAs database), plant RefSeq. RNA viruses face fluctuating environments and are incredibly effective at adaptation when a selective pressure is applied. Before the advent of the new generation sequencing, detection of new viruses and plant pathogenic bacteria that show latent infection was an unsolvable task. Plant genomes contain more transcription factors than animal genomes, but the plant proteins are smaller and contain less number of domains. It increases complexity of the gene expression regulation problem in plants relative to adaptation and pathogen interactions. Analysis of the variants of RNA transmitted inside the plant cell makes it possible to detect viruses that do not have clearly defined symptoms. We used bioinformatics tool Complexity for estimation of plant virus genome complexity, search for genome repeats and rearrangement sites. Finally we discuss statistical parameters of plant virus genomes.

Keywords: Agriculture, plant viruses, sequencing, plant pathogens, bioinformatics



**EFFECT OF CROPPING ENVIRONMENT ON SOME OIL QUALITY
PARAMETERS IN MOROCCAN RAPESEED (*Brassica napus* L.)**

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ABSTRACT

After soybeans, rapeseed (*Brassica napus* L.) is the world's second-largest oilseed crop. In the last 15 years, global rapeseed output has doubled, reaching over 60 million tons in 2018/2019. In Morocco, it was introduced as a promising oilseed crop and showed good adaptation and great potential, allowing it to contribute significantly to the improvement of vegetable oil production. To day, six varieties were developed and registered by INRA, the National Institute of Agricultural Research In this study, we examined the environment effect on oil quality of these varieties. The aim was to assess their capacity to keep their oil properties among contrasted environments. The field experiment was conducted at two locations, Douyet (34° 05' 16" north, 5° 10' 52" west, 400 mm, 4-43°C) and Allal Tazi (34° 31' 11" north, 6° 19' 25" west, 529mm, 13-27°C) according to a CRBD design with three replications. After harvest, oils extracted from seeds were analyzed for their oil content, acidity index, peroxide index, fatty acid composition (oleic, linoleic and linolenic), total phenolic content (TPC), total flavonoides content (TFC) and free radical scavenging activity (FRSA). Results of statistical analysis showed highly significant difference ($P < 0.001$) between both environments for oil content, TPC, TFC and FRSA, whilst for the other parameters the environments were comparable. In fact, by changing their growth environment, the planted varieties exhibited higher performance under Allal Tazi conditions than Douyet in terms of oil content (39.6 vs 37.3%), TPC (4.2 vs 3.9mgGAE/100 g), TFC (0.27 vs 0.21mg/1g) and FRSA (40.3 vs 21.8%).

Keywords: Rapeseed, oil, quality, environment effect, Moroccan varieties



DIFFERENT THICKNESSES OF AN ORGANIC MULCH EFFECT ON MOVEMENT AND ACCUMULATION OF SOME ELEMENTS IN SOIL

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ABSTRACT

Various management and protection strategies have been proposed and implemented to control the condition and protect the soil from salinization. The use of mulch is one way to control salinization of the soil surface. In this study, mulch produced from composted sugarcane bagasse investigated to control salinization of the surface soil, in the haloculture pilot of national salinity research center, which located in Jofair region of Khuzestan province. Mulch was applied on the local soil about 0.5, 1, 2 cm and control (0 cm) thicknesses and three replications set. The results showed that the salinity accumulated in the surface soil was control > 0.5 > 1 > 2 cm of compost mulch, respectively. A similar trend was observed in reducing the ESP, bioavailable boron saturation extracted Na concentration of surface soil saturated extract. Therefore, considering the negative effects of mulch produced from composted sugarcane bagasse on the salts accumulation in the surface soil and on the other hand, the organic and nature-friendly nature of this composition, it seems that this mulch can be an option to soil and water preservation. It is very suitable for use in arid and semi-arid regions of the country.

Keywords: Salt accumulation, evaporation, topsoil, soil and water conservation



BIOREMEDIATION OF CRUDE OIL CONTAMINATED SOIL, CASE STUDY: CO-COMPOSTING OF 1200 CUBIC METERS OF SALINE SOIL IN ARVANDAN OIL & GAS COMPANY AREA, IRAN

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ABSTRACT

Oil spilling happens due to many reasons and it remains oil-contaminated soils. Arvandan Oil & Gas Co. (AOGC) is an Iranian company, placed in Khuzestan province, southwest of Iran. This company faced oil pollution in its operational areas. This article is a report of full-scale petroleum-contaminated soil co-composting. This study explains the remediation of 1200 cubic meters of saline contaminated soil, which gathered from the polluted operational area of AOGC. The initial total petroleum hydrocarbon (TPH) of the soil was between 6.9 – 17.1% and contaminated with heavy oil. The soil was extremely repellent and the initial water repellency was between 12500-1500 S. the remediation procedure started by adding some organic waste of a local sugarcane sugar factory to the contaminated soils, in the meantime urea, sugar, and compost mix with it. After irrigation and aeration of the mixed piles of organic materials and soil for 3 months, the TPH falls to 108 mg kg⁻¹. At the end of the remediation project, and with the permission of the authorities, the recovered soils were added to the surrounding environment.

Keywords: Soil Recovery, petroleum contamination, bioremediation, TPH



DIESEL-OIL-CONTAMINATED SOLIDS BIOREMEDIATION USING REACTOR COMPOSTING

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ABSTRACT

Oil and gas well drilling operations generate wastes like diesel-oil-contaminated solids. This kind of pollution has to manage with a proper approach to reduce its environmental impacts. This research conducted aiming to investigate diesel-oil-contamination bioremediation of sediments using reactor composting. A 200-L vertical reactor (which has the ability of aeration and humidity control) was utilized for the bioremediation process. The initial total petroleum hydrocarbon (TPH) of the contaminated sediments was around 360 g/kg. Contaminated materials were mixed with green space compost with different ratio 1:0.2, 1:0.5, 1:1, 1:2, and 1:5 (w/w). The mixture aerated every 8 hours for 20 minutes and the moisture set around 40%. The amount of TPH was measured weekly for 70 days after initial treatment. Results showed a high amount of pollutant remediated by co-composting during the experiment time and more than 99% of TPH removed in most of the mixture ratio. Bioremediation rates of diesel oil were increased by increasing the amount of compost in the initial mixture. This experiment showed co-composting of diesel-oil-contaminated solids could be proper management for this kind of wastes.

Keywords: Drilling waste management, petroleum contamination, co-composting, TPH



ODUN SİRKESİNİN TARIMDA KULLANIMI

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ÖZET

Pirolignöz asit olarak da bilinen odun sirkesi biyokömür üretiminin önemli bir yan ürünüdür. Hasat ve budama atıklarının oksijensiz ortamda yakılması sırasında oluşan gaz soğutulduğunda, odun sirkesi adı verilen bir sıvıya yoğunlaşır. Odun sirkesinin özellikleri, hammaddeye ve üretim koşullarına bağlı olmakla birlikte, ham odun sirkesinin ana bileşeni sudur (80-90%). Suyun yanında en fazla bulunan bileşen asetik asit (30.45-70.60 mg/mL) olup, farklı oranlarda diğer asitler, alkoller, fenoller, esterler, karbonil ve furanlar ve diğer organik bileşenleri de içermektedir. Yapılan çeşitli araştırmalarda pH değerinin 2 ile 4, özgül ağırlığının 1.005 ile 1.016 g/mL, çözünmüş katran içeriğinin ise 0.23-0.89% arasında değiştiği bildirilmiştir. Doğal bir ürün olan odun sirkesi, endüstriyel, hayvancılık, ev ve tarım ürünleri gibi çeşitli işlemlerde kullanılmaktadır. Odun sirkesinin tarımdaki faydaları, muhteşem kimyasal bileşimi ile ilişkilendirilebilir. Tarımsal üretimde ise odun sirkesinin toprak kalitesini iyileştirdiği, hastalık ve zararlı kontrolünde etkin olduğu, tohumun çimlenmesini hızlandırdığı, bitki büyümesini geliştirdiği, yabancı ot kontrolünde etkin olduğu, bitki büyüme düzenleyicisi veya büyüme inhibitörü görevi gördüğü ve meyve kalitesini iyileştirdiği bildirilmiştir. Rizosferde köklerden salınan organik asitler, topraktaki fosforik asidi çözerek bitki köklerinin alımına daha uygun hale getirirler. Odun sirkesindeki organik asitlerin de toprakta benzer etkiye sahip oldukları ileri sürülmüştür. Odun sirkesinin toprak sağlığı üzerindeki etkisi konusunda bilimsel araştırmalar çok sınırlı olmasına rağmen, odun sirkesinin toprak mikrobiyal aktivitesini arttırdığı bilinmektedir. Mikrobiyal aktivitenin artışının da toprağın fiziksel ve kimyasal özelliklerini iyileştirmesi beklenmektedir. Bunların yanında, odun sirkesi, karakteristik duman tadı ve mikroorganizma gelişimini engelleyici özellikleri ile gıda işlemede de kullanılmıştır. Odun sirkesi ile ilgili devam eden çalışmalar ve elde edilen son bilgiler, odun sirkesinin tarım ve çevre yönetiminde üretimi ve daha geniş kullanımı için dikkate değer bir potansiyel olduğuna işaret etmektedir. Odun sirkesinin daha geniş kapsamlı kullanımı, daha sağlıklı çevre ve ekolojik sistemin yanı sıra sosyoekonomik yapının da iyileşmesine katkı sağlayacaktır.

Anahtar Kelimeler: Pirolignöz asit, asetic asit, biyokömür, odun sirkesi, piroliz, tarım



AGRICULTURAL USE OF WOOD VINEGAR

ABSTRACT

Wood vinegar, also known as pyroligneous acid, is an important byproduct of biochar production. The gas formed during the burning of harvested and pruned wastes in an oxygen-free environment is cooled, the gas condenses into a liquid called wood vinegar. The properties of wood vinegar depend on the raw material and production conditions, however, the main component of raw wood vinegar is water (80-90%). The most common component besides water is acetic acid (30.45-70.60 mg/mL), and the wood vinegar also contains other acids, alcohols, phenols, esters, carbonyl and furans and other organic compounds in different proportions. The pH value of wood vinegar varies between 2 and 4, the specific gravity varies between 1.005 and 1.016 g/mL, and the dissolved tar content varies between 0.23-0.89%. Wood vinegar, a natural product, is used in various purposes such as industrial, livestock, household and agricultural products. The agricultural benefits of wood vinegar can be attributed to its wonderful chemical composition. The wood vinegar improves soil quality, is effective in disease, pest and weed control, accelerates seed germination, improves plant growth, acts as a plant growth regulator or growth inhibitor, and improves fruit quality. Organic acids released from the roots in rhizosphere dissolve the phosphoric acid in soils, makes nutrients more available for plant roots to take. The organic acids in wood vinegar have a similar effect on the soil. Although studies investigating the effect of wood vinegar on soil health is very limited, studies revealed that wood vinegar increases soil microbial activity. Increased microbial activity is expected to improve the physical and chemical properties of soils. In addition, wood vinegar has also been used in food processing with its characteristic smoke taste and inhibiting the growth of microorganisms. Ongoing studies and recent information on wood vinegar pointed to considerable potential for the production and wider use of wood vinegar in agriculture and environmental management. The wider use of wood vinegar will contribute to the improvement of the socioeconomic structure as well as the healthier environment and ecological system.

Keywords: Pyroligneous acid, acetic acid, biochar, wood vinegar, pyrolysis, agriculture



SOLAR BASED MOBILE CHARGER FOR RURAL AREAS

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ABSTRACT

In the recent scenario, every person is using a mobile. The chargers of mobile phones can carry everywhere but we can't say that, everywhere there is availability of electricity. During summer days this problem occurs usually more times, to overcome this problem of charging of mobile phones in public places & especially for rural people this system designed. Now a days' there is no any such type of facility is available at the public places & at rural area. Lots of electronic devices can benefit greatly from solar energy, coming in the form of solar chargers and solar power banks. Solar chargers can help to collect sunlight and transform it into energy to power the electronic devices. A solar power bank works in much the same way as a standard power bank, letting to store power and charge devices on the go. The difference is that the power bank itself uses the sun (instead of costly electricity) to charge itself and then transfer the accumulated power into rechargeable batteries, which will hold it till the needed moment. This paper explains about solar based mobile charger using in rural areas.

Keywords: Solar, Rural, Areas



TÜRKİYE KAYISI FIDAN ÜRETİMİNİN DEĞERLENDİRİLMESİ

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ÖZET

Bu çalışmanın amacı tarım ve orman bakanlığı kayıtlarına göre, Türkiye kayısı fidan yetiştiriciliğindeki gelişmelerin değerlendirilmesidir. Türkiye dünya kayısı üretiminde yıllardır lider konumundadır. Son yıllarda diğer meyve türlerinde olduğu gibi kapama kayısı bahçe sayı ve büyüklüklerinde önemli artışlar olmuştur. Bahçe sayılarındaki bu artış kayısı fidan üretimini de tetiklemiştir. Türkiye kayısı fidan üretim miktarı yıllara göre artış ve düşüşler görünmekle beraber, 2010 yılından sonra her yıl belirli oranlarda artmıştır. Türkiye' nin Kayısı fidan üretim, 1976 yılında 944.000 adet, 2010 yılında 740.007 adet, 2015 yılında 1.499.457 adet ve 2020 yılında ise 3.127.139 adet olmuştur. Talebe göre olmak üzere, Türkiye'de 10 kayısı çeşidine ait sertifikalı bitkisel materyal üretim kaydına rastlanmıştır. Bu çeşitler içerisinde sırasıyla en fazla Kabaaşı (%29), Şekerpare (%16.53), Hacıhaliloğlu (%13.90) ve Roxana (%6.11) kayısı çeşitlerine, ait sertifikalı bitkisel materyal üretildiği belirlenmiştir. Türkiye'de büyük oranda (%75) yerli kayısı çeşitlerin üretildiği belirlenmiştir. Türkiye' deki toplam kayısı fidan üretiminde ilk sırayı 810.170 adet (%80) ile Malatya ili alırken, ikinci sırada 363.810 adet (%25) ile İzmir ve üçüncü sırada ise 70.950 adet (%4.81) ile Isparta ili yer almaktadır. Kayısı fidan üretiminin büyük çoğunluğu özel sektör tarafından yapılırken bazı kamu kuruluşlarında da belirli oranda fidan üretimi yapılmaktadır. Tarım ve orman bakanlığı tarafından 2009 yılında yayınlana yönetmeliğin uygulanmaya başlanması ile sertifikalı kayısı fidan üretiminde önemli artışların olduğu belirlenmiştir. Genel olarak son 10 yılda sertifikalı fidan üretimindeki artışlar, kapama bahçe tesislerindeki ismine doğru fidan probleminin de çok büyük oranda ortadan kalkmasına neden olmuştur. Türkiye de oransal olarak çok düşüğe olsa halen, kayıt dışı üretim kaynaklı fidan problemleri de mevcuttur. Özellikle ismine doğru, sağlıklı fidan üretim oranının artması ve kayıt dışı üretimin önüne geçilmesi için sertifikasyon sisteminin güçlü bir şekilde uygulanması gerekir.

Anahtar Kelimeler: Türkiye, kayısı, fidan, üretim



EVALUATION OF TURKEY APRICOTS SAPLING PRODUCTION

ABSTRACT

The aim of this study is to evaluate the developments in apricot seedling cultivation in Turkey according to the records of the Ministry of Agriculture and Forestry. Turkey has been the leader in world apricot production for years. In recent years, there has been a significant increase in the number and size of closed apricot orchards, as in other fruit species. This increase in the number of orchards has also triggered the production of apricot saplings. Although the production amount of apricot saplings in Turkey has increased and decreased over the years, it has increased at certain rates every year after 2010. Turkey's Apricot sapling production was 944,000 in 1976, 740,007 in 2010, 1,499,457 in 2015 and 3,127,139 in 2020. Certified plant material production records of 10 apricot cultivars were found in Turkey, on demand. It was determined that among these cultivars, the most certified plant material belonging to Kabaası (29%), Şekerpare (16.53%), Hacıhaliloğlu (13.90%) and Roxana (6.11%) apricot cultivars were produced, respectively. It has been determined that a large proportion (75%) of domestic apricot varieties are produced in Turkey. Malatya province ranks first with 810.170 (80%) in total apricot sapling production in Turkey, while İzmir ranks second with 363,810 (25%) and Isparta province ranks third with 70.950 (4.81%). While the majority of apricot saplings are produced by the private sector, a certain amount of seedlings are produced in some public institutions. With the implementation of the regulation published by the Ministry of Agriculture and Forestry in 2009, it has been determined that there has been a significant increase in the production of certified apricot saplings. In general, the increase in the production of certified saplings in the last 10 years has led to the elimination of the sapling problem, which is true to its name, in closed garden facilities. In Turkey, there are still problems with seedlings originating from unregistered production, although it is proportionally very low. In order to increase the production rate of healthy saplings, especially true to its name, and to prevent unregistered production, the certification system should be implemented strongly.

Keywords: Turkey, apricot, sapling, production



ROLE OF SENSORS IN SMART AGRICULTURE

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ABSTRACT

In the current scenario, sensors play a vital role in agriculture. To get more crop yield, parameters such as soil P^H, nutrients, availability of water, suitable climatic condition and resistivity to pathogen is very important. These factors can pose a significant risk to farms when they are not monitored and managed correctly. The sensor used in smart farming is called agriculture sensor. These sensors provide data that assist farmers to monitor and optimize crops by adapting to changes in the environmental conditions. These sensors are installed on weather stations, drones and robots used in the agriculture industry. They can be controlled using mobile phone tools such as camera, GPS, microphone, accelerometer, gyroscope. These sensors play a crucial role to meet the increasing demand for food by maximizing yields with minimum resources such as water, fertilizers and seeds. This paper gives an insight view of types of sensors used in agriculture, its benefits and future scope.

Keywords: Sensor, smart agriculture, crop yield, resources



SİVAS, ANKARA, KAYSERİ İLLERİ MERALARININ FLORİSTİK ÖZELLİKLERİ

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ÖZET

Bu çalışmada Sivas, Ankara ve Kayseri ili meralarının floristik özellikleri incelenmiştir. Sivas ilinde 103, Ankara ilinde 60, Kayseri ilinde 60 durak olmak üzere; toplam 223 durakta çalışma yapılmıştır. Vejetasyon etüdünde tekerlek-nokta yöntemi kullanılmıştır. Çalışma sonucunda 54 familya, 240 cins içinde 580 adet takson tespit edilmiştir. Çalışma alanında tespit edilen bitkilerin 159 tanesi Asteraceae familyası, 155 tanesi Fabaceae familyası, 109 tanesi Poaceae familyası, 93 tanesi Lamiaceae, 60 tanesi Caryophyllaceae familyası, 58 tanesi Brassicaceae familyası, 320 tanesi de diğer familyalara aittir. En fazla bulunan ilk üç tür; *Thymus sipyleus* Boiss., *Festuca valesiaca* Schleich. ex Gaudin, *Poa bulbosa* L.'dir. Sivas ilinde ilk üç baskın tür; *Festuca valesiaca* Schleich. ex Gaudin, *Thymus sipyleus* Boiss., *Bromus tomentellus* Boiss.'dir. Ankara ilinde ilk üç baskın tür; *Festuca valesiaca* Schleich. ex Gaudin, *Poa bulbosa* L., *Thymus leucostomus* Hausskn. & Velen.'dir. Kayseri ilinde ilk üç baskın tür; *Thymus sipyleus* Boiss., *Poa bulbosa* L., *Bromus tomentellus* Boiss.'dir. Sivas ilinde en fazla görülen ilk üç familya Poaceae, Fabaceae ve Lamiaceae familyalarıdır. Ankara ilinde en fazla görülen ilk üç familya Poaceae, Lamiaceae ve Asteraceae familyalarıdır. Kayseri ilinde en fazla görülen ilk üç familya Poaceae, Lamiaceae ve Asteraceae familyalarıdır. Meralarda 227 cins bulunmuştur. Meralarda en fazla türe sahip ilk beş cins sırasıyla; *Astragalus* cinsi 35 türe, *Alyssum* cinsi 14 türe, *Salvia* cinsi 14 türe, *Medicago* cinsi 11 türe, *Achillea* cinsi 10 türe, *Bromus* cinsi 10 türe, *Trifolium* cinsi 10 türe, *Onobrychis* cinsi 9 türe sahiptir. Çalışma alanındaki türlerin 428 tanesi çok yıllık, 130 tanesi tek yıllık ve 22 tanesi iki yıllık bitkilerdir. Çalışma alanında 110 endemik tür tespit edilmiştir. Endemik türlerin 11 tanesi çalışma alanımızdaki üç ilde de görülmüştür. İç Anadolu Bölgesi meralarının floristik yapısının belirlenmesi meraların sürdürülebilirliğine ve mera ıslah çalışmalarına ışık tutacaktır. İç Anadolu Bölgesinde yer alan çalışma alanımızdaki üç ile ait meraların zengin floristik yapısı hayvan beslemesi açısından öneme haizdir.

Anahtar Kelimeler: Flora, mera, otlatma yönetimi, iç anadolu meraları

(Bu çalışma TÜBİTAK tarafından KAMAG 106G017 nolu projeye desteklenmiştir.)



FLORISTIC FEATURES OF SIVAS, ANKARA, KAYSERİ PROVINCES PASSAGES

ABSTRACT

In this study, the floristic characteristics of the pastures of Sivas, Ankara and Kayseri provinces were investigated. 103 stops in Sivas, 60 stops in Ankara, 60 stops in Kayseri; A total of 223 stops were studied. Wheel-point method was used in the vegetation study. As a result of the study, 580 taxa were identified in 54 families and 240 genera. Of the plants identified in the study area, 159 belong to the Asteraceae family, 155 to the Fabaceae family, 109 to the Poaceae family, 93 to the Lamiaceae, 60 to the Caryophyllaceae family, 58 to the Brassicaceae family, and 320 to the other families. The three most common species are; *Thymus sipyleus* Boiss., *Festuca valesiaca* Schleich. ex Gaudin, *Poa bulbosa* L. The first three dominant species in Sivas province; *Festuca valesiaca* Schleich. ex Gaudin, *Thymus sipyleus* Boiss., *Bromus tomentellus* Boiss. The first three dominant species in Ankara; *Festuca valesiaca* Schleich. ex Gaudin, *Poa bulbosa* L., *Thymus leucostomus* Hausskn. & Velen. The first three dominant species in Kayseri province; *Thymus sipyleus* Boiss., *Poa bulbosa* L., *Bromus tomentellus* Boiss. The three most common families in Sivas are Poaceae, Fabaceae and Lamiaceae. The three most common families in Ankara are Poaceae, Lamiaceae and Asteraceae. The three most common families in Kayseri are Poaceae, Lamiaceae and Asteraceae. 227 genera were found in the pastures. The first five genera with the highest number of species in the rangelands are respectively; The genus *Astragalus* has 35 species, the genus *Alyssum* has 14 species, the genus *Salvia* has 14 species, the genus *Medicago* has 11 species, the genus *Achillea* has 10 species, the genus *Bromus* has 10 species, the genus *Trifolium* has 10 species, the genus *Onobrychis* has 9 species. Of the species in the study area, 428 are perennial, 130 are annual and 22 are biennial. 110 endemic species were identified in the study area. 11 of the endemic species were seen in all three provinces in our study area. Determining the floristic structure of the rangelands of the Central Anatolia Region will shed light on the sustainability of the rangelands and rangeland improvement studies. The rich floristic structure of the pastures of three provinces in our study area in the Central Anatolia Region is important in terms of animal nutrition.

Keywords: Flora, pasture, grazing management, central anatolian rangelands

(This work was supported by TÜBİTAK with the project numbered KAMAG 106G017.)



COMBINED USE OF APSIM AND LOGISTIC REGRESSION MODEL TO PREDICT THE QUALITY CHARACTERISTICS OF MAIZE GRAIN

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ABSTRACT

Knowledge of the factors modifying grain composition is required to predict the quality of a particular crop in a particular environment. A simple algorithm was adopted for predicting grain yield and quality in maize cultivars in response to different planting dates (20 June and 21 July), irrigation (12-day and 6-day intervals) and nitrogen rates (0 and 184 kg N ha⁻¹). Quality modelling was performed in two steps: (a) the APSIM-Maize model was used to simulate grain growth and grain protein and (b) a Three-Parameter Logistic model (3PLM) was adjusted to compute the starch and oil content of grain. Results showed that APSIM-Maize was able to accurately predict phenology (flowering and physiological maturity), biological yield and grain yield with normalized root mean square error (nRMSE) less than 10%, D-index more than 0.25 and the R² and model efficiency (ME) higher than 90%. APSIM-Maize was also able to accurately predict grain protein with nRMSE smaller than 20%, D-index more than 0.25 and the R² and ME higher than 90%. The 3PLM modeling accurately predicted starch, amylopectin, amylose and oil content with nRMSE less than 20%, R² and ME more than 90% in most of the studied treatments. This coupled modeling approach can be used to predict the starch and oil contents of maize grain in addition to the grain yield.

Keywords: APSIM, logistic regression, oil; protein, specific quality standard, starch, maize



NEW POTATO AND TOMATO PATHOGENS IN RUSSIA

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ABSTRACT

Climatic and ecological changes, the exchange of seeds, the use of new plant protection products and plant growing technologies lead to the appearance in the regions of Russia of previously undetected species and strains of phytopathogenic microorganisms. Phytopathogens expand their ranges, adapt to the defeat of new plants, and strains that are resistant to popular pesticides appear. In our work, new types of fungi affecting potatoes (*Septotinia populiperda*, *Ilyonectria crassa*, *Trichocladium* sp.) And tomato (*Phomopsis phaseoli*, *Irpex lacteus*) were identified. Previously not detected in Russia strains of *Rhizoctonia solani* of the AG-K group, affecting potato stems in the south of European Russia, were discovered. For the first time, *R. solani* strains resistant to the fungicide pencycuron and capable of growing at temperatures of 35 ° C and above were discovered; the presence of thiabendazole-resistant *Helminthosporium solani* strains in Russia and Europe was shown. The transition from cultural and morphological criteria to molecular genetic ones in the analysis of species and intraspecific diversity made it possible to identify species and intraspecific groups of fungi of the genera *Fusarium*, *Alternaria*, *Colletotrichum*, confined to the defeat of potatoes, tomatoes and other plants. The



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on FOOD, AGRICULTURE and VETERINARY
19-20 June, Izmir-TURKEY



differences were revealed between the strains of the section *Fusarium incarnatum-equiseti*, affecting tomato in Russia and Uganda. The prevalence of previously known pathogens is also changing. Thus, in the last decade in Russia and Belarus, diseases caused by the fungus *Colletotrichum coccodes* and the oomycete *Pythium ultimum* have become widespread in potatoes. Thus, a detailed analysis of phytopathogens using modern molecular methods shows constant changes in their species and intraspecific composition, which requires adjusting the plant protection schemes and predicting the development of diseases.

Keywords: Potato, tomato



***Chaetomium globosum* AS A PROMISING BIOCONTROL AGENT FOR THE
PROTECTION OF POTATO TUBERS**

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ABSTRACT

Biological pesticides are safe for the environment, do not accumulate in water and soil, and are relatively cheap to manufacture. They are allowed in organic farming. Potential biocontrol agents can inhibit the growth of pathogenic fungi by releasing biocidal substances or through direct parasitism. In the presented work, the ability of the fungus strain *Chaetomium globosum* to suppress the growth of potato pathogens *Alternaria alternata*, *A. solani*, *Colletotrichum coccodes*, *Rhizoctonia solani*, *Fusarium oxysporum* was studied. The investigated *C. globosum* strain was isolated from a tomato fruit. The species was determined by cultural and morphological characteristics and by sequencing of the ITS1 -5.8S-ITS2 region with primers ITS5/ITS4. The counter crop method was used to assess antagonistic activity (Royse and Ries, 1978). Small pieces of agar with fungal mycelium were placed in a Petri dish at 2.5 cm from each other and from the edge of the dish. On the 7th day of incubation, the zone of inhibition (sterile zone without mycelium) was measured. On day 30, the ability of the strain to parasitize on pathogenic fungi was assessed. For the estimation of *C. globosum* pathogenicity, a piece of agar with its mycelium was placed to the surface of a potato tuber. The tuber was placed in a humid chamber and incubated for 30 days. All experiments were carried out in 5 replicates. The strain of *C. globosum* studied showed a pronounced antagonistic effect against *Alternaria* sp., *A. solani*, *C. coccodes*, *R. solani*, and *F. oxysporum*. The zone of inhibition was 10, 5, 5, 3, 3 mm, respectively. During long-term joint incubation, *C. globosum* occupied the entire volume of the dish. Apparently, *C. globosum* can parasitize on pathogenic fungi. Evaluation of phytopathogenic properties showed that *C. globosum* does not attack potato tubers. In liquid media, the fungus did not give rise to sporulation. On steamed wheat grains, sporulation appeared on the 21st day of cultivation. Spores can be washed off wheat kernels by vigorously shaking the flask containing the kernels. Spores of *C. globosum* can be stored in distilled water and in water containing 15% glycerol. Thus, the studied *C. globosum* strain is a promising agent for biocontrol of pathogenic fungi of potato tubers.

Keywords: *Chaetomium globosum*, potato diseases, biopreparations, biocontrol



ABIYOTİK STRES KOŞULLARINA TOLERANS OLUŞTURULMASINDA SİLİKON UYGULAMALARININ ROLÜ

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ÖZET

Silicon (Si), bitkilerin abiyotik ve biyotik stres koşullarına tolerans geliştirmesi üzerine etki yapan ve doğada oksijenden sonra en fazla bulunan ikinci element olma özelliği bakımından oldukça önemlidir. Silisyum çoğu bitki için mutlak gerekli olan elementler kategorisinde yer almamasına rağmen, stres koşullarındaki varlığının özellikle azot fiksasyonu ve fotosentez gibi yaşamsal önem taşıyan fizyolojik olaylar üzerindeki iyileştirici etkisinin tanımlanması, son yıllarda bu elementin önemini arttırmış ve bitkilerde farklı streslere adaptasyon geliştirme ile ilgili çalışmalar ivme kazanmıştır. Bu çalışmalar özellikle son yıllarda nano silika partikülleri üzerine yoğunlaşmıştır. Günümüzde tıptan kozmetiğe kadar, pek çok kullanım alanına sahip olan nanopartiküller tarımsal üretimde yeni bir yaklaşım olarak birçok çalışmanın konusunu oluşturmakta, avantaj ve dezavantajları hala araştırılmaktadır. Nanosilikon partiküllerinin fizikokimyasal özellikleri nedeniyle tarım sektöründe kullanılabileceğine dair bilgiler mevcuttur. Tarımda yapılan umut verici yeni yaklaşımlar özellikle küresel gıda güvenliği açısından önem taşımaktadır. Bu materyallerin gübre, böcek ilacı ve herbisit olarak kullanımları araştırılmaktadır. Yapılan çalışmalar nanosilika materyallerinin farklı bitki türlerinde özellikle iklim değişikliği nedeniyle meydana gelen kuraklıkla başa çıkmada, tuz stresi ile mücadelede, ağır metal toksisitesinde, ultraviyole stresi koşullarında, yüksek sıcaklık ve neme karşı mücadelede ve ayrıca hastalığı direnci arttırmada etkili olabileceğini göstermektedir. Bitki dokularında bulunan içsel silikon miktarı bitki türlerine göre farklılık göstermektedir. Dışarıdan silikon uygulaması bitki hücre duvarlarının morfolojik yapısında değişiklikler meydana getirebilmekte ayrıca hücre zar bütünlüğünün korunmasına yardımcı olmak suretiyle bitkilerin farklı abiyotik stres koşullarına dayanımını arttırmaktadır. Bu iyileştirici etki silikonun fiziksel ve kimyasal bir bariyer oluşturması ile açıklanmaktadır. Silikonun bitkilerde yapmış olduğu bu iyileştirici etkiler bitkilerin stres koşullarına toleransında etkin rol oynayan antioksidant enzim aktiviteleri gibi bazı biyokimyasal değişimlere neden olarak oksidatif stresi azaltması ve ayrıca fotosentez ve mineral besin alımını iyileştirmesi suretiyle olmaktadır. Bu derleme çalışmasında değişik abiyotik stres koşullarında, farklı silikon ve nanosilikon materyallerinin bitkilerde meydana getirdiği morfolojik, fizyolojik ve biyokimyasal değişikliklerle abiyotik stres toleransının oluşturulmasındaki etkileri derlenmiştir. Bu derleme çalışmasının özellikle 21. yüzyılın gelişen teknolojilerinden biri olan nano materyallerin tarımsal üretimde küresel ölçekte kullanılabilirliğine dair bir bakış açısı oluşturulmasına katkı sağlayacağı düşünülmektedir.

Anahtar Kelimeler: Abiyotik stres, nano silikon, silikon, tolerans



THE ROLE OF SILICONE APPLICATIONS IN TOLERANCE TO ABIOTIC STRESS CONDITIONS

ABSTRACT

Silicon (Si) is very important in terms of being the second most abundant element after oxygen in nature, which affects the tolerance development of plants to abiotic and biotic stress conditions. Although silicon is not categorized as absolutely necessary element for most plants, the definition of the healing effect of its presence in stress conditions, especially on important physiological events such as nitrogen fixation and photosynthesis, has increased the importance of this element in recent years and the studies on developing adaptation to different abiotic stress condition with silicon have gained momentum. These studies have focused on nano silica particles especially in recent years. Today, nanoparticles, which have many uses from medicine to cosmetics, are the subject of many studies as a new approach in agricultural production, and their advantages and disadvantages are still being investigated. There are some informations that nano silicone particles can be used in the agricultural sector due to their physicochemical properties. Promising new approaches in agriculture are especially important for global food security. The use of these materials as fertilizers, pesticides, and herbicides has been investigated. Studies have shown that nano silica materials can be effective in different plant species, especially in coping with drought due to climate change, struggle to salt stress, heavy metal toxicity, ultraviolet stress conditions, and against high temperature and humidity, and also increasing disease resistance. The amount of intrinsic silicon in plant tissues differs according to plant species. External application of silicon can cause changes in the morphological structure of plant cell walls, and also increases the resistance of plants to different abiotic stress conditions by helping to preserve cell membrane integrity. This healing effect is explained by the fact that silicon creates a physical and chemical barrier. These curative effects of silicon in plants occur by reducing oxidative stress by causing some biochemical changes such as antioxidant enzyme activities, which play an active role in the tolerance of plants to stress conditions, and also by improving photosynthesis and mineral nutrient uptake. In this review study, the effects of different silicon and nanosilicone materials on the formation of abiotic stress tolerance with morphological, physiological and biochemical changes in plants under various stress conditions were compiled. It is thought that this review study will contribute to the creation of a perspective on the global usability of nanomaterials, which is one of the developing technologies of the 21st century, in agricultural production.

Keywords: Abiotic stress, nanosilicone, silicone, tolerance



KURAKLIK VE TUZ STRESİ KOŞULLARINDA BİTKİLERİN SERBEST AMİNO ASİT PROFİLLERİNDEKİ DEĞİŞİMLER

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ÖZET

Bitkisel üretim esnasında her zaman optimum çevre koşulları sağlanamamakta ve bazı metabolitlerin oluşumunda genotip kadar çevre faktörleri de etkili olmaktadır. Günümüz koşullarında nüfus artışı ve küresel iklim değişikliğinin etkileri de göz önünde bulundurulduğunda, mevcut tarım alanlarından maksimum yararlanılması zorunlu bir ihtiyaç haline gelmiştir. Bu durum stres koşullarına toleranslı çeşitlerle üretim yapılması ya da stres koşullarının üstesinden gelebilmek için bitkilerde oluşturulan bazı içsel metabolitlerin sentezini aktive edecek yöntemlerin pratiğe aktarılması ile mümkün olabilecektir. Bu nedenle stres koşullarında bitkilerde oluşan metabolik değişikliklerin ve metabolitlerin belirlenmesi oldukça önemlidir. Abiyotik stres koşulları, stresin şiddetine bağlı olarak bitki gelişimini olumsuz etkilemektedir. Bu stres faktörlerinden kuraklık ve dolaylı olarak kuraklık stresini tetikleyen tuz stresi, hücre büyümesi, bölünmesi, fotosentez ve terleme gibi fizyolojik mekanizmalar üzerinde olumsuz etkileri nedeniyle bitkilerde önemli verim kayıplarına neden olan yıkıcı stres faktörleridir. Bu stres faktörleriyle başa çıkmak için bitkilerde bazı morfolojik ve biyokimyasal değişiklikler meydana gelmektedir. Antioksidan enzim aktivitelerindeki değişiklikler, çözünebilir şeker içeriği, organik asitler ve proteinlerin yapı taşı olan amino asit profilinde meydana gelen modifikasyonlar bitkilerin stres koşullarında oluşturduğu içsel düzenlemelerdir. Amino asit profilinde meydana gelen değişiklikler genellikle bazı spesifik amino asitlerin birikimi olarak ortaya çıkmaktadır. Çalışmaların çoğu prolin üzerine odaklanmış olsa da diğer amino asitlerin de araştırılması stres koşullarına tepki mekanizmalarının anlaşılması açısından önem taşımaktadır. Amino asit profilindeki değişiklikler stresin şiddetine, bitki türüne ve genotipe bağlı olarak gerçekleşmektedir. Amino asitler reaktif oksijen türevlerinin detoksifikasyonu, pH'nın düzenlenmesi ve ozmotik basıncın ayarlanmasına katkı yaparak bitkilerin stres toleransı geliştirmelerinde etkili olan organik moleküllerdir. Eksojen amino asit uygulamaları bitkilerde membran geçirgenliği ve iyon alınımının düzenlenmesi yoluyla stres koşullarına tolerans oluşturulmasını sağlamaktadır. Ayrıca stres koşullarında protein yıkımı nedeniyle lösin ve valin gibi dallı zincirli amino asitlerin biriktiği ve bunların solunum substratları olarak işlev görebildiği bilinmektedir. Bu derlemede, gelecekte daha da önemli bir sorun olacağı tahmin edilen kuraklık ve tuz stresi koşullarında bitkilerdeki amino asit profil değişiklikleri incelenmiştir.

Anahtar Kelimeler: Amino asit, kuraklık stresi, tuz stresi



CHANGES IN FREE AMINO ACID PROFILES OF PLANTS UNDER DROUGHT AND SALT STRESS CONDITIONS

ABSTRACT

Optimum environmental conditions cannot always be provided during plant production and environmental factors are as effective as genotype in the formation of some metabolites. Nowadays, considering the population growth and the effects of global climate change, it has become a necessity to make maximum use of existing agricultural areas. This will be possible by making production with varieties that are tolerant to stress conditions or by putting into practice the methods that will activate the synthesis of some internal metabolites formed in plants in order to overcome the stress conditions. For this reason, it is very important to determine the metabolic changes and metabolites that occur in plants under stress conditions. Abiotic stress conditions adversely affect plant growth depending on the severity of the stress. Among these stress factors, drought and salt stress, which indirectly triggers drought stress, are destructive stress factors that cause significant yield losses in plants due to their negative effects on physiological mechanisms such as cell growth, division, photosynthesis and transpiration. To cope with these stress factors, some morphological and biochemical changes occur in plants. Changes in antioxidant enzyme activities, modifications of soluble sugar content, organic acids, and the amino acid profile, which is the building block of proteins, are internal regulations that plants create under stress conditions. Changes in the amino acid profile usually occur as the accumulation of some specific amino acids such as proline. Although most of the studies have focused on proline, the investigation of other amino acids is important in terms of understanding the response mechanisms to stress conditions. Changes in the amino acid profile occur depending on the severity of stress, plant species and genotype. Amino acids are organic molecules that are effective in the development of plants' stress tolerance by contributing to the detoxification of reactive oxygen derivatives, regulation of pH and regulation of osmotic pressure. Exogenous amino acid applications provide tolerance to stress conditions in plants by regulating membrane permeability and ion uptake. In addition, it is known that branched-chain amino acids such as leucine and valine accumulate due to protein degradation under stress conditions and can function as respiratory substrates. In this review, the changes in the amino acid profile in the plant under drought and salt stress conditions, which are predicted to be an even more important problem in the future, are examined.

Keywords: Amino acid, drought stress, salt stress



FUTURE ASPECTS OF SOLAR FARMING IN AGRICULTURE WITH REFERENCE TO INDIA

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ABSTRACT

The agriculture is one of the strong sector in the Indian economy. Approximately 60 percent of the Indian population depending in the industry, contributing about 18 percent to India's GDP. Agricultural demand for electricity is one of the largest burden on India's power sector as irrigation systems are largely undeveloped and farmers are dependent on electricity to power their pumps. Solar can mitigate this entire portion of demand by generating power at the source and converting users into suppliers. The newest crop in India could be electricity from the sun. "Solar Farming" can help change India's energy economy to clean and efficient renewable energy. Solar power is one of the most versatile forms of energy, with boundless potential, if tapped wisely. Solar can be a game changer for the agricultural sector, which helps saving precious water resources, reducing pollution and also reducing dependency on the electricity, and even becoming an additional revenue path for farmers. Generation of solar energy become enormous scope in India. The geographical location of the country stands to its benefit for generating solar energy. The reason being India is a tropical country and it receives solar radiation almost throughout the year, which amounts to 3,000 hours of sunshine.

Keywords: Agriculture, solar farming, electricity, kerala, India



**GENETIC DIVERSITY AND POPULATION STRUCTURE OF A BREAD WHEAT
LANDRACE POPULATION FROM THE FERTILE CRESCENT**

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ABSTRACT

Landraces are considered as a valuable source of potential genetic diversity that could be used in the selection process in any plant breeding program. The Fertile Crescent is considered as the centre of origin and diversity of bread wheat and even now landraces are grown in parts of Fertile Crescent on a small scale thus preserving the rich genetic diversity of the landraces prevalent to this region. , Here we assembled a population of 600 bread wheat landraces collected primarily from the Fertile Crescent, conserved at the ICARDAs gene bank, and evaluated the genetic diversity and the population structure of the landraces using Single nucleotide polymorphic (SNP) markers. A total of 11,830 high quality polymorphic SNPs with known chromosomal positions and distributed across the genomes A (40.5%), B (45.9%), and D (13.6%) were used for the final analysis. The population structure analysis was evaluated using Model based method (STRUCTURE) and distance based methods (Discriminant analysis of principle components (DAPC) and principle component analysis (PCA)). STRUCTURE



3rd INTERNATIONAL CONFERENCE
on FOOD, AGRICULTURE and VETERINARY
19-20 June, Izmir-TURKEY



method grouped the landraces into two major clusters with landraces from Syria and Turkey forming two clusters with high proportions of admixture whereas, the DAPC and PCA analysis grouped the population into three sub-populations mostly according to the geographical information of the landraces i.e. Syria, Iran and Turkey with admixture. The analysis of molecular variance revealed that the majority of the variation is due to genetic differences within the populations as compared with between sub-populations and it was same for both the cluster based and distance based methods. Genetic distance analysis was also studied in order to estimate the differences between the landraces from different countries and it was observed that the maximum genetic distance (0.389) was between landraces from Spain and Palestine whereas the minimum genetic distance (0.013) was observed between landraces from Syria and Turkey. It was concluded from the study that the model based methods (DAPC and PCA) were able to dissect the population structure more precisely as compared with STRUCTURE method. The population structure and genetic diversity analysis of the bread wheat landraces presented here highlight the complex genetic architecture of the landraces native to the Fertile Crescent region. The presence of admixture may be attributed to the historic free seed exchange between the farmers and traders due to the close geographic proximity of the countries from where the landraces were collected. The results of this study will provide useful information for genetic improvement of hexaploid wheat and facilitate the use of landraces in wheat breeding programs.

Keywords: Wheat landraces, genetic diversity, population structure, single nucleotide polymorphisms



SUSTAINABLE WATER AND FERTILIZER MANAGEMENT IN A SEMI-ARID CLIMATE FOR THE OPTIMIZATION OF AGRICULTURAL PRODUCTION

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ABSTRACT

Due to the increase in population, the agricultural community requires sustainable methods to increase agricultural production and to ensure the global food supply. Maximizing crop production with a minimum of irrigation water, fertilizers and energy is the main objective of sustainable agriculture. In the last decade, agriculture is faced many constantly changing requirements coming from natural and anthropogenic impacts, which needs more and more exigencies to keep the constant food security, otherwise, we are faced with socio-economic problems. So, the development of sustainable and innovative agricultural production systems is an unavoidable necessity. It is very important to develop a way to decrease inputs for all crops, whether for irrigation, fertilization, or plant protection products, while maintaining an acceptable agricultural yield. This review focuses on a literature review that treats water use efficiency and fertilizer application as sustainable agricultural management. Fifty papers were analyzed with the goal to determine the application of sustainable agriculture in arid and semi-arid areas. The researches show that the better management usually refers to the improvement of the water allocation and the use of fertilizer effectively, which depends closely on the type of irrigation technology, soil composition, and climate conditions. It is important to reduce irrigation and the use of fertilizer during specific phenological stages without risk of agricultural yield as well as on fruit quality. So, this review discusses the adopted strategies for optimum agricultural production for greater gross return, less fertilizers use, and less irrigated water use than the normal production plan.

Keywords: Irrigation, fertilizer, sustainable agriculture, low inputs, agricultural production



PRODUCTION OF POLYHYDROXY BUTYRATE BY AGRICULTURE WASTE USING SOLID STATE FERMENTATION

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ABSTRACT

Polyhydroxybutyrate (PHB), a bioplastic, has attracted the attention in the recent years due to its ability to replace the polyethylene, a non-biodegradable plastic. The aim of the present research work was to evaluate the potential of different agricultural wastes like wheat bran, rice polishings and corn cob for the synthesis of PHB by *Bacillus thuringiensis* FCBP-SB-0002 using solid state fermentation. Optimization of different components of basal media and various physical parameters was also performed. Changing one factor at a time was used and ANOVA applied to check significance level. Maximum PHB yield (420 mg/100g) was achieved on fermentation of rice polishing at substrate water ratio of 10:36 at 72 hours of incubation time, pH 7, temperature of 30⁰C by addition of 1 mL inoculum. Addition of different optimum levels of ionic salts (1.5% of KH₂PO₄·2H₂O, 2% MgSO₄ and 2% NaCl) and nitrogen sources (0.75% urea and 1% corn steep liquor) increased the PHB production to 680 mg/100g respectively. Identification of PHB was done by FTIR analysis and was found to be 98% pure in comparison to standard by spectrophotometric method. The outcomes of the present study indicated that agricultural wastes can be used for the cheap production of bioplastic. This strategy will also help to reduce environmental pollution caused due to disposal of this waste material.

Keywords: Polyhydroxybutyrate, Agricultural waste, *Bacillus thuringiensis*, optimization, solid state fermentation



MONITORING OF HEAVY METALS CONTENT IN SEDIMENTS COLLECTED FROM KOUDIET MEDOUAR DAM AND ITS TRIBUTARY (Batna, Algeria)

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ABSTRACT

The aim of this study is to assess the level of recent contamination by heavy metals (HM) of the surface sediments of the Koudiet Medouar dam and its main tributary Rebaa wadi. This dam is intended to produce drinking water, irrigation and fishing activity. This study is carried out on 9 stations, 6 of which are selected from upstream to downstream of Rebaa wadi and 3 at the Koudiet Medouar dam. Eight sampling campaigns covering *in situ* physical measurements of water and sediment sampling were carried out over 2 years from September 2012 to July 2014. The analytical approach concerned the physicochemical characterization of sediments (water content, organic matter, pHs, electrical conductivity and total limestone, determined on the fraction less than 2 mm) and their contents of 8 HM on the fraction less than 63 μ m, determined by Flame Atomic Absorption Spectrophotometry. The sediments of the Koudiet Medouar dam and Rebaa wadi, which are slightly alkaline, are characterized by high electrical conductivity, medium organic matter and high carbonate load. The pseudo-total concentrations of HM in the sediments show the following order of abundance: Mn > Zn > Cr > Cu > Co > Pb > Ni > Cd. The spatial and temporal distribution of HM shows natural background levels of Co, Pb, Ni and Mn. Contamination by Cd, Cr, Cu and Zn is highlighted and affects all stations. The pollution load index and Sediment Pollution Index (SPI) reveal polymetallic contamination dominated by two or more elements; Cd, Cr, Cu and Zn being of greatest concern. The same results are confirmed by the Ecological Risk Factor (ERF). Our results reflect the footprint of anthropogenic inputs of Cd, Cr Cu and Zn resulting from agricultural activities by runoff water and soil erosion as well as domestic water discharges.

Keywords: Sediment, trace metals, dam, wadi, physicochemical characteristics



**EFFECT OF X-RAY IRRADIATION AND OVEN-DRYING ON THE BIONOMICS
OF *Acanthoscelides obtectus* SAY (COLEOPTERA: CHRYSOMELIDAE) INFESTING
COMMON BEAN IN STORAGE: CAN X-RAY IRRADIATION AFFECT SEED
VIABILITY AFTER PEST CONTROL PROCESS?**

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ABSTRACT

Effectiveness of X-ray irradiation at 60, 70 and 80 KeV solely and in combination with oven-drying against *Acanthoscelides obtectus* Say infesting common bean seeds in storage were investigated in the laboratory at temperature and relative humidity of 29.7°C and 76.5%, respectively. The results showed that the maximum number of eggs oviposited per day by *A. obtectus* is 2.20 and this is comparatively low for bruchinae females. Restricted fecundity in



the female individuals of *A. obtectus* is strongly attributed to effect of X-ray irradiation. The results further revealed that X-ray irradiation caused 37% maximum mortality of *A. obtectus* adults after 24 hours. Mortality was highly significant (minimum of 86.67%) after 7 days of exposure. In combination with oven-drying, there were significant reductions in daily and accumulated emergence of new progenies of *A. obtectus*, seed damage and powder production. The study recommends integrated application of X-ray irradiation and oven-drying in order to cope with *A. obtectus* infestation in stored bean. X-ray irradiation did not adversely affect the viability of bean seeds after the pest control process.

Keywords: Bruchinae, fecundity, seed damage, integrated application, stored bean



HONEY EXTRACTION USING GEOTHERMAL WATER: CASE STUDY FROM INDIA

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ABSTRACT

Low enthalpy geothermal water is available in Gujarat, India. Temperature of exploited water is about 50 degree Celsius. Using heat pump the water temperature is elevated to 80 degree Celsius. Honey processing was demonstrated using two batches of water-one natural 50 degree Celsius and other conditioned 80 degree Celsius. The societal benefit was showcased which improved honey farming in Gujarat and Rajasthan, India. After honey is removed from honey comb we demonstrated two models to farmers, namely, Simple Straining Method and water bath method. The materials used are water of 50 and 80 degree Celsius , settling tank, sieve tank and sump tank. The demonstration and commercialization of honey was performed using geothermal water. This is first of its kind experimentation in India. A flowchart is demonstrated to the honey farmers which included results obtained from bee boxes, extraction of honey and liquefactions using geothermal water. The paper describes the use of geothermal water in improving livelihoods of local communities in India. The major constraints and types of vegetation requirement is also described.

Keywords: Honey, geothermal water, extraction, liquefaction



SES DALGALARININ BİYOLOJİK SİSTEMLER ÜZERİNE ETKİSİ

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ÖZET

Ses, titreşim yapan bir kaynağın, hava basıncında yaptığı dalgalanmalar ile oluşan ve kulağın iletilmesiyle beyinde uyarıcı etki sağlayan fiziksel bir olay olup; geçmişten günümüze bu dalgaların canlılar üzerindeki etkilerinden bahsedilmektedir. Sesin duygularımızı dolayısıyla da hayatımızı etkilediği yadsınamaz bir gerçektir. Eski çağlardan bu yana dünyanın her yerinde; anneler bebeklerini ritmik ve ses tonu birbirine çok benzeyen ninnilerle uyutmakta, çobanlar çaldıkları kavallarla hayvanlarını otlatırken sürülerini bir arada tutmakta ve hekimler hastalarını tedavi ederken çeşitli müzik türlerinden yararlanmaktadır. Hatta sinir sistemleri bulunmayan bitkilerle bile konuşulduğunu çoğu kez duymuşuzdur. Ayrıca dünya üzerindeki her canlı, hayatını devam ettirebilmek için birbirleriyle iletişim kurmak zorundadır ve bu görevi yerine getirirken de bireyler çoğunlukla sessel iletişimden yararlanmaktadır. Yani ses, iletişimin de bir parçasıdır ve bu sistemde üretilen sesler, canlılar arasında çok fazla çeşitlilik göstermektedir. Anlaşılacağı üzere ses, tüm canlıların algılayabildiği evrensel bir dil özelliği taşımakla birlikte, başta insanlar olmak üzere hemen her canlı grubunda, fizyolojik etkileri de bulunmaktadır. Ses dalgası ile ilgili araştırmalar 1950'li yıllara kadar uzanmaktadır. Son yıllarda ise özellikle tıp ve ziraat alanında daha da popülerlik kazanmış ve sesin etkisi birçok disipline yayılmıştır. Yapılan çalışmalar etki mekanizması temelde stresi azaltmaya yönelik olan ses dalgalarının; sadece insanlarda iyileştirici etkisi olmakla sınırlı kalmayıp; hayvanlarda verim ve canlı ağırlık artışını sağladığını, bitkilerde büyüme ve gelişimi teşvik ettiğini, tarımsal üretimde ürün ve kaliteyi artırdığını ve gıda endüstrisinde ürünlerin muhafazasında etkili olduğunu göstermektedir. Bu sonuçlar, ses dalgalarının içinden geçtiği ortamda fiziksel ve kimyasal değişiklik yapabilecek potansiyele sahip olduklarına işaret etmekte olup; çalışmamızda, ses dalgalarının insanlar ve çeşitli canlılar üzerindeki etkilerine değinilmiştir.

Anahtar Kelimeler: Ses dalgası, biyolojik sistem, stres, müzik



EFFECTS OF SOUND WAVES ON BIOLOGICAL SYSTEMS

ABSTRACT

Sound is a physical event caused by pressure waves from a vibrating source, and it provides a stimulating effect in the brain as a result of the transmission by the ear. The effects of these waves on living things have been mentioned for a long time. It is an undeniable fact that sound affects our emotions and therefore our lives. Since the ancient times, all over the world, mothers put their babies to sleep with rhythmic and tone-sore lullabies, shepherds keep together the herds of grazing animals with the flutes they play, and physicians use various types of music to treat their patients. You might have even heard that people talk to plants which don't have nervous systems. Every living thing on Earth has to communicate with each other in order to continue their lives, and individuals often benefit from voice communication while performing this task. In other words, sound is part of communication, and the sounds produced in this system vary considerably among the creatures. Therefore, it seems that sound has a universal language feature that all living things can perceive, but it also has physiological effects in almost every group of organisms, especially humans. Research on sound wave dates back to the 1950s. In recent years, this issue has gained even more popularity, especially in the field of medicine and agriculture, and the effect of sound has spread to many disciplines. Studies showed that sound waves, which are basically aimed at reducing stress, are not limited to having a healing effect in humans. It was also shown that sound waves result in yield and live weight increase in animals, promote growth and development in plants, increase yield and quality in agricultural production, and play roles in preservation of food products. These findings indicate that sound waves have the potential to make physical and chemical changes in the environment which they pass through. In the present study, the effects of sound waves on humans and some other living beings were addressed.

Keywords: Biological system, music, sound wave, stress



**PTEROSTILBENE PLUS PHYSICAL EXERCISE PREVENTED COLLAGEN
INDUCED RHEUMATOID ARTHRITIS VIA THE MARESIN-1 / NF- κ B /
AUTOPHAGY SIGNAL AXIS**

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ABSTRACT

The existing literatures also showed that physical exercise (PE) has the effect of preventing rheumatoid arthritis (RA). As a novel proinflammatory mediator, maresin-1 can inhibit the expression of inflammatory factors by activating PI3K/Akt pathway. Its anti-inflammatory effect has been confirmed in a variety of inflammatory related diseases. Our previous research results also showed that resveratrol possesses the biological activity of preventing the formation of RA. So, whether oral administration of pterostilbene (Pte, methoxystilbene), an analogue of resveratrol (hydroxystilbene), association with PE are better in preventing the formation of RA by increasing the level of maresin-1? Based on this hypothesis, this study explored the preventive effect of Pte and PE on RA, and its underlying molecular mechanism based on a bovine type II collagen (BIIC)-stimulated rat RA model. After the continuous intervention with Pte plus PE of adjuvant arthritis rat models for 8 weeks, the maresin-1 content in serum increased significantly. The changes in the relative expression level of p-NF- κ B and p-Akt AKT stimulated by BIIC were reversed. At the same time, observations under transmission electron microscope also demonstrated that the level of autophagy was mitigated upon the intervention of Pte plus PE. Collectively, these results revealed that Pte plus PE prevented the pathological process of RA through the maresin-1/NF- κ B/autophagy signal axis. Thus, our findings confirmed that orally taking Pte association with reasonable PE can better prevent the occurrence of RA.

Keywords: Arthritis, existing



MÜRDÜMÜK (*Lathyrus sativus* L.) VE YULAF (*Avena sativa* L.) KARIŞIMLARININ SİLAJ KALİTESİNİN BELİRLENMESİ

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ÖZET

Bu çalışmanın amacı; Mürdümük (*Lathyrus sativus* L.) ile yulaf (*Avena sativa* L.) karışım oranlarının belirlenerek silaj kalitesine etkisini incelemektir. Deneme, Mardin ili Kızıltepe ilçesi Köprübaşı mahallesi çiftçi arazisinde kışlık olarak 2019/2020 yetiştirme döneminde kurulmuştur. Deneme materyali olarak, GAP Mavisı Mürdümük çeşidi ve Albatros yulaf çeşidi kullanılmıştır. Bitkiler birer parselde (parsel alanı= 20 m²) yalın olarak ekilmiş olup mürdümük tam çiçeklenme döneminde, yulaf ise süt olum döneminde hasat edilmiştir. Hasat edilen bitkiler, yalın (%100M, %100Y) ve 4 farklı (%80M+%20Y, %60M+%40Y, %40M+%60Y, %20M+%80Y) oranda karıştırılarak silaj örnekleri hazırlanmıştır. Silajlanacak materyal, gofrajlı vakum poşetlerine 1 kg'lık karışımlar halinde konularak Lavion marka vakum makinesi ile içinde hava kalmayacak şekilde 3 tekerrür olarak hazırlanıp vakumlanmıştır. Işıksız ortamda fermantasyona bırakılan silaj örnekleri, 45 gün sonra açılarak pH, kuru madde oranı, ham protein oranı, asit deterjanda çözünmeyen lif (ADF), nötr deterjanda çözünmeyen lif (NDF), nispi yem değeri (NYD), Fleig puanı ve laktik asit bakterisi (LAB) oranı değerleri belirlenmiştir. pH değeri 3.81-4.53, kuru madde oranı %27.3-32.6, ham protein oranı %14.6-23.4, ADF oranı %31.4-39.9, NDF oranı %44.3-55.1, NYD 97.6-134.8, laktik asit oranı %1.92-3.58 ve fleig puanı 89-109 aralığında tespit edilmiştir. Karışımlarda yulaf oranı arttıkça; kuru madde oranı, ham protein oranı ve nispi yem değerinde düşüş, ADF oranı ve NDF oranında ise artış görülmüştür. En düşük ve en yüksek pH değerleri sırasıyla %20M+%80Y ve %100M uygulamalarından elde edilmiştir. En düşük LAB oranı %100M, en yüksek LAB oranı %100Y uygulamasından, en düşük fleig puanı %100M, en yüksek fleig puanı ise %60M+%40Y uygulamasından elde edilmiştir. Sonuç olarak, analiz sonuçları birlikte değerlendirildiğinde; özellikle kuru madde oranı, ham protein oranı, ADF oranı, NDF oranı ve NYD açısından en kaliteli silajın %80M+%20Y karışımından elde edildiği tespit edilmiştir.

Anahtar Kelimeler: Mürdümük, yulaf, silaj, Mardin



DETERMINATION OF SILAGE QUALITY OF GRASSPEA (*Lathyrus sativus* L.) AND OAT (*Avena sativa* L.) MIXTURES

ABSTRACT

The aim of this study was to investigate the quality characteristics of silage obtained by mixing Grasspea (*Lathyrus sativus* L.) and Oat (*Avena sativa* L.) in different ratios. The experiment was established in a farmer in the Köprübaşı suburb of Kızıltepe district of Mardin province, in winter period, during 2019/2020 growth period. GAP Mavisi grass pea cultivar and Albatross oat cultivar were used as material. Seeds of each crop were planted in a single plot (plot area = 20 m²) and grass pea was harvested during full bloom and oat was harvested during milk dough stage. Silage samples were prepared from monocultures (100M, 100%Y) or mixtures of harvested plants in four different ratios (80M+20%Y, 60%M+40%Y, 40%M+60%Y, 20%M+80%Y). 1 kg of the material to be silaged was put into embossed vacuum bags and vacuumed by Lavion brand machine to exclude air content which was prepared in 3 repetitions. The silage samples, which were kept to fermentation in a dark environment, were opened after 45 days and pH, dry matter content, crude protein content, acid detergent insoluble fiber (ADF), neutral detergent insoluble fiber (NDF), relative feed value (NYD), Fleig score and lactic acid bacteria (LAB) ratio values were determined. pH value, dry matter ratio, crude protein ratio, ADF ratio, NDF ratio, NYD, lactic acid ratio and fleig score was determined in the range of 3.81-4.53; 27.3%-32.6%; 14.6%-23.4%; 31.4-39.9%; 44.3-55.1%; 97.6-134.8; 1.92%-3.58%; 89-109, respectively. As the ratio of oats increased in the mixtures, dry matter ratio, crude protein ratio and relative feed value were decreased, while ADF ratio and NDF ratio were increased. The lowest and highest pH values were obtained from 20%M+80%Y and 100%M applications, respectively. The lowest and highest LAB rate was obtained from 100%M and 100%Y applications, respectively. The lowest and the highest fleig score fleig score was obtained from 100%M and 60%M+40%Y applications, respectively. As a result, when the analysis results were evaluated together, it was determined that the best quality silage was obtained from 80%M+20%Y mixture, especially in terms of dry matter ratio, crude protein ratio, ADF ratio, NDF ratio and NYD.

Keywords: Grasspea, oat, silage, Mardin



**COMPARATIVE STUDY OF BIOCHEMICAL MECHANISMS OF RESISTANCE
TO WATER STRESS IN SIXTEEN ADVANCED LINES OF DURUM WHEAT
(*Triticum durum* Desf.)**

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ABSTRACT

The objective of the study is to evaluate drought tolerance of 16 durum wheat advanced lines (*Triticum durum* Desf) using several agronomic and physiological traits. The experiment was carried out in the greenhouse at the Regional Agricultural Research Center (CRRRA) of Meknes. The effect of different treatments on morpho-physiological and agronomic responses was studied using a Randomized Complete Block Design (RCBD) with three replication. In the first trial, we studied the effect of different water regimes on the morpho-physiological and biochemical responses of 16 durum wheat advanced lines through a comparative analysis. A significant decrease in leaf area, relative water content, content of proline and soluble sugars was observed with an increase in leaf temperature. The second part we analyzed the impact of water stress on agronomic parameters. The results showed a very significant decrease in plant height, above-ground biomass and grain yield and a decrease in the harvest index (HI). Depending of the water stress level we observed a significant increase in root length in the different lines studied. The results revealed significant differences between lines and water regimes. The lines, V1 and V16 have showed a good osmotic adjustment, low stomatal sensitivity, and maintenance of turgidity under low water potential. Under water stress V1 and V16 have developed a more important root system compared to other lines. The results concerning the yield in terms of grains reveal that lines V1 and V16 were the most efficient showing the highest yields and a better biomass production compared to the other lines tested.



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Statistical analysis reveals the presence of a highly significant correlation, Relative Water Content TRE is negatively and significantly correlated ($r = -0.566^{**}$, $r = -0.841^{**}$ and $r = -0.746^{**}$) with the content of proline and soluble sugars respectively, on the other hand it is positively and significantly correlated with Yield and PMG, ($r = 0.822^{**}$, $r = 0.798^{**}$) this indicates that the content of its parameters related to the hydric state of the plant.

Keywords: Durum wheat, water stress, tolerance, physiological traits, agronomic traits, relative water content, proline



TRİKLOSAN MARUZİYETİNİN ZEBRA BALIĞI (*Danio rerio*) BÖBREK DOKUSU ÜZERİNDEKİ HİSTOPATOLOJİK ETKİLERİ

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ÖZET

Triklosan (5-kloro-2-(diklorofenoksi) fenol), geniş spektrumlu antimikrobiyal etkinliği nedeniyle çeşitli kişisel bakım, evsel, endüstriyel, tıbbi ve veterinerlik ürünlerinde kullanılan sentetik ve noniyonik bir bileşiktir. Triklosanın yaygın biçimde kullanımı çevresel kontaminasyona yol açmış ve yüzey sularında triklosan tespit edilmiştir. Bu çalışmada, zebra balığı (*Danio rerio*) böbrek dokularındaki triklosan kaynaklı histopatolojik etkiler araştırılmıştır. Ergin zebra balıkları 120 saat boyunca triklosanın subletal konsantrasyonlarına (34 µg/L, 85 µg/L ve 170 µg/L) maruz bırakılmıştır. Böbrek dokuları çıkarılarak Bouin sıvısında tespit edilmiş ve parafin bloklara gömülmüştür. 5 µm kalınlığındaki kesitler hematoxilen ve eozin ile boyanarak ışık mikroskobu ile incelenmiştir. Kontrol örnekleri normal böbrek histolojisi gösterirken maruziyet gruplarında triklosan; hemoraji, dejeneratif renal tübüller, tübül lümeninde tıkanma, nekroz, Bowman boşluğunda daralma ve glomerulusta büzüşmeye sebep olmuştur. Bu sonuçlar, akut triklosan maruziyetinin zebra balıklarının böbrek histolojisini ciddi şekilde etkilediğini ve triklosan kontaminasyonunun sucul organizmaların sağlığı üzerinde olumsuz etkilere yol açabileceğini göstermiştir.

Anahtar Kelimeler: Triklosan, toksisite, *danio rerio*, böbrek, histopatoloji



HISTOPATHOLOGICAL EFFECTS OF TRICLOSAN EXPOSURE ON ZEBRAFISH (*Danio rerio*) KIDNEY TISSUE

ABSTRACT

Triclosan (5-chloro-2-(2,4-dichlorophenoxy) phenol) is a synthetic and nonionic compound used in various personal care, household, industrial, medical, and veterinary products due to its broad-spectrum antimicrobial activity. Widespread use of triclosan led to environmental contamination, and triclosan has been detected in surface water. In this study, triclosan-induced histopathological effects on kidney tissues of zebrafish (*Danio rerio*) were investigated. Adult zebrafish were exposed to sublethal concentrations of triclosan (34 µg/L, 85 µg/L, and 170 µg/L) for 120 hours. Kidney tissues were removed, fixed in Bouin's fluid, and embedded in paraffin blocks. 5 µm-thick sections were stained with hematoxylin and eosin and investigated by light microscopy. Control samples showed normal kidney histology; however, triclosan caused haemorrhage, degenerative renal tubules, occlusion of tubular lumen, necrosis, reduction of Bowman's space, and shrinkage of glomerulus in the exposure groups. These results indicated that acute triclosan exposure severely affected the kidney histology of zebrafish, and triclosan contamination might lead to adverse health effects on aquatic organisms.

Keywords: Triclosan, toxicity, *Danio rerio*, kidney, histopathology



BIOCONTROL OF BACTERIAL PLANT DISEASES BY BACTRIOPHAGE APPLICATION

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ABSTRACT

Global climate warming and dissemination of new epidemic populations of phytopathogenic microorganisms in commercial seed produced in limited areas have led to an increase in the diversity of phytopathogenic bacteria that are affecting major crops. The emergence of new pathogens was well-associated with importation of infected seeds and planting material of different species and varieties of plants. The most important new phytopathogens were found in the genera *Xanthomonas*, *Pseudomonas*, *Pectobacterium*, and *Dickeya*. We consider application of bacteriophages (bacterial viruses) as promising mean of biological control capable to reduce risk of epidemics of new and old genotypes of diverse plant pathogenic bacteria. Using bacteriophages to control pathogenic bacteria is a promising approach in horticulture. However, the application of this strategy in greenhouse or field conditions requires compliance with particular technological and environmental restraints. The process of phages' selection to create a cocktail that is efficient against the circulating causal agents of plant diseases need preliminary knowledge of plant pathogen diversity, phage efficiency under different environmental conditions and frequency of phage-resistance appearance in bacterial population. The resulting phage cocktail must causes a significant reduction of population in a mixture of circulating pathogenic strains. Bacteriophage cocktails were applied to protect seed potatoes before planting, ware potatoes during off-season storage, cabbage seedlings in greenhouse, the protocol of phage application via the humidity maintenance system was designed. Phage cocktail applied in potato storage was shown to reduce the population of *Pectobacterium* spp. by 10-12 times, achieving a population that was below a symptomatic threshold. Bacteriophage PP16 efficiently inhibited development of bacterial infection in field experiment and demonstrated a substantial increase of plant germination and yield after the treatment of seed potato. Bacteriophages specific to *Xanthomonas campestris* pv. *campestris* were more efficient than most of biocontrol agents based on antagonistic microorganisms. Four isolates of bacteriophages specific to *Pseudomonas savastanoi* pv. *glycinea* were obtained from



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soil samples taken from fields with soybean crops. The bacteriophage effect control conducted on soybean plants inoculated by Psg experiments confirmed that 2 treatments of plants by the bacteriophage significantly reduced the disease development. Biological effect of the bacteriophage application was about 75% - at the same level as control bactericide. The use of bacteriophages is a promising strategy for the control of bacterial pathogens in food industry and agriculture. The successful implementation of phage control requires solutions to many problems of the genomics of pathogenic bacteria and their corresponding phages, the molecular biology of their interaction and issues to be resolved in the construction, production, application and regulatory registration of phage preparations or cocktails.

Keywords: Agriculture, plant pathogenic bacteria, bacteriophages, plant disease biological control



ADAPTATION TO CLIMATE CHANGE OF WHEAT BREAD IN CONDITIONS UZBEKISTAN

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ABSTRACT

The main object of the scientific research is in exploration of agrobiologic characteristics of collection specimens of autumn soft wheat, definition of variety ecologic plasticity, mutual influence of outer environment and genotypes, having constant productive level. Serving as source of the research CIMMYT from gene pool of international organization of the 46-th IBWSN (from selected nursery of international soft wheat), 200 samples were used, specimens were planted on the plot with 1m²area in three repetitions by randomization method during three years, yield stability, soil adaptation to climatic conditions and ecologic plasticity were studied. On experiment results of 2016 ($ij=0.4$, 2018 ($ij=0.5$) positive conditions, and in 2017 ($ij=1.0$) negative conditions were observed. Regression coefficient b_i exercises influence on grades and their productivity in changeable environmental conditions. How high coefficient $b_i > 1$, so it can be subjected to environmental conditions, that is ecologic plasticity property can be low, such sorts require high farming practices. If $b_i < 1$ lower, causing less influence as regards to changes in environmental conditions, then it is considered that plasticity properties are high. It can be used low level of farming practices in such grades. In our research works in specimens with catalogue number 1125 and 1251 ecologic plasticity ($b_i > 0.9$) was on high level and close to them indexes were observed in samples with catalogue numbers 1289 (1.0); 1131 (1.0); 1088 (1.0); 1006 (1.0) and 1164 (1.0). However, among specimens relatively the lowest index on relative stability property observed in 1006 (0.21); 1164 (0.73); 1136 (0.46); 1251 (0.50); 1131 (0.71) and 1296 (0.80) specimens. On abovementioned results, the highest index of productivity on years was observed in specimen with catalogue number 1251, sample 1125 was on the next place. It was observed that these samples possessing by high plasticity and stability characteristic from genetic point of view, differ from other specimens by their adaptability to environmental conditions.

Keywords: Wheat, stability, ecologic stability, adaptation, climate change



BOR STRESİ KOŞULLARDA TREHALOZ UYGULAMALARININ BUĞDAYDA MEYDANA GETİRDİĞİ BİYOKİMYASAL DEĞİŞİMLERİN ARAŞTIRILMASI

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ÖZET

İnsanlığın var olduğu günden beri en çok tüketilen besin maddesi olan buğday, günümüzde de bu önemini korumakta olup, gelecek dönemlerde de bu önemini artırarak devam ettirecek bir kültür bitkisidir. Tahıllar içerisinde önemli bir yere sahip olan buğday, dünyanın birçok ülkesinde olduğu gibi ülkemizde de temel besin kaynağı olarak tüketilmektedir. Ülkemizin topraklarında mikro besin elementleri bölgeler arasında ve bitkilerin gelişmeleri sırasında besin elementleri ihtiyaçlarına göre bitkinin türleri içinde geniş farklılık göstermektedir. Diğer taraftan, bu mikro besin elementleri bitkinin ihtiyaçlarından fazla yada eksik bulunması durumunda bitkilerde toksisiteye yada noksanlığa neden olmaktadır. Daha önce yapılan çalışmalarda, Orta Anadolu tarım topraklarının önemli bir kısmında bor noksanlığı ve bor toksisitesi sorunu olduğu belirlenmiştir. Bor, bitkilerin normal olarak gelişebilmesi için mutlak gerekli olan mikro besin elementlerinden birisidir. Tarım yapılan alanlarda bor noksanlığı veya bor toksisitesi, bitki yetiştiriciliğinde sınırlayıcı önemli bir etkidir. Bor noksanlığının giderilmesi için toprakların borlu gübrelere gübrelenebilirken gereğinden fazla bor uygulamalarında bor toksisitesi ortaya çıkabilmektedir. Bor stresi (bor noksan ve toksisitesi) özellikle kurak ve yarı kurak bölgelerin yüksek düzeyde bor ve düşük yağışlı topraklarda yetişen birçok bitki türü için yaygın bir sorun haline gelmektedir. Tarımsal üretimi sınırlandıran abiyotik stres faktörlerinden olan bor stresi diğer abiyotik stres faktörleri kadar önemli olup bitkilerin büyüme ve gelişimini olumsuz yönde etkileyerek ürün veriminde kayıplara neden olmaktadır. Bu nedenle araştırmamızda yaygın olarak tüketilen buğdayın bor stresi koşullarında trehaloz uygulamalarının olumlu etkilerinin yanında bitkinin büyüme ve gelişimi, fizyolojik ve biyokimyasal yanıtlarında meydana getirdiği değişimlerin araştırılması amacıyla yapılmıştır. Ülkemiz tarımında yetiştiriciliği yapılan Karahan 99 genotipine su kültürü koşullarında Kontrol (Yeterli bor), bor noksan (0 mM B) ve bor toksik (1 mM B) koşullarda 100 µM trehaloz uygulanmıştır.

Anahtar Kelimeler: Bor, trehaloz, antioksidan



INVESTIGATION OF BIOCHEMICAL CHANGES CAUSED BY TREHALOSE APPLICATIONS IN WHEAT UNDER BORON STRESS CONDITIONS

ABSTRACT

Wheat, which is the most consumed nutrient since the day of humanity's existence, retains this importance today and is a cultivated plant that will continue to increase this importance in future periods. Wheat, which has an important place in cereals, is consumed as a main source of food in our country, as in many countries of the world. Micronutrients in the territory of our country vary widely between regions and within the types of plants according to the needs of nutrients during the development of plants. On the other hand, these micronutrients cause toxicity or deficiency in plants if they are found to be more or less than the needs of the plant. In previous studies, it was determined that there is a problem of boron deficiency and boron toxicity in a significant part of the agricultural lands of Central Anatolia. Boron is one of the micronutrients that are absolutely necessary for plants to develop normally. Boron deficiency or boron toxicity in agricultural areas is an important limiting factor in plant cultivation. In order to eliminate boron deficiency, soils can be fertilized with boron fertilizers, while boron toxicity can occur in excessive boron applications. Boron stress (boron deficiency and toxicity) is becoming a common problem for many plant species, especially in arid and semi-arid regions where high levels of boron and low rainfall grow in soils. Boron stress, which is one of the abiotic stress factors that limit agricultural production, is as important as other abiotic stress factors and negatively affects the growth and development of plants, causing losses in crop yield. For this reason, our research was conducted to investigate the positive effects of trehalose applications on boron stress conditions of widely consumed wheat, as well as changes in plant growth and development, physiological and biochemical responses. 100 μ M trehalose was applied in water culture conditions Control (sufficient boron), boron deficiency (0 mM b) and boron toxic (1 mM b) conditions to the genotype of Karahan 99, which was cultivated in our country's agriculture.

Keywords: Boron, trehalose, antioxidant



**IDENTIFICATION AND CHARACTERIZATION OF ENDOPHYTIC BACTERIA
ISOLATED FROM GINGER (*Zingiber officinale*) GROWN IN TASHKENT REGION,
UZBEKISTAN**

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ABSTRACT

The present study the endophytic bacteria from rhizome, shoot and leaves of ginger (*Zingiber officinale*) grown in Tashkent region, Uzbekistan were isolated and their plant beneficial properties were characterized. A total of 19 isolates were isolated from rhizome (6), shoot (6) and leaves (7) of ginger. Of all endophytic bacteria was identified by MALDI-TOF. The endophytic bacteria were tested for plant growth promoting traits such as phosphate solubilization, protease, amylase, catalase, lipase, ACC deaminase production as well as inhibition of phytopathogens. Three genus were isolated from ginger (*Zingiber officinale*) grown in Tashkent region, Uzbekistan. They belong to the genera *Bacillus*, *Enterobacter* and *Pseudomonas*. All endophytic bacteria were positive to catalase, ACC deaminase activity and phosphate solubilization. Sixteen endophytic bacteria were able to produce protease enzyme. The maximum production of protease enzyme by *Bacillus cereus* IGPEB 4. Sixteen endophytic bacteria showed salt tolerance up to 10% NaCl concentration. Three endophytic bacteria showed salt tolerance up to 7% NaCl concentrations. The endophytic bacteria showed antifungal activity against selected fungal strains. Eighteen endophytic bacteria did not show antifungal activity fungal strains *F. oxysporum* 316, *F. graminearium* 611 and *F. solani* 528. *Bacillus cereus* IGPEB 6 had antimicrobial activity against fungal strains *F. sporotrichiodes* 404, *F. globosum* 905, *F. oxysporum* 328, *F. culmorum* 903, *F. oxysporum* 316, *F. graminearium* 611, *F. graminearium* 940, *F. solani* 528 and *F. prloliferatum* 516. Results clearly suggest that *Bacillus cereus* IGPEB 6 is a potential plant growth promoting bacteria which could be used as efficient microorganism for improvement of plant growth and suppression of fungal disease.

Key words: Ginger, endophytic bacteria, enzyme, salt tolerant, antifungal activity



ARAZİ TOPLULAŞTIRMA PROJESLERİNDE MÜLAKAT ÇALIŞMALARININ ÖNEMİ: KESİK KÖYÜ ÖRNEĞİ

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ÖZET

Arazi toplulaştırma projeleri kapsamında proje alanında parseli bulunan arazi sahipleri (katılımcı) ile birebir görüşmeler yapılarak mülakat çalışması yürütülmektedir. Mülakat çalışması, proje alanında bulunan parsellerin kullanım durumları, sabit tesis varlığı, parsellerin özellikleri, işletim durumları gibi güncel bilgileri elde etmek amacıyla önem taşımaktadır. Proje alanında bulunan tüm katılımcılarla ayrı ayrı görüşülerek, sahip oldukları parsellere karşılık olarak, her bir parselin yeni konumu için tercihler alınır. Bu tercihler alınırken yeni parsellerin nerede ve nasıl olacağı, parselleri hisseli ise hisse ayrımı veya birleştirmesi isteyip istemediği gibi özel istekleri sorularak, cevapları özenle alınmalıdır. Arazi toplulaştırma kapsamında beklenen tüm istek, düzenlemeler ve kişi düşünceleri, mülakatta belirlendiğinden bu aşama oldukça önemlidir. Katılımcıların ilk isteğinin her zaman yerine getirilmesi olası değildir. Tek istekle dağıtımda blokların dengelenmesi mümkün olmayabilir. Bu nedenle özellikle birden fazla parseli olan katılımcılardan mutlaka 2. ve 3. isteklerin alınması gereklidir. Mülakat çalışmaları, projenin başarısını etkileyen önemli bir aşamadır. Bu nedenle mülakat çalışması, proje mühendisleri tarafından eksiksiz, güncel ve doğru bilgileri yansıtacak şekilde titizlikle uygulanmalıdır. Ancak gerekli özen gösterilmeden uygulanan mülakat çalışması sonucunda katılımcının mülakatta belirttiği özel durumlar göz ardı edilebilmekte, bu ise projelene süresini olumsuz etkilemektedir. Bu çalışmada Kayseri ilinin Yeşilhisar ilçesine bağlı Kesik Köyü'nde gerçekleştirilen arazi toplulaştırma projesi verilerinden yararlanılmıştır. Arazi toplulaştırma öncesi proje alanında parsel sayısı 2136 iken arazi toplulaştırma sonrası bu sayının 1562 parsel düşüğü bulunmuştur. Çalışmada mülakata katılım oranı %88 dir. Ancak katılımcıların %65'i tek tercih yapmıştır. Tercihler sonucunda 137 işletmeye ait 238 parselin tercihlerine dağıtılamadığı görülmüş, söz konusu parsellerin mülakatlari incelenerek nedenleri irdelenmiştir. İncelenen mülakatlardan elde edilen sonuçlar, mülakat çalışmalarının önemini ortaya çıkarmak amacıyla yorumlanmıştır.

Anahtar Kelimeler: Arazi toplulaştırması, istek, katılımcı, mülakat



THE IMPORTANCE OF INTERVIEW ON THE LAND CONSOLIDATION PROJECTS THE CASE STUDY IN KESIK VILLAGE

ABSTRACT

As part of land consolidation projects, one-on-one interviews are conducted with landowners (participants) who have a parcel in the project area. The interview study is important to obtain up-to-date information such as the use cases of parcels in the project area, the presence of fixed facilities, the characteristics of parcels, and the operating conditions. By interviewing all participants in the project area separately, preferences are taken for the new location of each parcel in response to the parcels they have. When receiving these preferences, their answers should be taken with care by asking special requests, such as where and how the new parcels will be, whether they want to divide or merge the parcels if they are shares. This stage is very important, as all the wishes, arrangements, and personal thoughts expected within the scope of land consolidation are determined in the interview. It is unlikely that the first request of participants will always be fulfilled. Balancing blocks in a single-request deployment may not be possible. Therefore, especially from participants with more than one parcel, it is necessary 2nd and 3rd requests must be received. Interview Work is an important stage that affects the success of the project. For this reason, the interview work should be carefully applied by the project engineers to reflect complete, up-to-date, and accurate information. However, as a result of the interview work performed without due care, the special situations indicated by the participant in the interview can be ignored, which negatively affects the duration of the project. In this study, data from the land consolidation project carried out in Kesik village of Yeşilhisar District of Kayseri province were used. It was found that the number of parcels in the project area before land consolidation was 2136, while after land consolidation this number fell to 1562 parcels. The interview participation rate in the study is 88%. However, 65% of those polled had a single choice. As a result of the preferences, 238 parcels belonging to 137 enterprises were not distributed to their preferences, the interviews of these parcels were examined and the reasons were examined. The results of the interviews were interpreted to reveal the importance of the interview studies.

Keywords: Interview, land consolidation, participant, request



DETERMINATION OF Dn GENES OF SOFT WHEAT (*T. aestivum* L) RESISTANT TO RUSSIAN WHEAT APHIDS IN THE CONDITION OF UZBEKISTAN

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ABSTRACT

Grain aphids reduce wheat yield by 30 to 75%. As a result of absorption of plant sap by aphids from the leaves and ears of grain crops, the crops become stunted, and in some cases no ear emergence is observed. DNA was extracted from the wheat genome by the CTAB method. Polymerase chain reaction (PCR) was performed using SSR (simple sequence repeats) markers to identify Dn genes in genome DNA. The PCR products were analyzed by agarose gel electrophoresis of 3.5% Hi-Res and photographed on AlphaImager™ 3400 system. Accordingly, this leads to a sharp decrease in the quantity and quality of the yield. In order to determine the genetic polymorphisms of resistance to grain aphids, among 38 samples of ancient, foreign (CIMMYT) and local wheat varieties of soft wheat grown in Uzbekistan, 9 SSR primers and PCR amplifications were performed, and this article presents an analysis of these PCR results. Resistance to Russian wheat aphids has been identified in 6 of the Dn genes, namely Dn1, Dn2, Dn4, Dn5, Dn6 and Dn8 genes, and the genotypic polymorphism was studied to be 60%. The genes identified during the genotyping of the result of PCR amplification by gel-electrophoresis consisted of the following: Cl2401-(Xbarc214), Dn4-(Xksue18), Dn2-(Xgwm44), Dn2-(Xgwm111), Cl2401-(Xgwm111), Dn6-(Xgwm111), Dn6-(Xgwm111), Dn-(Xgwm44), Dn1-(Xgwm111), Dn2-(Xgwm111), Dn5-(Xgwm111), Dnx-(Xgwm111), Dn8-(Xgwm635), Dn5-(Xgwm44), Dn5-(barc76), DnCl2401-(Xbarc214), Dn1-(Xgwm111) and Dn1-(Xgwm635). For genotyping, 4 of BARC (Xbarc214, Xbarc26, Xbarc172, Xbarc76), 7 GWM (Xgwm106, Xgwm111, Xgwm337, Xgwm44, Xgwm473, Xgwm635, Xgwm642) and 1 KSUE (Xksue18) primer pairs were used, where GWM collection showed the highest polymorphism (60,0 %) among the SSR primers. It can be concluded from the results obtained that when wheat samples were tested with SSR markers in the condition of Uzbekistan, the RWA- resistance were detected in Dn1, Dn2, Dn4, Dn5, Dn6 and Dn8 genes, and 60% polymorphism was observed in genotypes.

Keywords: Wheat (*T. aestivum* L), *Diuraphis noxia*, , variety, marker, resistance



**PHYTOCHEMICAL EVALUATION, CURCUMIN, FLAVONOID AND TOTAL
PROTEINS CONTENTS OF TURMERIC (*Curcuma longa* L.) RHIZOMES GROWN
IN DIFFERENT REGIONS OF UZBEKISTAN**

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ABSTRACT

Turmeric (*Curcuma longa* L.) a documented medicative plant, is used as a foodstuff, cosmetic, and medicine. The objective of this study was to assess the influence of mineral fertilizers on phytochemical evaluation, curcumin, flavonoids and total proteins contents of turmeric (*Curcuma longa* L.) rhizomes grown in different regions of Uzbekistan. The experiment were carried out in randomized block design with three replications a lysimeter experiment at Institute of Genetics and Plant experimental Biology, Kibray district, Tashkent Region and a field experiments at the Surkhandaryo scientific experimental station of the vegetable, melon crops and potato research Institute, Uzbekistan. Experimental treatments included: T1 – Control (without fertilizer), T2 - N₇₅P₅₀K₅₀ kg/ha, T3 - N₁₂₅P₁₀₀K₁₀₀ kg/ha and T4 – N₁₀₀P₇₅K₇₅+B₃Zn₆Fe₆ kg/ha. At harvest, after eight months, phytochemical evaluation, curcumin, flavonoids and total proteins contents of turmeric rhizomes were determined. The results revealed presence of alkaloids, terpenoids, tannins, flavonoids, steroids, carbohydrates, and saponins of methanolic extract of turmeric rhizomes grown in different regions (Tashkent and Surkhandaryo). Chloroform extract shows the presence of 6 phytochemicals such as alkaloids, terpenoids, flavonoids, steroids, carbohydrates and saponins from the rhizomes of turmeric collected both regions Tashkent and Surkhandaryo. However N₁₀₀P₇₅K₇₅+B₃Zn₆Fe₆ kg/ha treatment significantly increased the curcumin, rutin and quercetin contents of turmeric rhizomes grown in Tashkent and Surkhandaryo regions. The maximum the total protein content was recorded in the N₁₂₅P₁₀₀K₁₀₀ kg/ha treatment increase significant the total protein content higher compared to control. It was concluded that the N₁₀₀P₇₅K₇₅+B₃Zn₆Fe₆ kg/ha application rate significantly increased the curcumin and flavonoids contents of turmeric rhizomes grown in Tashkent and Surkhandaryo regions as compare to control.

Keywords: Turmeric, phytochemical analysis, curcumin, flavanoids, total protein



COVID-19 SÜRECİNDE TARIM

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ÖZET

Dünyada ilk olarak, Çin'in Wuhan şehrinde deniz ürünleri ve canlı hayvan satan bir yerel pazarda ortaya çıkan Koronavirüs, ilk başta Çin olmak üzere dünyanın hemen her yerinde yayılma göstermiş ve küresel bir pandemi ilan edilmesine sebep olmuştur. Virüs kaynaklı oluşan hastalıktan dolayı ölen insan sayısının yüzbinleri geçmiş olması ve her geçen gün bu sayının artması ile dünyanın birçok ülkesinde hayat durma noktasına gelmiştir. Hayatın normal akışını etkileyen bu süreç yalnızca kişisel yaşamlarda değil küresel ekonominin gidişatında da tehdit edici boyutlara ulaşmıştır. Her ülkenin kendi içerisinde aldığı tedbirlerin başında gelen sokağa çıkma yasakları ile toplumlar izole bir hayata geçiş yapmışlardır. Bu durum da tüm üretim sektörlerinin üretim zincirlerinde iş yürütme çizgisinin sekteye uğramasına neden olmuştur. Virüs dâhilinde geçen bu süreç, toplumlarda sağlık güvenliğinin daha da ön plana çıkmasına ve bireylerde temel ihtiyaçlarını güvenli şekilde karşılamaya yönelik kaygıların oluşmasına yol açmıştır. Bu kaygıların başında beslenme ve gıda güvencesi gelmektedir. Bu da bizi doğrudan ana beslenme kaynağımız olan tarıma götürmektedir. Tarımsal üretim alanlarının genelinde başta temel gıdaların üretim alanlarından biri olan tarla alanları olmak üzere, hem yıllardır süregelen iklim değişikliğinin getirdiği dezavantajlar hem de son yıllarda halen içinde bulunduğumuz küresel salgının baş göstermesi, tarımsal faaliyetlerin sürdürülmesi açısından zorluklara, üretici tüketici arasında arz talep dengesizliklerine, dolaylı olarak çiftçinin ekonomik zorluklar sebebiyle faaliyetlerine düzenli devam edememesine sebep olmuştur. Bu sürecin tarımsal üretim alanlarının yanında uygulanan mecburi kısıtlamalar sebebiyle tarladan gıdanın sanayisel işlenmesine, tarımsal gıda ticaretinden lojistik alanlarına kadar birbiri ile bağlantılı birçok sektörde zincirleme aksamalara da kaynaklık ettiği görülmektedir. Ancak çok ciddi gibi görünmese de uluslararası lojistik aksamalar, özellikle tarımsal ürünlerin bir çoğunda dışa bağımlı hale gelmiş olan ülkemiz için ciddi sorunlara sebebiyet vermektedir. Çalışmada, içinde bulunduğumuz Covid-19 küresel pandemi sürecinin dünyada ve özellikle de ülkemizde tarım ve tarımsal üretimdeki olası etkileri detaylı şekilde açıklanması amaçlanmıştır.

Anahtar Kelimeler: Covid-19, tarım, tarımsal üretim



AGRICULTURE IN THE COVID-19 PROCESS

ABSTRACT

The coronavirus, which first appeared in a local market in China selling Wuhan broadcast seafood and live animals, spread in the first place in the world, being the first in China, and caused a global pandemic to be declared. Life has come to a standstill in many countries of the world due to the fact that the number of people who died due to the disease caused by the virus has exceeded hundreds of thousands and this number is increasing day by day. This process, which affects of the life, has reached threatening dimensions not only in personal lives but also in the course of the global economy. Societies have been obliged to an isolated life with the curfews, which are the primary measures taken by each country. This situation caused the business execution line to be interrupted in the production chains of all production sectors. This process, which takes place within the virus, has led to the emergence of health safety in societies more and to the emergence of concerns about meeting their basic needs safely. Nutrition and food security are the main concerns. This leads us directly to our main source of nutrition, agriculture. In general in agricultural production areas, especially in the field areas, which are one of the production areas of basic food, both the disadvantages caused by the ongoing climate change and the emergence of the global epidemic in recent years, difficulties in terms of continuing agricultural activities in the production areas, supply and demand imbalances between the producer and consumer, indirectly, it caused the farmers to not continue their activities regularly due to economic difficulties. In this process, it is seen that it is the source of chain disruptions not only in agricultural production areas, but also in many interconnected sectors, from the field to industrial processing of food, from agricultural food trade to logistics areas, due to the global pandemic process and the mandatory restrictions applied in this process. Although it does not seem serious in this process, international logistics disruptions cause serious problems especially for our country, which has become foreign-dependent in many of its agricultural products. The aim of the study, the possible effects of the Covid-19 global pandemic process on agriculture and agricultural production in the world and especially in our country will be explained in detail.

Keywords: Covid-19, agriculture, agricultural production



INCLUSION OF SUSTAINABLE PROGRESS STEM IN EDUCATION FOR RENEWABLE ENERGY INTO NIGERIA'S SECONDARY SCHOOL CURRICULUM

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ABSTRACT

This study investigated teachers' view on the progress in education for renewable energy resources. It is a quantitative study that employed a survey research design for the smooth achievement of the set objective. More emphasis was laid on renewable energy resources due to the reoccurring issues of power dropping in Nigeria. An online survey was shared with the science teachers in the metropolis of Sokoto in which 104 were retrieved and hence used for analysis. The result indicated that Nigeria surely is experiencing serious problems of continuous interrupted electric power supply. Furthermore, the finding of the study indicated that a country shall not rely solely on a single source of power supply. Interestingly, the respondents believed that renewable resources should be taught in the integrated STEM education rather than a topic/concept in the curriculum. It concludes that Nigeria's secondary school students have the ability to learning the various form of renewable energy resources from the expert.

Keywords: Renewable resources, renewable energy resources, curriculum, STEM education, students



**CHARACTERIZATION, ANTIBACTERIAL AND DYE DEGRADING ACTIVITY
OF SILVER NANOPARTICLE SYNTHESIZED FROM METHANOLIC LEAF
EXTRACT OF *AYAPANA TRIPLINERVIS***

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ABSTRACT

Over the last decades, silver has been engineered into nanoparticles that attracted much attention and found applications in diverse areas. The small size of the nanoparticles has maximized the total surface area that leads to increased activity to weight ratio. The aim of the present study is to synthesize silver nanoparticles (AgNPs) from methanolic leaf extract of *Ayapana triplinervis* Vahl. and assess their antibacterial and dye degrading properties. The AgNPs produced were characterized by using UV-Vis spectroscopy, FTIR, TEM and SEM. The antibacterial activity and dye degrading property of these nanoparticles was also analysed. UV-Vis spectroscopy of prepared silver colloidal solution showed an absorption maximum at 410 nm. The FTIR analysis confirmed the presence of different functional groups which were responsible in the reduction and stabilization of silver ions. The SEM analysis revealed that AgNPs are clustered and exhibited both cubical and spherical shape. TEM analysis helped to investigate the effect of capping agent and precursor concentration on the size and shape of the nanoparticles. The nanoparticles synthesized also exhibited antibacterial activity against *Staphylococcus aureus* and *Salmonella sp.* Catalytic degradation of dyes by these silver nanoparticles in the presence of sunlight was in the order Methyl Red (MR) > Eosin > Methylene Blue (MB). For a healthy environment, it is advocated to promote green technology and hence the adoption of synthesis of nanoparticles from plant extracts gains much significance. In collaboration with plant metabolites having good antioxidant content these nanoparticles can be used as a successful alternative for synthetic drugs in order to combat the issue of multi-drug resistance. Photocatalytic degradation of Methylene blue dye was also exhibited by these nanoparticles which assumes significance to overcome the problem of environmental pollution due to highly stable organic dyes from industrial effluents.

Keywords: Silver nanoparticles, *Ayapana triplinervis*, antibacterial activity, catalytic degradation



EFFECT OF CROPPING PRACTICES (NO-TILL, MINIMUM TILL, CHISEL PLOUGH AND DEEP PLOUGH) ON AGRONOMIC PARAMETERS ON THE PRODUCTION OF BREAD WHEAT (*Triticum aestivum*)

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ABSTARCT

Morocco is severely affected by climate variability; the projections suggest that by 2050 aridification undergoes a further increase in temperature and a decrease in rainfall. Consequently, the future of agriculture and correspondingly that of the national economy could be compromised. Also, the fragility of its ecosystem causing erosion and chronic water deficit, is influencing the productivity of cropping systems. This difficult and random situation, is aggravated by conventional agricultural practices that lead to a deterioration of soil quality, fertility, structure and soil organic matter due to the soil disturbance which has potential negative consequences for yield. The no-till presents several advantages in agronomic, environmental and socio-economic terms. It is an important approach to address declining soil fertility and the adverse effects of climate change. Nonetheless, the aim of this work was the comparison and evaluation of the impact of four cultivation techniques (no-till, minimum till, chisel plough and deep plough) on production of bread wheat. In this context, a field experiments was conducted at the experimental station of Douyet of the National Institute of Agronomic Research of Meknes, Morocco during 2019-2020 cropping season. The experiment design was a Split-plot with three replications. Crop was attributed to the main plots. While, the tillage sequences were assigned to the sub-plots. The results showed that the conventional tillage registered the highest yield for bread wheat compared with other cultural practices (chisel plough, minimum till and no-till) which had shown a similar yield.

Keywords: No-till, Tillage system, *Triticum aestivum*



ROLE OF REPATRIATED MIGRANTS IN STRENGTHENING SUPPLY CHAIN OF AGRICULTURAL PRODUCE OF RURAL ODISHA

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ABSTRACT

Agricultural produce does not get the apt recognition so far as the pricing and match between the supply and demand forces of it is concerned. In fact, the supply chain of the agricultural produces in India, particularly in the state of Odisha, is very weak. Supply chain of agricultural produces, i.e., the flow of agricultural produces from the farmers to the end-users, i.e., consumers, is not smooth one for which the farmers receive a very less price whereas the consumers pay exorbitant prices for the agricultural produces. Sometimes, the farmers fail to sell their produces owing to unavailability of buyers, particularly for perishable produces during harvesting season. It happens for two things; 1) because the supply chain of agricultural produces is not scientific, and 2) because the farmers don't have enough man-hour during harvesting season to sell their produces directly to the consumers in the local markets. However, insertion of some productive manpower in the existing supply chain of the agricultural produces may solve the purpose. Current pandemic owing to Covid-19 has caused inflow of out-migrant people to their native places, i.e., repatriated migrants or returnee migrants. Since those returnee migrants are having the threat of life in migrated place for the on-going pandemic, their inclusion in the supply chain of agricultural produces may solve the problems of pricing and mismatch of demand and supply forces of agricultural produces. On this backdrop, this paper is to design a framework to make use of the repatriated migrants in upgrading the supply chain of the agricultural produces. The methodology adopted for this paper is content analysis from the existing literature and secondary data.

Keywords: Repatriated migrants, supply chain, agricultural produce, pricing, rural, odisha



***Frankliniella occidentalis* (THYSANOPTERA: THIRIPIDAE)'İN BİYOLOJİK
SAVAŞINDA *Typhlodromus recki* (ACARI: PHYTOSEIIDAE)'NİN PREDATÖRLÜK
POTANSİYELİ**

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ÖZET

Batı çiçek thrips, *Frankliniella occidentalis* (Thysanoptera: Thripidae), sebze ve süs bitkilerinde en yaygın olarak bulunan bir zararlıdır. Yaprak, çiçek ve tomurcuklarla doğrudan beslenerek zarar verir, ayrıca birçok önemli bitki virüsünü de indirect olarak taşırlar. Ergin dişiler yaprakların içine yumurta bırakır ve yumurtadan çıkan genç larvalar yapraklar üzerinde beslenirler. Son dönem larvalar toprakta pupa olurlar. Yaşam döngülerinin kısa olması ve yüksek üreme potansiyelleri nedeniyle insektisitlere karşı çok fazla direnç geliştirme yetenekleri vardır. Bu nedenle kimyasal savaşı oldukça zordur. Predatör akarları içeren Phytoseiidae (Acari: Mesostigmata) familyası biyolojik savaşta kullanılmaktadır. Predatör akarlardan bazıları kitle halinde üretilerek ticari olarak dünyada satışı yapılmaktadır. *Typhlodromus recki* Wainstein (Acari: Phytoseiidae) Türkiye, Fransa, Yunanistan, İtalya ve İspanya gibi diğer Akdeniz ülkelerinde sebzelerde saptanan en yaygın predatör akarlardan biridir. Bu tür genel predatör Type III beslenme tipine sahip olup, *F. occidentalis*'inde içinde olduğu çok geniş bir beslenme yelpazesine sahiptir. Bu çalışmada *T. recki*'nin laboratuvar koşullarında *F. occidentalis* ki beslenme ve üreme potansiyeli saptanmıştır. Deneme alanı Munger tipi hücrelerden oluşturulmuştur. Bu hücreler 60 × 45 mm boyutlarında ve 2 mm kalınlığında pleksiglas levhalar, filter kağıdı, fasulye yaprağı, 60 × 45 mm boyutlarında 5 cm yüksekliğinde ve ortasında 23 mm çapında açık alan bulunan bir başka pleksiglas levha, üzerinde havalandırmayı sağlamak için şeffaf delikli plastikten oluşmaktadır. Deneme alanlarını birbirine tutturmak için 2 adet kısıkaç kullanılmıştır. Dört farklı besin yoğunluğunda (2, 4, 8, 16), birinci dönem thrips larvalarıyla beslenmesi için, 10 günlük çiftleşmiş dişi predatör akar verilerek 24 saat hücrelerde bırakılmıştır. Deneme öncesinde predatör akar Eppendorf tüplerinde 16 saat aç bırakılmıştır. Her bir av yoğunluğu 20 tekerrürlü olarak yürütülmüştür. Sonuçlara göre, *T. recki* tarafından tüketilen besin farklı av yoğunluklarında (2, 4, 8, 16) sırasıyla 1.36±0.19, 1.31±0.21, 1.57±0.28 ve 1.36±0.26 olarak saptanmıştır. Aynı av yoğunluklarında günlük ortalama yumurta sayıları 0.90±0.17, 0.50±0.13, 0.50±0.13 ve 0.90±0.1 olarak saptanmıştır. Besin tüketimi ve bırakılan yumurta sayısında farklı av yoğunluklarında istatistiksel olarak fark bulunmamıştır. Sonuç olarak yerli ırk olan *T. recki*'nin *F. occidentalis*'in biyolojik savaşında kullanılabilmesi için daha ayrıntılı çalışmalar gerekmektedir.

Anahtar Kelimeler: Predatör akar, Phytoseiidae, biyolojik savaş, besin tüketimi, üreme potansiyeli



**PREDATION POTENTIAL OF *Typhlodromus recki* (ACARI: PHYTOSEIIDAE) IN
BIOLOGICAL CONTROL OF *Frankliniella occidentalis* (THYSANOPTERA:
THRIPIDAE)**

ABSTRACT

Western flower thrips, *Frankliniella occidentalis* (Thysanoptera: Thripidae) is one of the most common polyphagous pests associated with vegetable and ornamental crops. It damages crops by direct feeding on leaves, flowers, buds also indirectly by transmitting several important plant viruses. Adult females lay eggs inside the leaves, and emerging young larvae feed on the leaf, old larvae and pupae stages occur in soil. Due to a short lifecycle and a high reproductive potential, it has a great ability to develop resistance to insecticides. Therefore, its chemical control has become challenging. The predatory mites belong to the family Phytoseiidae (Acari: Mesostigmata) have been used in the biological control systems, and some of them are mass-produced and available in commercial markets worldwide. *Typhlodromus recki* Wainstein (Acari: Phytoseiidae) is one of the most common predatory mites detected in vegetables in Turkey, and in other Mediterranean countries such as France, Greece, Italy and Spain. It is considered to be a Type III generalist predator feeding on a wide range of food sources including *F. occidentalis*. In this study, the feeding and reproductive potentials of *T. recki* on WFT was determined under laboratory conditions. The experimental arenas consisted of modified Munger cells constructed with a stack of transparent acrylic slides (60 × 45 mm), filter paper, bean leaf discs transparent acrylic slides (60 × 45 mm) with a hole (25 mm in diameter) in the center covered with a transparent plastic sheet with small perforations to allow for ventilation. Two binder clips were used to hold experimental arenas from both sides. Four different densities (2, 4, 8, 16) of the first instar larvae of WFT were separately offered to a gravid female (10 days old) of the predatory mite for 24 hours. Prior to the experiments, predatory mites were starved for 16 hours in Eppendorf tubes. Each prey densities was repeated 20 times with different predatory mite individuals. According to the results, the prey consumed by *T. recki* was 1.36 ± 0.19 , 1.31 ± 0.21 , 1.57 ± 0.28 , and 1.36 ± 0.26 , at 2, 4, 8, and 16 densities of *F. occidentalis*, respectively. In addition, fecundity was estimated to be 0.90 ± 0.17 , 0.50 ± 0.13 , 0.50 ± 0.13 , and 0.90 ± 0.12 at the same prey densities given above, respectively. There was no significant differences food consumption and fecundity between prey densities. In conclusion, further studies are essential in order to obtain detailed knowledge with regard to the using possibility of this Turkish strain of *T. recki* in biological control of *F. occidentalis*.

Keywords: Predatory mite, Phytoseiidae, biological control, food consumption, reproductive potential



FORMATION OF ECOLOGICAL EDUCATION AND ECOLOGICAL CULTURE AMONG STUDENTS OF THE AGRICULTURAL AREA

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ABSTRACT

Nowadays, it is very important that any country in its progressive development and improvement of the well-being of the population follows three basic principles: economic growth, social protection and environmental security. In this regard, since the first years of independence, our country has been implementing a strong, far-sighted policy, the achievements of which are now recognized not only by Kazakhstanis, but also by developed countries of the world and international organizations. The beginning of the third millennium can be characterized by two important trends. First, people have encountered such global environmental problems as climate change, the destruction of the ozone layer, the pollution of drinking water, the degradation of forests and soil, the reduction of biodiversity, and the decontamination of waste. Secondly, the world is changing at such a rapid pace that some of yesterday's criteria do not fit today's criteria at all. Over time, environmental concerns have expanded. A person is a part of nature, life is connected with the continuous activity of natural systems that are a source of energy and food, a person can change nature by his actions, use its resources, so he must fully understand the need to maintain balance and quality in nature, to preserve natural resources. The main task of ecological consciousness and ecological culture is to achieve effective use of natural resources on the basis of the principles of legal civil society by increasing the ecological culture of our people, together with the state control in the field of nature protection, to strengthen the environmental control of the public, to comprehensively increase in the ecological consciousness and culture of the people all-round concern for nature, to show the importance of environmental protection, environmental protection measures in providing future generations with the necessary conditions for life. Currently, various events are held in Kazakhstan under the mottos "Healthy environment — human health", "Clean nature - for a healthy future", "Formation of ecological consciousness and ecological culture", "Clean water-the key to the future" and optional courses on ecology are conducted at the school. Ecological consciousness is aimed at the environment and the human being, reflects the main patterns of interaction between the biosphere and nature. Humanity has realized the possibility of catastrophic consequences and is striving to radically change the approach to the surrounding world and solve environmental problems. Our country has also taken great steps in this area. On July 15, 1997, the Law " On Environmental Protection "was adopted. In this law, in order to form a reasonable attitude to nature among the population, especially among the younger generation, to educate them in a thrifty attitude to natural resources, to increase environmental



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19-20 June, Izmir-TURKEY**



awareness and environmental culture, all educational institutions have introduced a course on ecology. Now it is no secret that human intervention in natural processes can lead the environment to a deplorable state, which is difficult to restore even through science and technological progress. Therefore, a person must master the knowledge that makes it possible to use natural resources carefully, to preserve all types of ecosystems. Mastering this knowledge, applying it in practice in everyday life, and realizing your responsibility for the cleanliness and safety of the environment is the foundation of ecological culture. In a society in which an ecological culture is formed, everyone treats nature reasonably, thriftily and with responsibility. Thus, the development of environmental education and upbringing, the involvement of the public in the search for solutions to environmental problems are considered the most important task of our time.

Keywords: Environmental education, environmental culture, environmental protection, nature protection, Environmental movement of Kazakhstan, agriculture



UNRAVELING EARLY DEFENCE RESPONSE OF OIL PALM AGAINST THE HEMIBIOTROPHIC FUNGAL PATHOGEN, *Ganoderma boninense* TOWARDS DEVELOPMENT OF EFFECTIVE CONTROL MEASURES

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ABSTRACT

Hemibiotrophic fungal pathogens strategically switch from the biotrophic mode of infection for host colonization to the aggressive necrotrophic mode to overcome the host defense system. However, knowledge on the corresponding transcriptional switching of the host defense mechanism essential for developing effective control measures is lacking. We employed transcriptomic approach to unravel early defense response of oil palm (*Elaeis guineensis*) against the devastating hemibiotrophic fungal pathogen, *Ganoderma boninense* that causes major economic loss to both big plantations and smallholdings. Oil palm seedlings were artificially inoculated with *G. boninense* and destructive sampling of root samples performed at 3, 7, and 11 days-post-inoculation (d.p.i) for RNA sequencing to identify differentially expressed genes. Potential transcription factors involved in transcriptional switching were analysed for their interaction with promoter motif in co-expressing genes using yeast 1-hybrid and electrophoretic mobility shift assay. Differentially expressed genes involved in multifaceted defense response including four established defense-related pathways responsible for cell wall modification, reactive oxygen species (ROS)-mediated signaling, programmed cell death (PCD) and plant innate immunity helped to deduce early biotrophic (3 and 7 d.p.i.) and later stage necrotrophic phase (11 d.p.i.) defense responses. Suppression of auxin signalling and iron uptake genes was observed, which most likely compromised growth and nutrient distribution. Early upregulation of *JUNGBRUNNEN 1* (*EgJUB1*) transcription factor (TF) may suggest its role in regulating fungal biotrophic phase while *Ethylene Responsive Factor 113* (*EgERF113*) TF demonstrated prominent upregulation when the palm switches to defense against necrotrophic phase. *EgJUB1* binds to a 19 bp palindromic SNBE1 element, WNNYBTNNNNNNNNAMGNHW found in the promoter region of co-expressing *EgHSFC-2b*. Identification of these phase-specific oil palm TFs is important in designing strategies to delay the progress of infection. The potential use of the findings in the development of early detection strategy in the field for effective control of the disease will be discussed.

Keywords: Oil palm, *Ganoderma boninense*, hemibiotroph, transcription factors, defense responsive genes



**ERMENEK (KARAMAN) İLÇESİ ZEYTİN BAHÇELERİNDE ZEYTİN SİNEĞİ
[*Bactrocera oleae* (Gmel.) (DIPTERA: TEPHRITIDAE)]'NİN ERGİN POPÜLASYON
GELİŞİMİ VE BULAŞIKLIK ORANININ BELİRLENMESİ**

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ÖZET

Bu çalışma, Ermenek (Karaman) ilçesinde bulunan Karagedik, Köyiçi ve Sekil lokasyonlarında ki zeytin bahçelerinde zarar yapan Zeytin Sineği (*Bactrocera oleae*)'nin ergin popülasyon gelişimi ve bulaşıklık oranının belirlenmesi amacıyla 2017-2018 yıllarında yürütülmüştür. Çalışmada zararlı popülasyonlarının belirlenmesi amacıyla McPhail tuzakları kullanılmıştır. Tuzakların içerisine, sineklerin cezbedilmesi için kuru maya ilave edilmiştir. Bu sayede ilk ergin çıkışları, erginlerin popülasyon gelişimi ve zeytinlerdeki bulaşıklık oranlarının belirlenmesi amaçlanmıştır. Tuzaklar her bahçede üçer adet olacak şekilde, bahçeleri temsil ederek, belirli aralıklarda ve ağaçların yaklaşık olarak 1.5 m yüksekine gelecek şekilde, Haziran ayının son haftasında asılmıştır. Tuzaklar haftada bir kez kontrol edilip yakalanan zeytin sineklerinin sayısı kaydedilmiştir. Asılan tuzaklardaki yemler her hafta yenisi ile değiştirilmiştir. Zararlının meydana getirdiği bulaşıklık oranının tespiti için bahçelerden rastgele seçilen 10'ar adet zeytin ağacının dört tarafından 25 adet olmak üzere her bahçeden toplam 1000 adet zeytin alınıp vuruk yüzde oranı hesaplanmıştır. Çalışma sonucunda McPhail tuzaklarından çıkan sonuçlara göre ilk erginler her iki yılda da Temmuz ayının ilk haftasında görünmeye başlamıştır. Zeytin sineği Karagedik'te bir kez, Köyiçi'nde üç kez ve Sekil'de ise iki kez tepe noktası oluşturmuştur. Zararlının Ermenek ilçesinde iklim ve yıllara göre 1-3 döl verdiği tespit edilmiştir. Zararlının Kasım ayı sonuna kadar yaklaşık beş ay süreyle bahçelerde aktif olarak bulunduğu gözlenmiştir. Bu çalışma Ermenek ilçesinde zeytin sineği ile alakalı yapılan ilk çalışma olma özelliğini de taşımaktadır. Zeytin sineğinin Ermenek'te ki zeytinlerde zarar oluşturmaya başladığı ve erken uyarı ve mücadele için McPhail besi tuzaklarının kullanılabilmesi ve üreticilerin tuzakları en geç Haziran ayı sonuna kadar ağaçlara asmaları tavsiye edilmektedir. Böylelikle tuzaklar, zararlının gerekli ise kimyasal mücadele zamanına karar vermede de katkı sağlayacaktır.

Anahtar Kelimeler: Bulaşıklık oranı, mcphail tuzağı, popülasyon gelişimi, zeytin, zeytin sineği



**DETERMINATION OF ADULT POPULATION DEVELOPMENT AND
INFESTATION RATES OF OLIVE FLY [*Bactrocera oleae* (Gmel.) (DIPTERA:
TEPHRITIDAE)] in OLIVE ORCHARDS in ERMENEK (KARAMAN)**

ABSTRACT

This study was carried out to determine the adult population development and infestation rate of Olive Fly (*Bactrocera oleae*), which causes damage in olive orchards of Karagedik, Köyiçi and Sekil locations in Ermenek (Karaman) between years of 2017-2018. In the study, McPhail traps were used to determine the pest population development. Dry yeast was added to the traps to attract flies. Thus, it was aimed to determine the first adult emergence, population development of adults and the infestation rates at the olives. The traps were hung in the last week of June, three of them in each garden, as representing of them, at certain intervals and approximately 1.5 m above the trees. The traps were checked once a week and the number of olive flies which were caught was recorded. The baits in the traps were replaced with new ones every week. In order to determine the infestation rate caused by the pest, a total of 1000 olives were taken from each orchard, 25 olives from all four sides of 10 olive trees randomly selected from the orchards and the hit rate was calculated. As a result of the study, according to the results of McPhail traps, the first adults started to appear in the first week of July in both years. The olive fly peaked once in Karagedik, three times in Köyiçi and twice in Sekil. It was determined that the pest gave 1-3 generations by fact that the climate and years in Ermenek. It was observed that the pest was actively present in the gardens for about five months until the end of November. This study is also the first study on olive fly in Ermenek. It is recommended that the olive fly starts to damage the olives in Ermenek and McPhail bait traps can be used for early warning and control, and producers are advised to hang the traps on the trees by the end of June at the latest. Thus, the traps will also contribute to the decision of the pest chemical control time, if necessary.

Keywords: Infestation rate, mcphail trap, population development, olive, olive fly



YÜZEY TOPRAĞINDA AYRIŞMA ORANLARININ pXRF KULLANILARAK BELİRLENMESİ

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ÖZET

Bu araştırmanın amacı alüvyal arazi üzerinde ağırlıklı olarak buğday yetiştiriciliği yapılan 10 ha alanda toprakların bazı ayrışma oranlarının değişim aralıklarının ve konumsal dağılımlarının belirlenmesidir. Araştırma Eskişehir Osmangazi Üniversitesi Ziraat Fakültesi Araştırma çiftliğinin 10 ha ile sınırlı alanında gerçekleştirilmiştir. Sistemik grid örnekleme modeli ile (35 m * 35 m) 0-30 cm derinlikten toplam 81 adet toprak örneği alınmıştır. Toprak örnekleri laboratuvar koşullarında hava kurusu hale getirildikten sonra 2 mm elekten elenerek element konsantrasyonlarının ölçümleri için hazır hale getirilmiştir. Portatif X-Ray floresens (pXRF) kullanılarak toprak örneklerinde Si, Al, Ti, Fe, Ca ve Zr gibi element konsantrasyonları belirlenmiştir. Element konsantrasyonlarına bağlı olarak Ruxton oranı (SiO_2/Al_2O_3), Ti/Zr oranı, seski-oksit oranı (Si/Al+Fe) ve Ca/Ti oranı (CaO/TiO_2) hesaplanmıştır. Araştırma alanı içerisindeki toprakların ayrışma oranlarının konumsal dağılım haritaları Ordinary Kriging interpolasyon metodu ile üretilmiştir. Araştırma alanındaki toprakların element konsantrasyonları; Si % 20.3-25.5, Al % 5.9-7.0, Ti % 0.3-0.6, Fe % 5.4-12.8, Ca % 3.0-7.1 ve Zr % 0.01-0.05 arasında değişim gösterdiği tespit edilmiştir. Araştırma alanındaki toprakların ayrışma oranları; Ruxton oranı 3.5-4.3, Ti/Zr oranı 6.4-36.5, seski-oksit oranı 1.1-2.0 ve Ca/Ti oranı 4.4-22.9 arasında değiştiği tespit edilmiştir. Araştırma alanında en yüksek değişim katsayısı (CV=44.59) Ti/Zr oranında elde edilirken, en düşük değişim katsayısı (CV=3.79) Ruxton oranında tespit edilmiştir. Özellikle araştırma alanının güney batı gölgesinde yayılım gösteren toprakların diğer bölgelere göre daha fazla ayrışma gösterdiği tespit edilirken, kuzey doğu gölgesinde yayılım gösteren toprakların diğer bölgelere göre daha az ayrışma gösterdiği tespit edilmiştir. Araştırma sonucunda, alüvyal arazide toprak ayrışma oranlarının kısa mesafelerde dahi önemli ölçüde değiştiği sonucuna varıldı.

Anahtar Kelimeler: Eskişehir, alüvyal arazi, toprak weathering, jeoistatistik



DETERMINATION OF WEATHERING RATE OF SURFACE SOIL USING pXRF

ABSTRACT

The aim of this research was to determine the changing intervals and spatial distributions of some weathering rates of soils in a 10 ha area where was mainly cultivated wheat on alluvial land. The research was carried out in the 10 ha area of Eskişehir Osmangazi University Faculty of Agriculture Research farm. A total of 81 soil samples were taken from 0-30 cm depth with the systematic grid sampling model (35 m * 35 m). After the soil samples were air-dried under laboratory conditions, they were sieved through a 2 mm sieve and made ready for the measurement of element concentrations. Elemental concentrations such as Si, Al, Ti, Fe, Ca, and Zr were determined using portable X-Ray fluorescence. Ruxton rate ($\text{SiO}_2/\text{Al}_2\text{O}_3$), Ti/Zr rate, sesqui-oksit rate ($\text{Si}/\text{Al}+\text{Fe}$), and Ca/Ti rate (CaO/TiO_2) were calculated based on elemental concentrations of pXRF. The spatial distributions maps of the weathering rates were produced by the Ordinary Kriging interpolation method. Elemental concentrations of soils in the research area were determined as Si 20.3-25.5 %, Al 5.9-7.0 %, Ti 0.3-0.6 %, Fe 5.4-12.8 %, Ca 3.0-7.1 %, and Zr 0.01-0.05 %. Weathering rates of soils in the research area were determined as Ruxton ratio varied from 3.5 to 4.3, Ti/Zr ratio 6.4 to 36.5, sesqui-oxide ratio between 1.1 to 2.0 and Ca/Ti ratio between 4.4 to 22.9. In the study area, the highest coefficient of variation ($\text{CV}=44.59$) was found in Ti/Zr ratio, while the lowest coefficient of variation ($\text{CV}=3.79$) was found in Ruxton ratio. It was determined that the soils that spread especially in the south-west regions of the research area showed more weathering rate than other regions, while it was determined that the soils that spread in the north-east regions showed less weathering rate than other regions. As a result of the research, it is concluded that the soil weathering rates in alluvial land changed significantly even at short distances.

Keywords: Eskişehir, alluvial land, soil weathering, geostatistics



EFFECT OF PESTICIDES ON SOIL BIOCEANOSIS

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ABSTRACT

Soil is the most important component of the Earth's ecosystem, as it is an indispensable source of agricultural products and raw materials used in industry. However, at present, the soil is often polluted by a large group of chemicals, primarily pesticides, which leads to a change in the biocenosis of the soil cover. The paper presents the results of the analysis of the physical and chemical properties of the soil taken from the land plot subjected to excessive treatment with insecticides "Aktara" and "Tabu" in 2020. It was found that the studied soil samples correspond to the indicators of sandy soils, that is, the soil fertility is significantly low. The percentage of heavy metals in the soil was revealed. The predominant pollutant is copper ions. All the above results were compared with the data obtained from the research work of previous years.

Keywords: pesticides, land plot, physical and chemical parameters, heavy metals



CHEMICAL CONSTITUENTS OF ESSENTIAL OIL AND WATER EXTRACT of *Mentha longifolia* (L.) Huds. GROWING IN TURKEY

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ABSTRACT

Herbs and spices have been used to enhance the flavour and organoleptic properties since ancient times. In addition to this, many natural compounds in terms of phytochemicals extracted from various plants have nutraceutical properties that are getting popular day by day. There is an increase in usage of the herbs and spices due to their health protective characteristic against the increase of the disease and health concerns. *Mentha longifolia* L. Hudson (horsemint) belongs to the *Lamiaceae* family in the genus *Mentha* with an extensive distribution in Mediterranean region, Europe and eastwards into Asia. *Lamiaceae* family contains a large quantity of phenolic acids, flavonoids and essential oil. The essential oil or extracts have been reported as antimicrobial, antioxidant, anti-inflammatory, antiemetic, antiasthmatic, carminative, digestive, anticatarrhal activities and stimulants. Moreover, they have been used as a folk medicine for treatment of bronchitis, flatulence, and liver ailments. Leaves, flowers and stems of *Mentha* spp. and its essential oil are used as a flavouring in salads, cooked foods, especially in sweets, perfumes and pharmaceuticals. The aim of this study was to investigate the composition of *Mentha longifolia* (L.) Huds. essential oil and hot water extract from Tekirdağ (Turkey). The chemical profile of essential oil and water extract was evaluated by the gas chromatography-mass spectrometry. Chemical composition of the essential oil is quite variable depending on the habitat and climate. Thirty-two and thirty-one constituents were identified in the essential oil and extract, respectively. The main constituents of the essential oil and water extract of *M. longifolia* were oxygenated monoterpene, piperitone oxide with an amount of 57.99% and 68.29%, respectively. Other main components of hydro distilled essential oil contains cis-11-eicocenamamide (20.64%), linalool L (4.12%), trans-caryophyllene (3.38%), 1,8-cineole (2.38%) and germacrene-D (1.79 %). Besides piperitone oxide, there were common components of essential oil and water extract of *Mentha* such as linalool L, (+)-alpha-terpineol, geraniol and bicyclogermacrene. The other main constituents of water extract were eucalyptol (8.99 %), linalool L (5.89 %), (+)-alpha-terpineol (3.22%) and geraniol (1.66%). Linalool, which is used for sedative, immune potentiating effects, is commonly found as a major component of essential oils of various aromatic spices. Piperitone oxide, carvone and linalool are reported as being responsible for antimicrobial activity of essential oils. In conclusion, the compounds of both extracts consisted of monoterpene hydrocarbons such as limonene; oxygenated monoterpenes such as borneol, 1,8-cineole (eucalyptol), cis-jasmone; sesquiterpene hydrocarbons such as germacrene-D; oxygenated sesquiterpenes such as caryophyllene oxide.

Keywords: *Mentha longifolia* (L.) Hudson; horsemint; essential oil; chemical composition



THE IMPACT OF SOIL COMMUNITIES ON BIODIVERSITY IN NORTH OF IRAN

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ABSTRACT

Soil communities play an important role in maintaining ecosystem services and biodiversity. Earthworms have significant effect on vegetation in Rangeland. Furthermore, the relationship between earthworms and biodiversity is important in ecological researches. Therefore, the effects of earthworm on biodiversity and various indices of diversity and richness in three different of vegetative types on enclosure and grazing sites of biosphere reserve of Miankaleh Mazandaran is investigated in this work. Each vegetative types was placed on three transects of 100 meters, 10 plots at a distance of 30 meters. Earthworm and soil were sampled from the center of each plot of 25 cm × 25 cm. The Simpson and Shannon-Wiener indexes and Margalef and Menhinick richness indices were used to evaluate diversity and richness of species at different grazing intensities. PAST software was used to evaluate diversity and enrichment indices statistically. There is a significant relationship between the number of species index in enclosure and grazed sites at the level of 1% ($P \leq 0.01$). There is also a significant relationship at the lengths of the earthworm in the shrub type in both enclosure and grazed sites. According to the stepwise regression, the role of the earthworm length (0.84) to predict the number of species index is greater than the wet biomass index (0.54) in the shrub type and the enclosure site. Consequently, the highest length, median diameter, wet and dry biomass of earthworm is observed in the shrub type and the enclosure site.

Keywords: Soil communities, biodiversity, grazing, shannon-wiener index



İNDÜKTİF EŞLEŞMİŞ PLAZMA-KÜTLE SPEKTROMETRESİ İLE *Hypericum triquetrifolium* TÜRÜNÜN ELEMENTEL ANALİZİ

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ÖZET

Bitkisel bir ilacın saflığı, güvenli kullanımıyla yakından bağlantılıdır bu nedenle civa, kurşun, bakır, kadmiyum ve arsenik gibi ağır metallerin kontaminasyonu, kullanıcının sağlığı için klinik olarak önemli tehlikeler oluşturabilir ve bu nedenle sınırlandırılmalıdır. Bu çalışmanın amacı *Hypericum triquetrifolium* türünün topraküstü kısmındaki metaller; kurşun(Pb), civa(Hg), arsenik(As), selenyum(Se) ve yarı metaller; alüminyum (Al), kadmiyum (Cd) bakır (Cu), demir (Fe), nikel (Ni), çinko (Zn), kobalt (Co), kalsiyum (Ca), potasyum(K) içeriklerinin tespiti ve miktar tayininin gerçekleştirilmesidir. Adana-Tarsus bölgesinden toplanan bir *H. triquetrifolium* örneği indüktif eşleşmiş plazma-kütle spektrometresi (ICP-MS) yöntemi ile incelenmiştir. Bitki numunesinin analize hazır hale getirilmesi aşamasında mikrodalga yakma yöntemi ile 3 eşit miktar toz edilmiş numune çözünür hale getirilmiştir. Yanma işlemi üç kez gerçekleştirildikten sonra, elde edilen numune birleştirilmiş, uygun seyreltmenin ardından Perkin Elmer NexIon 2000P cihazı kullanılarak Helyum KED (Kinetik Enerji Ayırma) modunda analiz edilmiştir. ICP-MS ölçümleri sonucunda, yüksek toksik özellik gösteren kadmiyum ve arsenik metallerine rastlanmazken, diğer yüksek toksik özellik gösteren ağır metal içerikleri; civa ($0,35\pm 0,01\text{mg.kg}^{-1}$) ve kurşun ($6,36\pm 0,25\text{mg.kg}^{-1}$) olarak belirlenmiştir. Elde edilen sonuçlar, bitki numunesinde toprak alkali metallerden kalsiyum ($1226,780\pm 43,4\text{mg.kg}^{-1}$) ve potasyum ($10308\pm 103,7\text{mg.kg}^{-1}$) içeriklerinin oldukça yüksek oranda buldukları tespit edilmiştir. Bitki içeriğinde analizi gerçekleştirilen diğer elementlerin miktarları; Se ($129,8\pm 3,9\text{mg.kg}^{-1}$) Al ($373,95\pm 17,1\text{mg.kg}^{-1}$), Cu ($12,6\pm 0,7\text{mg.kg}^{-1}$), Fe ($609,3\pm 24,1\text{mg.kg}^{-1}$), Ni($8,7\pm 0,4\text{mg.kg}^{-1}$), Zn($25,2\pm 1,2\text{mg.kg}^{-1}$), Co ($0,08\pm 0,01\text{mg.kg}^{-1}$) olarak belirlenmiştir.

Anahtar Kelimeler: *Hypericum triquetrifolium*, kalite-kontrol, ICP-MS, elementel analiz standardizasyon



ELEMENTAL ANALYSIS OF *HYPERICUM TRIQUETRIFOLIUM* BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY

ABSTRACT

Purity of an herbal drug is closely linked with its safe use and contamination by heavy metals such as mercury, lead, copper, cadmium, and arsenic can pose clinically relevant dangers for the health of the user and should therefore be limited.(1) The aim of this study is to explore the presence and content of metals; lead(Pb), Mercury(Hg), arsenic(As), selenium(Se) and semi-metals; aluminium (Al), cadmium (Cd), copper (Cu), iron (Fe), nickel (Ni), zinc (Zn), Cobalt (Co), calcium (Ca), potassium(K) in aerial part of *Hypericum triquetrifolium* species. A sample of *H. triquetrifolium* species is collected from Adana-Tarsus district is analyzed by using inductively coupled plasma-mass spectrometry (ICP-MS) method. 3 equal amounts of dried and powdered homogeneous plant sample were placed in the microwave digestion device. After the combustion process was carried out in triplicate, the sample obtained was combined and analyzed in Helium KED (Kinetic Energy Separation) mode using the Perkin Elmer NexIon 2000P device after appropriate dilution. As a result of ICP-MS measurements, heavy metals with high toxicity such as mercury ($0.35 \pm 0.01 \text{ mg.kg}^{-1}$) and lead ($6.36 \pm 0.25 \text{ mg.kg}^{-1}$), were determined, however other heavy metal such as arsenic and cadmium were not found in the plant sample. The results obtained showed that the alkaline earth metals, calcium ($1226.780 \pm 43.4 \text{ mg.kg}^{-1}$) and potassium ($10308 \pm 103.7 \text{ mg.kg}^{-1}$) contents were found to be quite high in the plant sample. Based on the results obtained, it was concluded that the microwave-heated sample preparation method, which is faster and prevents the loss of volatile components in the sample, and the ICP-MS method, which allows analysis below the ppb level, are suitable for elemental analysis of *Hypericum triquetrifolium* species.

Keywords: *Hypericum triquetrifolium*, quality-control, ICP-MS, elemental analysis, standardisation



**OVEREXPRESSION OF CDF1.2 ALLELE MEDIATES EARLY MATURITY AND
TUBERISATION IN LATE MATURING POTATO CULTIVAR**

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ABSTRACT

Cycling dependent DNA with one finger transcription factor (CDF) circadian gene family, that underlies a major quantitative trait locus QTL for timing of tuber initiation and it has been well demonstrated in short day Andigena population, showed that QTL encodes three types of CDF allele i.e. CDF1.1 (late maturity allele), CDF1.2 and CDF1.3 (early maturity allele) gene responsible for early and late maturity. For the importance of developing earliness in existing tetraploid commercial potato cultivars in India, targeted CDF1.2 gene. Isolated CDF1.2 gene (1329 bp), from early maturing potato cultivar and overexpressed in late maturing and late blight resistant cultivar Kufri Girdhari using *Agrobacterium* mediated genetic transformation with intermodal stem cuttings as explants. Out of 95 transformed lines, 35 were found NptII



PCR positive and these positive lines were subjected to phenotyping for tuberisation. Analysed phenotypically for maturity and early tuberization, in which 25 of the transformed lines were tuberising 13 days early and senescence phenotype in comparison to the non-transgenic Kufri Girdhari. In the second clonal generation, 6 lines were subjected to long day condition phenotype and observed significant difference in earliness and more number of tubers and size in promised CDF1.2 lines compare control KG line. qRT-PCR analysis of StCDF1.2, StSP6A gene showed more than 5 fold to 16 fold expression compared to control. To support the CDF1.2 expression, analyzed the StSP5G and CONSTANS gene expression, showed down regulation of the transcript (<1 fold compare to control KG showed 1 RQ value. This study demonstrated that role of CDF1.2 allele in enhancing early tuberisation and form the basis of the domestication of potato in tropical latitudes of the Indian continent.

Keywords: Overexpression, DNA



THE IMPACT OF SOURCES OF CREDIT ON FARMER'S DISTRESS – A STUDY IN BALASORE DISTRICT

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ABSTRACT

India is an agrarian society. The state of Odisha which is owning Krishi Karmana award from Govt. of India for many subsequent years, majorly depends on agriculture. Since last two and half decade the farmer's distress in Odisha has emerged as a primary issue. The major focus of this article is to identify the sources of the credit causing distress among the farmers and also to find out why the farmers prefer private moneylenders as their first choice for taking credit over banks or any other formal money lending institutions. First objective of the article is to find out the major sources of credit instigating the farmer's distress. Second objective is to find out why the farmers prefer private money lenders over any other institutional money lenders. In order to achieve the objective of the study, the authors used descriptive study. Data were collected from the farmers of Balasore districts through personal interview with the help of structured questionnaire. A sample of 500 farmers of the districts were taken in to consideration. The collected data were analyzed through using different statistical tools to get the findings. The findings of the study revealed that sources of loan plays a significant role in farmer's distress in Balasore district as many of them are small and marginal farmers. The results also revealed that bureaucracy, lengthy documentation procedure, inadequate response of bank staffs etc. are the primary reason for choosing private money lenders over any other formal financial institutions as they are easily approachable. The reluctant nature of bank staffs are pushing them to go for easily available loans from private money lenders with high amount of interest.

Keywords: Sources of credit, private money lenders, documentation procedure



ADANA İLİ KIRSALI AİLELERİNDE İLKOKUL ÖĞRENCİLERİ SÜT TÜKETİM ALIŞKANLIKLARI

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ÖZET

Süt annenin doğumuna yakın memelerde sentezine başlanan ve yavru için elzem olan besinleri içeren mucizevi besin kaynağıdır. Özellikle yavrunun doğum sonrası ilk dönemlerinde sütü yeterince, kaliteli ve sağlıklı bir şekilde alabilmesi yaşam boyu sağlık açısından önem arz etmektedir. Bu çalışmada Adana ili kırsalında yaşayan ailelerdeki ilkokula giden çocukların süt ve süt ürünleri tüketimi ile vücut kitle indekse değerlerinin yanı sıra, süt ve süt ürünlerinin tüketimiyle ilgili tercihleri ortaya konulmaya çalışılmıştır. Bu amaçla Adana ili kırsalında bulunan 34 aileden elde edilen veriler değerlendirilmiştir. Sütün önemli bir besin kaynağı olması sebebiyle insan sağlığı üzerinde olumlu etkileri olduğu konusunda genel olarak katılımcıların bilgi sahibi olduğu anlaşılmıştır. Katılımcılara sütü sevme nedenleri sorulduğunda %80'den fazlası lezzetli ve sağlıklı olduğu için sütü seviyorum derken sevmeyenlerin %90'nı tadı ve kokusu nedeniyle sütü sevmediğini 1 kişi ise süt içince mide rahatsızlığı yaşadığı için süt içmediğini bildirmiştir. Ancak süte alerji konulu soruya %94,1 yok diye cevap vermiştir. %5.9'u ise bilmiyorum şeklinde cevaplamışlardır. Ankete katılan ailelerin kız çocuklarına ait kilo ve boy değerleri kullanılarak hazırlanan vücut kitle indeksi değerleri dağılımına bakıldığında genel olarak normal kabul edilen 18.5–24.9 arasında yer aldıkları görülmektedir. Ancak anne ve babaların vücut kitle endekslerine bakıldığında fazla kilolu grupta yer aldıkları görülmektedir.

Anahtar kelimeler: Adana, kırsal aile, ilkokul, süt tüketimi



MILK CONSUMPTION HABITS OF ELEMENTARY SCHOOL STUDENTS IN RURAL FAMILIES OF ADANA PROVINCE

ABSTRACT

Milk is a miraculous food source that is started to be synthesized in the breasts near the birth of the mother and contains the nutrients that are essential for the baby. Especially in the early postnatal period of the baby, it is important for the life-long health that the milk is able to receive enough milk in a quality and healthy way. In this study, it was tried to reveal the preferences of milk and dairy products consumption and body mass index values, as well as the consumption of milk and dairy products of children living in rural areas of Adana. For this purpose, the data obtained from 34 families living in rural Adana province were evaluated. It was understood that the participants were generally informed about the positive effects of milk on human health as it is an important food source. When the participants were asked about their preferences for milk, more than 80% said it is taste and health care, while 90% of those who do not like it do not like milk because of its taste and smell, and 1 person stated that they do not drink milk because of stomach discomfort when drinking milk. However, 94,1% answered the question about allergy to milk as no 5,9% of them answered as "I do not know". Considering the distribution of body mass index values of the children of the families participating in the questionnaire, which is prepared using the weight and height values, it is seen that they are between 18.5 and 24.9, which is generally accepted as normal. However, when the body mass index of mothers and fathers is examined, it is seen that they are in the overweight group.

Keywords: Adana, rural families, elementary school, milk consumption



**EVALUATION OF VIRULENCE AND THE OXALIC ACID PRODUCTION ON
Cryphonectria parasitica VIRULENT AND CONVERTED STRAINS BY CHV1
HYPOVIRUS**

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ABSTRACT

Chestnut Blight, caused by *Cryphonectria parasitica* (Murrill) Bar, is a major disease in *Castanea sativa* Mill. on the European continent. Biological control by hypovirulence is a sustainable and efficient method to control the disease. The presence of *Cryphonectria hypovirus* 1 (CHV1) in *C. parasitica* reduces the fungus virulence that promote canker healing and tree recovery. Hypovirus infection results in phenotypic and metabolic changes, including the reduction of ligninolytic enzymes activity, and decreased oxalic acid production. The aim of this work was to evaluate the oxalic acid production in both virulent and converted strains on PDB (Potato Dextrose Broth, 24g/L) and to access the virulence of these strains on chestnut stems. Six isolates were converted with two characterized hypovirulent *C. parasitica* isolates (RBB111, SR44.2) and the presence of CHV1 was detected by molecular methods. Oxalic acid production was evaluated by spectrophotometry after the growth of the strains on 100 ml of PDB supplemented with 2mM MnSO₄ in an orbital incubator during five days. To evaluate the virulence of the isolates, chestnut stems were inoculated with the virulent isolates, their converted ones and the hypovirulent isolates. The characterized hypovirulent isolates used in this work has complete ability to convert virulent isolates with effective hypovirus transmission and PCR detection of CHV1 was obtained in all *C. parasitica* converted strains. The obtained results by spectrophotometric analysis have revealed that virulent strains always produced more



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oxalic acid than converted strains. The infection area on chestnut stems caused by virulent strains was significantly higher ($P < 0.05$) than the infection area caused by converted strains. The converted strains Cast26/RBB111 and Cast26/SR44.2 showed 50% and 88.6% reduction in the content of oxalic acid present in supernatant, respectively. This suggests that the reduction in enzymatic activities caused by hypovirulent strains is variable with the hypovirulent donor used in conversion.

Keywords: European chestnut, pathogenesis, oxalate



**YAĞ ENDÜSTRİ YAĞ YAN ÜRÜNLERİNDEN ELDE EDİLEN GUM
ÇÖZELTİSİNİN TİKSOTROPİK DAVRANIŞININ MODELLENMESİ: CHIA
TOHUM YAĞI YAN ÜRÜN GAMI, KETEN TOHUM YAĞI YAN ÜRÜN GAMI VE
ROKA TOHUM YAĞI YAN ÜRÜN GAMI**

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ÖZET

Bu çalışmada, Chia tohumu gamı (CTG), Keten tohumu gamı (KTG), Roka tohumu gamı (RTG) gibi yağ endüstrisi yan ürünlerinden elde edilen gamların sulu çözeltisinin tiksotropik davranışının modellenmesi amaçlanmıştır. Bu çalışma kapsamında, chia, keten ve roka tohumlarından gam elde edilmiştir. Bu gamlar kullanılarak hazırlanan tüm konsantrasyonlarda (%1-5) CTG, KTG ve RTG dispersiyonlarının reolojik özellikleri (sabit kesme, dinamik reolojik özellikler, 3-ITT ve histerisis alan) belirlenmiştir. CTG, KTG ve RTG, tüm konsantrasyonlarda kayma incelmeye akış davranışı göstermiştir. Gam çözeltileri pseudo-plastik katı özelliği göstermiştir. K değerleri CTG, KTG ve RTG için 0,209 ile 49,028 Pa.sⁿ arasında değişmiş ve artan gam konsantrasyonu ile önemli ölçüde artmıştır. K', K'', n', n'' ve R²'yi hesaplamak için frekans tarama testinden elde edilen verilere doğrusal olmayan regresyon analizleri uygulandığında R²'nin 0,95'ten yüksek olduğu bulundu, bu da Güç Yasası modelinin uyumlu olduğu ve bulgu sonuçlarımızla uyumlu olduğu anlamına gelmektedir. G' (depolama modülü, Pa) için geri kazanım yüzdesi, gam konsantrasyonlarından önemli ölçüde etkilenmiştir. CTG, KTG ve RTG katı benzeri bir yapı gösterdi, depolama modülü (G') tüm frekans aralığında kayıp modülünden (G'') daha yüksek olduğu belirlenmiştir. G' ve G'' değeri, CTG, KTG ve RTG konsantrasyonunun artmasıyla artmıştır. Sakız çözeltilerinin tüm konsantrasyonlarındaki Histeresis alanı (%), bağı kırmak için gereken enerjiyi göstermekte olup bu çalışmanın sonuçları konsantrasyon artışı ile tiksotropik özelliklerin gelişeceğini göstermektedir. CSG, FSG ve RSG'nin ani ve yüksek deformasyon altında geri kazanım özelliklerini belirlemek için Üç Aralıklı Tiksotropik Zaman Testi (3-ITT) uygulandı. Tüm gam çözeltileri için 3-ITT sonucu elde edilen k*1000 değerleri 7,02-56,71 arasında değişirken G₀/G₀ değerleri 1,200-2,381 arasında değişmektedir. CSG, FSG ve RSG tüm konsantrasyonlarda geri kazanım gösterdi. Bu çalışma, CTG, KTG ve RTG'nin reolojik karakterizasyonlarına bağlı olarak kıvam arttırıcılar, emülgatörler ve jelleştiriciler olarak gıda endüstrisindeki çeşitli uygulamalarda kullanılabileceğini önermektedir.

Anahtar Kelimeler: Chia tohumu yan ürün gamı, keten tohumu yan ürün gamı, roka tohumu yan ürün gamı, reoloji, tiksotropik davranış



MODELING OF THIXOTROPIC BEHAVIOR OF THE GUM SOLUTION OBTAINED FROM OIL INDUSTRY BY-PRODUCTS: CHIA SEED OIL BY- PRODUCT GUM, FLAXSEED OIL BY-PRODUCT GUM AND, ROCKET SEED OIL BY-PRODUCT GUM

ABSTRACT

This study aimed to investigate the modeling of thixotropic behavior of the gum solution obtained from edible oil industry by-products, which are Chia seed gum (CSG), Flaxseed gum (FSG), Rocket seed gum (RSG). In this study, gum was obtained from chia, flax and rocket seeds. Rheological properties (constant shear, dynamic rheological properties, 3-ITT and hysteresis area) of CSG, FSG, and RSG dispersions at all concentrations (1-5%) prepared using these gums were determined. Gum solutions (CSG, FSG, and RSG) showed pseudo-plastic solid properties. The K values ranged between 0.209 and 49.028 Pa.sⁿ for CSG, FSG, and RSG and significantly increased with increased gum concentration. When nonlinear regression analyzes were applied to the data obtained from the frequency sweep test to calculate K', K'', n', n'', and, R² values were found to be higher than 0.95, which mean that the Power Law model is fitted and compatible with our results. The percentage recovery for the G' was significantly affected by gum concentrations. CSG, FSG, and RSG showed a solid-like structure, the storage modulus (G') was higher than the loss modulus (G'') in all frequency range. G' and G'' value increased with increased the concentration of CSG, FSG, and RSG. The rheological characterization indicated that CSG, FSG, and RSG could be evaluated as thickeners and gelling agents in the food industry. The Hysteresis area (%) at all concentrations of gum solutions indicates the energy required to break the bond, and the results of this study show that thixotropic properties will improve with increasing concentration. The Three Interval Thixotropic Time Test (3-ITT) was applied to determine the recovery characteristics of CSG, FSG and RSG under sudden and high deformation. The k*1000 values obtained as a result of 3-ITT for all gum solutions vary between 7.02-56.71, while Ge/G0 values vary between 1.200-2.381. CSG, FSG and RSG showed recovery at all concentrations. This study suggested that CSG, FSG, and RSG could be used in a variety of applications in the food industry as thickeners, emulsifiers, and gelling agents depending on their rheological characterization.

Keywords: Chia seed by-product gum, flax seed by-product gum, rocket seed by-product gum, rheology, thixotropic behavior.



FINDIK VE FINDIK ÜRÜNLERİNDE AMBALAJ MALZEMELERİ

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ÖZET

Ambalaj, gıda maddelerini fiziksel tehlikelerden, kimyasal ve mikrobiyolojik kontaminasyondan koruyan, üzerinde ürün hakkında çeşitli tanıtıcı ve uyarıcı bilgiler içeren, gıdanın taşınmasını kolaylaştıran, raf ömrünü koruyan, tek veya pek çok malzemenin kombinasyonu ile oluşturulmuş malzemeler olarak tanımlanabilen bir ürün grubudur. Ambalaj malzemesi kullanımı ve seçimi fındığın hasatından başlayarak harman, depolama, işleme ve nihai ürün aşamalarının tamamında fiziksel, biyokimyasal ve mikrobiyolojik tehditlerden korunması açısından hayati önem arz etmektedir. Fındık yıllık ortalama 2 milyar dolar ile ülkemizin tüm tarımsal ihracatının yaklaşık %10'unu karşılaması bakımından en önemli tarımsal ihraç ürünüdür ve bu ürünün bahçeden son tüketiciye ulaşmaya kadar korunması doğru ambalaj seçimi ve kullanımıyla mümkün olmaktadır. Fındık hasatında ve depolanmasında doğru ambalaj malzemesinin seçilememesi, renk ve tad değişimi gibi duyuşal, aflatoksin oluşumu gibi mikrobiyolojik, serbest yağ asitliği ve peroksit değeri artışı gibi kimyasal istenmeyen değışimlere sebebiyet vermektedir. Yine ara ve son ürünlerde ürünün taşınmasında ekonomik kayıplara ve son ürünün raf ömrünün kısılması gibi problemlere neden olmaktadır. Bu çalışmada fındığın hasatından son ürün haline gelinceye kadarki tüm aşamalarda ambalaj malzemeleri ve seçiminde dikkat edilmesi gereken hususlar derlenmiştir.

Anahtar Kelimeler: Fındık, ambalaj, jüt, vakum paketlenme



PACKAGING MATERIALS IN HAZELNUT AND HAZELNUT PRODUCTS

ABSTRACT

Packaging is a product group that protects foodstuffs from physical hazards, chemical and microbiological contamination, contains various introductory and stimulating information about the product, facilitates the transportation of food, preserves its shelf life, and can be defined as a combination of single or many materials. The use and selection of packaging materials is very important for the protection of the hazelnut from physical, biochemical and microbiological threats throughout the drying, storage, processing and final product stages. Hazelnut is the most important agricultural export product in terms of covering approximately 10% of all agricultural exports of our country with an average of 2 billion dollars annually and it is possible to protect this product from the garden until it reaches the consumer with the proper packaging selection and use. Failure to choose the proper packaging material in hazelnut harvest and storage causes sensory changes such as change in color and taste, microbiological changes such as aflatoxin formation, increase in free fatty acidity and peroxide value. Again, it causes economic losses in the transportation of the product in unprocessed and final products and problems such as shortening the shelf life of the final product. In this study, the matters to be considered in the selection of packaging materials at all stages from the harvest of the hazelnut to the final product are compiled.

Keywords: Hazelnut, packing, jüte sack, vacuum packaging



NATURAL FIBER-REINFORCED COMPOSITE PROPERTIES AND APPLICATION IN BEAM DESIGN: A REVIEW

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ABSTRACT

The paper aims to discuss beam design using bamboo which is a substitute for steel fiber for low cost, weight-saving, and good for sustainable development. The most widely utilised building material in history is reinforced concrete. Given the limited availability of steel in developing countries, the rising costs of steel as the main reinforcement material, the amount of energy required in steel production, and the sensitivity of steel to corrosion, alternative natural and synthetic materials are being investigated for reinforcing concrete structures. The main obstacle for the application of bamboo as a reinforcement is the lack of sufficient information about its interaction with concrete, strength and durability. The static nonlinear analysis is done to find out ultimate capacity. Load deflection response was also closely observed and compared with the result from the theoretical calculation. This study presents the evaluation of the feasibility of the use of Bamboo as reinforcement in concrete members. The bamboo is proving itself where earthquakes, hurricanes, and typhoons occur regularly due to its light weight and elasticity. Bamboo constructions absorb earthquake and high wind shocks significantly better than inflexible concrete and steel structures.

Keywords: Natural fibers, bamboo, beam design



APPLICATION OF ULTRASOUND IN EXTRACTION OF POLYPHENOLS FROM FOOD BY-PRODUCTS

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ABSTRACT

Significant waste is generated through food industry which is always destined either for feed purposes or dumped in the soil causing burden on the environment. Although, significant work has been done on the utilization of these food by-products by extracting important components from them and applying in various industrial products however most of the work has been done using conventional technologies. Novel technologies like ultrasound or sonication could be an important value addition in such processes. Ultrasound is an innovative technology to have an important effect on the outcome of various processes especially extraction of targeted components from plant sources. By using ultrasound technology, extraction processes can now be accomplished in short time with high yield, simplifying work-up, decreasing the process cost, providing greater pureness of the final extract, reducing post-treatment of waste solvents and consuming only a portion of the energy and time normally required for conventional extraction processes. Extraction of polyphenols is getting particular attention by several food as well as pharmaceutical industries. Extraction performed by other means presents various disadvantages like degradation, high energy and time consumption etc. While the benefits of using ultrasound for extraction, includes: reduced thermal and concentration gradients, faster energy and mass transfer, targeted extraction, low temperature, faster response to process extraction control, reduced equipment size, improved production, faster start-up, and exclusion of some processing steps. This review presentation will describe the importance of ultrasound in the extraction of polyphenols from food by-products.

Keywords: Ultrasound, extraction, plant sources, polyphenols, conventional processes



**DEVELOPMENT AND VALIDATION OF LC-MS METHOD FOR THE
DETERMINATION OF SELECTED PESTICIDE RESIDUES FROM VEGETABLES
IN THE RAJKOT REGION**

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ABSTRACT

Quantification of selected pesticides in vegetables samples was carried out using liquid chromatography with mass spectroscopic detection. A class of organophosphate pesticides and neonicotinoids pesticides are selected as these pesticides are commonly used in this region. Selected analytes were separated on column ACE (100mm x 4.6mm, 5 μ m) using a mixture of methanol-10mM ammonium formate (90:10 v/v) as the mobile phase at a flow rate of 0.5mL min⁻¹ and injection volume of 10 μ l. For Ethion, Phorate, Acephate, Chlorpyrifos, Quinalphos, Acetamipride, Imidachlopride and Thiamethoxam the method was linear ($R^2 \geq 0.995$) according to the range of 0.50-100 ng/ml, 20-4000 ng/ml, 1-200 ng/ml, 2-400 ng/ml, 0.25-50 ng/ml, 0.25 ng/ml, 1-200 ng/ml and 1-200 ng/ml. The retention time for Ethion, Phorate, Acephate, Chlorpyrifos, Quinalphos, Acetamipride, Imidachlopride and Thiamethoxam was found to be 3.80 \pm 0.03 min, 3.45 \pm 0.02 min 4.34 \pm 0.03 min, 3.23 \pm 0.03, 2.26 \pm 0.03, 2.28 \pm 0.02, 2.30 \pm 0.03 and 3.42 \pm 0.03. The developed method has been validated according to SANCO guidelines. The developed method was applied to vegetables procured from the local market and organic mall available in the Rajkot region. Key Words: Multi Residue Method; Organophosphate; Neonicotinoids; Liquid Chromatography-Mass Spectrometry; SANCO Guideline.

Keywords: Development, lc-ms



INFRARED-ASSISTED EXTRACTION AND ITS APPLICATIONS IN FOOD PRODUCTS

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ABSTRACT

Novel extraction techniques have recently been developed as alternatives to conventional solvent extraction which is commonly used in the extraction of such components as oil, bioactive components with functional properties, and minor components from foods. Such novel applications as ultrasound, microwave, pressurized liquids, pulsed electric field, enzyme assisted techniques, and supercritical fluids have gained increasing interest in the extraction of food components and several studies are being conducted on them. Although these technologies manage to obtain high-quality extracts, they have some disadvantages regarding their specialized equipment requirements such as initial costs and excess energy consumption. Infrared-assisted extraction (IRAE), in which infrared lamps are used as energy sources in the heating of solvent, comes into prominence due to its significant advantages. When compared to other conventional extraction methods, IRAE has such advantages as being simpler, cheaper, more rapid, energy-saver, and yielding better in extraction as well as high-permeable in energy distribution with no special equipment requirement and safe operating procedure. There is only a limited number of studies regarding the use of IRAE in food applications. In particular, the extraction of phenolic compounds using IRAE has been widely studied. In this presentation, the principles of IRAE, the equipment used, the advantages and disadvantages in comparison with other extraction techniques, and the applications of IRAE in food applications will be discussed. It can be concluded that IRAE is a promising alternative extraction technique with high-quality products while harming the environment and human health less than those of other conventional extraction methods.

Keywords: Infrared, extraction, food industry, novel technologies



IMPACT OF FRACTIONATION ON FATTY ACIDS PROFILE AND OXIDATIVE STABILITY OF HIGH OLEIC ACID BUTTER

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ABSTRACT

In recent years, intake of dairy products is declining across the globe, therefore, it is needed to convert the traditional dairy products to functional foods for increasing their acceptability and to carry bioactive compounds associated with them to the body. Temperature of cream (from cow milk with 40% fat content) was raised to 63°C followed by slow cooling (4hrs) to 0°C, -5°C and -10°C and held for 24hrs and filtered through vacuum assisted filtration facility. Sweet cream butter (without culture and salt) was prepared and filled in tins of 500g capacity, stored at -18°C for 90 days. fatty acids composition, oxidative stability and sensory profile was examined. Composition of butter prepared from all the three olein fractions of milk fat were same in all the treatments and control. Amount of C₄₄, C₄₆, C₄₈, C₅₀, C₅₂ and C₅₄ in olein fractions collected at 0°C, -5°C and -10°C were significantly higher than the control. Amounts of short-chain fatty acids in control and fractions harvested at 0°C, -5°C and -10°C were 10.32%, 18.41%, 24.62% and 31.66% respectively. C_{12:0}, C_{14:0}, C_{16:0} and C_{18:0} was not detected in the fraction harvested at -10°C. Concentration of C_{18:1} and fractions harvested at 0°C, -5°C and -10°C were 21.78%, 35.95%, 46.47% and 55.52%. Concentration of C_{18:2} and fractions harvested at 0°C, -5°C and -10°C were 1.76%, 7.14%, 9.13% and 10.51%. Concentration of C_{18:3} and fractions harvested at 0°C, -5°C and -10°C were 0.52%, 2.28%, 4.15% and 5.89%. Concentration of conjugated linoleic acid (9*c*,11*t*-18:2) in control and fractions harvested at 0°C, -5°C and -10°C were 0.34%, 0.51%, 0.92% and 1.21%. Samples of experimental and control butter showed reasonable oxidative stability and sensory properties up to 60 days with improved spread ability than the control butter. Butter with more than 55% oleic acid can be produced by fractionating the cream at -10°C with improved spread ability, reasonable oxidative stability and sensory characteristics.

Keywords: Oleic acid, fractionation, fatty acids profile, triglyceride profile



GIDA KATKILARININ İNSAN BAĞIRSAK MİKROBİYOTASI ÜZERİNE ETKİSİ

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ÖZET

Gıda katkı maddeleri, gıda işleme endüstrisinde, etiketlerde "içerik maddeleri" olarak belirtilen, gıda ürünlerinin rengini, tadını, kokusunu, besin değerini ve raf ömrünü iyileştirmek için kullanılan maddelerdir. Mikrobiyom, belirli bir ortamdaki mikroorganizmaların kolektif genomlarını, mikrobiyota ise mikroorganizma topluluklarını ifade eder. Bağırsak mikroorganizmaları bağışıklık, metabolik ve nörodavranışsal özelliklerin dahil olduğu insan sağlığı için birçok yönden anahtar durumundadır. 100 trilyondan fazla simbiyotik mikroorganizma insan vücudunun üzerinde ve içinde yaşar ve yine insan sağlığı ve hastalıklarında önemli rol oynarlar. İnsan mikrobiyotası, özellikle bağırsak mikrobiyotası, tüm insan genomunda bulunandan yaklaşık 150 kat daha fazla gen taşıyan bir "temel organ" olarak kabul edilmiştir. Bağırsakta yaşayan bakteri türleri, konakçı ile etkileşime girerek, yerel ve sistemik olarak bağışıklık hücrelerinin gelişimini ve işlevini teşvikler. Gıda katkı maddeleri, ilaçlar, antibiyotikler ve böcek ilaçları gibi bileşikler bağırsak mikrobiyotası üzerinde olumsuz etki oluşturabilir. İşlenmiş gıdalarda bolca bulunan emülgatörler gibi gıda katkılarının hayvanlardaki bağırsak mikrobiyotasını etkilediği gösterilmiştir. Bununla beraber probiyotik gibi gıda takviyelerinin ise insan sağlığı üzerinde birçok yararlı etkisi de mevcuttur. Gıdalar ve içerikleri, GM için metabolit üretiminde başlıca öncül kaynaklardır. Mikrobiyotanın düzenlenmesinde alınan prebiyotik içeriği kadar önemli olan bir konu, alınan canlı probiyotik mikroorganizmalardır. Bu noktada, fermente besinlerin potansiyel yararları dikkat çekmektedir. Bu çalışmanın amacı, çeşitli gıda katkı maddelerinin insan bağırsağı mikrobiyotası (GM) üzerindeki etkilerini belirlemektir. Araştırma bu alandaki bazı önemli yeni bulguların altını çizmek için yapılmıştır.

Anahtar Kelimeler: Gıda katkıları, bağırsak mikrobiyotası, bağırsak sağlığı



THE IMPACT OF FOOD ADDITIVES ON THE HUMAN GUT MICROBIOTA

ABSTRACT

Food additives are used in the food processing industry to improve color, taste, smell, nutritional value, and shelf-life of food products, which are indicated in labels as “ingredients.” Microbiome refers to the collective genomes of the microorganisms in a particular environment, and microbiota is the community of microorganisms themselves. Gut microbes are key to many aspects of human health including immune, metabolic and neurobehavioural traits. More than 100 trillion symbiotic microorganisms live on and within human beings and play an important role in human health and disease. The human microbiota, especially the gut microbiota, has even been considered to be an “essential organ”, carrying approximately 150 times more genes than are found in the entire human genome. Food additives, drugs, antibiotics, and pesticides could all have adverse effects on the gut microbiota (GM). Food additives, such as emulsifiers, which are ubiquitous in processed foods, have also been shown to affect the gut microbiota in animals. Probiotic supplementation has several beneficial effects on human health. Foods and their ingredients are major precursor sources in metabolite production for GM. Dietary alive probiotic microorganisms are as important as prebiotic content of diets for modulation of microbiota. At this point, potential benefits of fermented foods attract attention. The aim of the present study is to establish the effects of several food additives on the human GM. This review will highlight some of the important recent findings in this area of research

Keywords: Food additives, gut microbiota, gut health



JOSEPH'S AGRICULTURAL POLICY (GENESIS 41:46-57) AND FOOD INSECURITY IN NIGERIA

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ABSTRACT

In Genesis 41:46-57, Joseph, with the knowledge that famine is imminent went through the land of Egypt, talking with farmers, knowing their locations, their problems, the conditions of their crops, their farmlands, the roads, and the means they used in conveying their goods from their farmlands to the consumers. He did this for seven years and built storehouses where he stored excess food from the farmers. It was this excess food that helped in lessening the effect of famine in Egypt. The narrative in the pericope is similar to the present food insecurity in contemporary Nigeria. Farmers suffer undue losses owing to their inability to afford storage facilities. Farmers find it difficult to even convey their produce from their farms to the market. Extension services by the Nigerian agricultural ministry are seldom carried out to workers. Fertilizers meant for farmers are diverted to public markets. Farmers entertain gross losses as middlemen make more money from farm produce than the farmers. Using a phenomenological approach this study discovered that there is still a high reliance on food imports in Nigeria due to the lack of political will from the government to assist farmers. Consequently, food security will continue to be threatened as long the government continues to show neglect of Nigerian farmers.

Keywords: Joseph, food insecurity, agriculture, nutrition security, Egypt



EFFECT OF DIFFERENT MULCHES ON SALINITY CHANGES AND EVAPORATION REDUCTION IN SOILS WITH DIFFERENT TEXTURE

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ABSTRACT

Reducing irrigation losses due to surface evaporation using mulch layer on soil surface can help in maintaining water in the current situation that our country is suffering from water deficit. In this research, the effect three types of mulch layer on evaporation reduction was evaluated on three soil textures (sandy loam, loam and clay loam). For this purpose, a layer of three centimeters mulches (water repellent layer, fine gravel and manure) was placed on the soil surface, and their effect and control (without mulch layers) on the evaporation rate of small lysimeters in Yazd city was investigated. The experiments were performed in a factorial experiment with completely randomized design with four treatments and three replications. The results showed that the surface mulch layer significantly decreased evaporation in the mentioned three soils. The maximum evaporation reduction in fine gravel layer compared to the control was 59.8, 58.2 and 61.4% in the sandy loam, loam and clay loam soil, respectively. After fine gravel, the manure was more effective than the water repellent layer mulch in evaporation reduction. The effect of mulches on salinity changes in soil depth was different, so that the lowest amount of salinity was observed in the treatment of fine gravel and manure mulches on the surface of the three soils. Water repellent mulch had less effect on reducing the salinity of topsoil than the other two mulches and more salts were transferred from the depth to the soil surface.

Keywords: Evaporation, mulch, soil moisture, water repellency



ÇİLEĞİN DEPOLAMA STABİLİTESİ ÜZERİNE KİTOSAN KAPLAMA VE ELEKTROLİZE SU UYGULAMASININ ETKİNLİĞİ

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ÖZET

Taze çilek besleyiciliğine ve oldukça sevilen bir meyve olmasına rağmen, yüksek metabolik aktivitesi sebebiyle hızlı bozulur ve sınırlı depolama ömrüne sahiptir. Bu çalışmada, depolama stabilitesini artırmak amacıyla, taze çilekler elektrolize su (30 ppm veya 90 ppm) ya da %1'lik kitosan ile muamele edildikten sonra 180 g olarak PVC/PE kaplarda mikroperforeli film ile kapatılmıştır. Depolama stabilitesi üzerindeki etkiler gaz kompozisyonu, pH, su aktivitesi, ağırlık kaybı, bozulma oranı ve renk değişimi (L, a, b) açısından 5 haftalık depolama (4°C) boyunca takip edilmiştir. Mikroperforeli film kullanımı ile meyvenin solunumu sebebiyle üretilen ya da tüketilen O₂/CO₂'nin ambalajdan geçişinin denge modifiye atmosfer oluşturulduğu gösterilmiştir. Depolama sonunda, kontrol grubu dışında tepe boşluğunda yer alan O₂ %20.9'dan %12-14% seviyesine düşmüş, kitosan ile muamele edilen gruplarda ise CO₂ oranı %0.03'ten %14 seviyesine yükselmiştir. Sonuçlar, pH değerleri yükselirken, ortalama Brix değerlerinin depolama boyunca 8.7'den 7.3'e düştüğünü göstermektedir. Renk değerleri (L ve a) kitosan kaplanmış meyvelerde azalma eğilimi gösterirken, diğer gruplarda artan bir eğilim olduğu görülmektedir. Görsel olarak yapılan küf ve bozulma kontrolleri, görünür biçimde kitosanın taze çilek kalitesi üzerinde, depolama stabilitesini artıracak şekilde pozitif bir etkisi olduğunu ortaya koymaktadır. Depolama sonunda, kitosan ve elektrolize su (ES) kombinasyonu ağırlıkça %25-30 bozulmuş meyve oranına sahipken, bu oran kontrol grubunda %67'ye varmaktadır. Ağırlık kaybı kontrolü de depolama sonunda kitosan kaplı grupta %0.4'lük kayıp gösterirken, kontrol grubunda %1'den fazla kayıp olduğunu ortaya koymaktadır. Çileklerdeki sertlik değeri depolama boyunca azalmaktadır. Bu çalışma sonunda, kitosan ve 30 ppm ya da 90 ppm'lik elektrolize su kombinasyonu taze çileklerin depolama stabilitesinin geliştirilmesinde yenilikçi bir yöntem olarak görülmüştür.

Anahtar Kelimeler: Çilek, kitosan, elektrolize su, mikroperfore filmler



EFFECTIVENESS OF CHITOSAN COATING AND ELECTROLYZED WATER APPLICATION ON FRESH STRAWBERRY STORAGE STABILITY

ABSTRACT

Fresh strawberries are very popular and nutritious fruit with its high perishability and limited storage stability due to their high metabolic activity. In this study, fresh strawberries were packed in microperforated polypropylene lid film on trays [(180gr) in (PVC/PE)] after treatment by electrolyzed water (EW)(30 ppm and 90 ppm) or coated with 1% chitosan solution to achieve extended storage stability. The effects on extended storage stability based on gas compositions, pH, water activity, texture, weight loss, percent decay, and color change (L, a, b) were determined during 5 weeks of storage (4°C). Use of microperforated film is shown that an equilibrium modified atmosphere in the package is created by O₂/CO₂ transfer through the packaging which is utilized or produced during respiration of the fruits. At the end of the storage, except from the control group, O₂ in the head space decreased from 20.9% to 12-14% and CO₂ ratio was elevated from 0.03% to 14% for all chitosan treated groups. The results showed that pH values were increased and Brix values were decreased from 8.7 to 7.3 on average during storage. Color values (L and a) showed a decreasing tendency for chitosan coated fruits while others showed increasing trend. Apparently, visual control of mold and deteriorated strawberries revealed that chitosan has a positive extended storage stability effects on fresh strawberry quality. At the end of the storage, chitosan and electrolysed water (EW) combination has 25-30% (w/w) defected fruits, while this ratio reaches 67% for control group. Weight loss control is also indicating that chitosan coated groups have 0.4% loss, while control group has more than 1% weight loss at the end of the storage period. The hardness value of strawberries was decreased during storage. In this study, chitosan and 30ppm or 90ppm electrolyzed water combination is shown that it is an innovative method for enhancing storage stability of fresh strawberries.

Keywords: Fresh strawberry, chitosan, electrolyzed water, microperforated films



ESTIMATION OF SALINITY TOLERANCE THRESHOLD AND SOME GROWTH CHARACTERISTICS OF PURSLANE (*Portulaca oleracea L*)

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ABSTRACT

In order to evaluate the salinity tolerance of Purslane, an experiment was conducted in a completely randomized design with 3 replications in a pot in the greenhouse of the National Salinity Research Center. Experimental treatment includes 7 levels 0.44 (control), 3, 6, 9, 12, 15 and 18 dS/m. The results showed that the application of salinity levels significantly reduced all the studied traits. Regarding some growth and yield-related traits, increasing salinity from control to salinity of 18 dS/m reduced shoot wet weight by 83%, root wet weight by 71% and leaf wet weight by 78%. Also, with increasing salinity level, ion leakage increased by 43.56%. The results showed that the salinity tolerance threshold (shoot yield) was 0.65 dS/m and a 50% reduction in yield was obtained at salinity of 12.97 dS/m.

Keywords: Leaf area, plant height, root



SOLAR BASED COOL CAP

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ABSTRACT

This paper implements the use of Solar Panels. It makes use of renewable energy from the sun and clean environmentally sound means of collecting solar energy. The Solar Cooling Fan Caps are used for fishing, climbing mountains and people working in outdoors. It transfers solar energy into electric power which can turn on the fan. Its fanning can change automatically depending on the availability of sunlight. This cap can sense the intensity of the sunlight temperature and automatically switches on the cooling fan without user's interference. . This Solar Panel collect energy in the form of sunlight and convert into electricity. In this project 3V 150mA Solar Panel is used and a rechargeable battery is provided to store the energy. A temperature sensor is used to detect the hotness intensity of the atmosphere. It is designed to charge the battery with the help of household AC supply for emergency. It improves humanity health in the long run. It reduces dependence on non-renewable energy resources. The Solar fan cap offers you a pleasant cool world to accompany you in summer activities. The novel design of solar fan caps is fun for all kids. It prevents sunstroke and lowering the temperature and they make great gifts. The proposed work is the ON/OFF switch is for user-controlled operations. A Solar Panel produces direct current, the sun on the panel stimulates the flow of electrons, creates current. This is the most affordable solution to replacing the air conditioner unit due to its lack of inefficiency.

Keywords: Solar cooling fan caps, solar panel, renewable energy, fishing



SOYADA KÖMÜR ÇÜRÜKLÜĞÜNE [*Macrophomina phaseolina* (Tassi) Goid] DAYANIKLI ÇEŞİTLERİN BELİRLENMESİ

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ÖZET

Macrophomina phaseolina (Tassi) Goid, soyada [*Glycine max* (L.) Merrill] fide yanıklığı ve kök çürüklüğü hastalığına neden olan, kömür çürüklüğü olarak bilinen, toprak kökenli bir fungal hastalıktır. Soya çeşitlerinde kömür çürüklüğüne karşı farklı duyarlılıklar görülsede, genetik olarak kaydedilmiş dayanıklı ticari genotip bulunmamaktadır. Bu amaçla, *M. phaseolina*'nın neden olduğu kömür çürüklüğü hastalığına karşı dayanıklılığı taranan ticari soya çeşitlerinin belirlenmesi amacıyla bu çalışma yürütülmüştür. Araştırma, 2018 yılında *In vivo* koşullarında gerçekleştirilmiştir. Üç tekerrürlü denemelerde yirmi çeşit kullanılmıştır. Soya tohumlarına ekim sırasında *M. phaseolina* spor süspansiyonu inokule edilmiştir. Kömür çürüklüğüne bağlı çeşitlerin hasatlık şiddeti ekimden 65 gün sonra değerlendirilmiştir. Soya kömür çürüklüğü hastalığı dayanıklılığı değerlendirmede 1-5 skoru kullanılmıştır. Araştırma sonuçları, denemede kullanılan 20 farklı çeşidin hassas ve çok hassas olduğunu göstermiştir. Kömür çürüklüğüne dayanıklı soya çeşitleri için dayanıklı ebeveynler geliştirilmelidir.

Anahtar Kelimeler: *Macrophomina phaseolina*, kömür çürüklüğü, dayanıklılık, soya çeşitleri



DETERMINATION OF CHARCOAL ROT [*Macrophomina phaseolina* (Tassi) Goid] RESISTANT VARIETIES IN SOYBEAN

ABSTRACT

Macrophomina phaseolina (Tassi) Goid is a soil-borne fungal disease to be known as charcoal rot that caused seedling blight and root rot disease of soybean [*Glycine max* (L.) Merrill]. Although different susceptibility to resistant to charcoal rot is observed in soybean varieties, there are no genetically recorded resistant commercial genotypes. For this aim, this study conducted to determine the commercial soybean genotypes screened for their resistance against charcoal rot disease caused by *M. phaseolina*. The research was performed in 2018 at the *In vivo* conditions. Twenty-four genotypes were used in the trials with three replications. Spore suspension of *M. phaseolina* was inoculated during sowing on soybean seeds. The genotypes percent disease severity due to charcoal rot was evaluated at 65 days after sowing. A score of 1-5 was used to evaluate soybean charcoal rot disease resistance. The research results showed that 20 different genotypes were determined to be susceptible and highly susceptible. Resistant parents should be developed for soybean varieties with charcoal rot resistance.

Keywords: *Macrophomina phaseolina*, charcoal rot, resistance, soybean varieties



THE EFFECT OF ALTITUDE AND SOIL SURFACE PARAMETERS ON PLANT DIVERSITY IN NORTH OF IRAN

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ABSTRACT

This study aimed to evaluate the efficiency of the LFA method to predict the species diversity indices. Sampling was carried out using 140 plots of 1 m² along 14 transects based on a randomly-systematic design and so, the final indexes of soil infiltration, nutrient cycle and soil stability were calculated. Also, the cluster analysis was applied to determine the similarity among the diversity indices, soil surface parameters and final indices by using PAST software. The results showed that at the level of 1 percentage ($P \leq 0.01$), the Shannon diversity and Simpson indices were predicted by altitude from the sea level and nutrient cycle parameter, respectively and, richness indices was predicted by these two parameters. Also, at the 1% confidence level, 33% changes in the Shannon Diversity Index can be predicted by the altitude parameter. It seems that the LFA method can create the final indices by considering and scoring some of the surface parameters of the soil (eleventh indices) and these indices can finally display the ecosystem's performance.

Keywords: Diversity, shanon, landscape function analysis, soil surface parameters



APPLICATIONS OF NANOMATERIALS IN FOOD ADULTERATION

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ABSTRACT

Food adulteration has become a significant public health issue in both developed and non-developed countries. These adulterants are added to food material intentionally or unintentionally. Adulterated food is toxic, and it could reduce the essential nutrients. So, it will affect the growth and development of the body. Consumption of adulterated food causes serious health problems. In the olden days, several traditional methods such as spectroscopy, chromatography, ELISA methods are used to identify these adulterant materials. But last few years, metal nanoparticles such as gold nanoparticles, silver nanoparticles, etc., are used to determine the adulterant in several food products. Similarly, carbon nanotubes, carbon nanofibers are also used to detect food contaminants. These materials are also used in biosensors, nano sensors, and immunosensors which can help detect at susceptible levels toxic contaminants. This paper gives an insight into various types of food adulterants added to food, the ill effects of these materials, identification of these contaminants by using nanotechnology.

Keywords: Food adulteration, traditional methods, nanotechnology, metal nanoparticles



ELEKTROLİZE SU VE ULTRASONİKASYON UYGULAMALARININ MODİFİYE ATMOSFER PAKETLEME İLE TAZE ÇİLEĞİN (FRAGARIAANANASSA) DEPOLAMA STABİLİTESİNE ETKİSİ

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ÖZET

Çilek, lezzeti, içerdiği biyoaktif fenolik bileşik zenginliği ve besin değerlerinden dolayı popüler bir meyvedir. Ancak, yüksek metabolik aktivitelerinden dolayı depolama ömürleri kısadır. Taze çileklerin depolama stabilitesini artırarak, biyoaktif bileşiklerin korumak için uygun termal olmayan yöntemlere ihtiyaç vardır. Yeni yaklaşımlardan ozon, elektrolize su, ultrasonikasyon gibi 'genel olarak güvenli' olarak tanımlanan uygulamalar oldukça etkilidir. Bu araştırma, elektrolize su (50 ve 100 ppm 3-dakika) ve ultrasonikasyon (80W-3 dakika) ve bunların kombinasyonun taze çileklerin [(180 gr) tepsilere (PVC / PE)] depolama (4 °C) stabilitesini korumadaki etkinliği seçilen kimyasal ve fiziksel özellikleri (pH, brix, renk-L, a, b, çürüme yüzdesi, antosiyanin ve toplam fenolik madde miktarı ile tekstür) 5 haftalık depolama boyunca değerlendirildi. Analizde, başlangıçtaki toplam fenolik miktarı ortalama 120 mg/ 100g, beş hafta sonunda kontrol grubundaki toplam fenol miktarı 83 mg/ 100g, 50 ppm ve 100 ppm elektrolize su 90.94 ve 88.72 mg/ 100, ultrason 84 mg/ 100g ölçülmüştür. Elektrolize su muamele edilen çilekler daha yüksek (%30'a kadar) toplam fenolik korumuştur. Tekstür analizine göre çileklerin sertlik değeri başlangıç 2650 gr, depolama sonunda kontrolde 826 gr, 50 ppm (1116 gr) ve 100-ppm (1158 gr) ve ultrasonikasyonda 963 gr dır. Bu sonuçlara göre, 100 ppm elektrolize su uygulaması, sertlik değerinde en az düşüğe (% 56,9) sahipken, en yüksek düşüş (% 69,3) kontrol grubunda görülmüştür. Taze çileğin depolanması boyunca, kontrole göre düşük konsantrasyonlu elektrolize su (50 ppm 3 dakika) ve mikroperforasyon uygulamalarında kimyasal ve fiziksel özelliklerin (pH, brix, renk-L,a,b) ayrıca antosiyanin ve toplam fenolik özellikleri ile tekstür profilinin korunduğu ortaya çıkmıştır. Düşük konsantrasyonlu elektrolize su uygulaması, taze çileğin depolama stabilitesini artırmak için yenilikçi bir yöntem olduğunu göstermektedir.

Anahtar Kelimeler: Çilek, elektrolize su, ultrasonikasyon, mofiyede paketleme



THE EFFECT OF ELECTROLYZED WATER AND ULTRASONICATION WITH MODIFIED ATMOSPHERE PACKAGING ON STORAGE STABILITY OF FRESH STRAWBERRY (FRAGARIA ANANASSA)

ABSTRACT

Strawberry is a popular fruit due to its flavor, richness of bioactive phenolic compounds and nutritional values. However, their storage life is short due to their high metabolic activity. Appropriate non-thermal methods are needed to preserve bioactive compounds by increasing the storage stability of fresh strawberries. Among the new approaches, "generally safe" applications such as ozone, electrolyzed water, ultrasonication are very effective. The aim of study is to evaluate effectiveness of electrolyzed water (50 and 100ppm 3-minutes), ultrasonication (80W-3 minutes) and their combinations in preserving the storage stability of fresh strawberries [(180gr) in (PVC/PE)trays] based on its physical and chemical properties (pH, brix, color-Lab, percent decay, texture, anthocyanin and total phenolic content and texture) during 5 weeks of storage (4 °C). In the analysis, the initial total phenolic amount averaged 120 mg/100g, control group was 83 mg/100g, 90.94 (50ppm) and 88.72 (100ppm)mg/100, ultrasound 84 mg/100g at the end of storage. Electrolyzed water treated strawberries maintained higher (upto 30%) total phenolic. According to the texture profile analysis, the hardness value of strawberries was 2650g on the first day, while 826g (the control), 1116g (50ppm), 1158g (100ppm), and 963g (ultrasonication) at the end of storage. According to these results, 100 ppm electrolyzed water application (56.9%) had the least decrease in the hardness value after five weeks of storage, while the control group had the highest decrease (69.3%). During the storage of fresh strawberries, it was revealed that chemical and physical properties (pH, brix, color-L, a, b), anthocyanin and total phenolic properties and texture profile were effectively preserved in low concentration electrolyzed water (50ppm 3 minutes) with microperforation applications compared to control. The application of low concentration electrolyzed water shows that fresh strawberries are an innovative method to increase their storage stability. This study reveals that applications of low concentration electrolyzed water are an innovative method to increase the storage stability of the fresh strawberries.

Keywords: Strawberry, electrolyzed water, ultrasonication, modified atmosphere packaging



SENSOR TECHNOLOGY IN FOOD INDUSTRY

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ABSTRACT

In the modern technology sensors play a key role in all the industries to enhance the quality of the products. In food industry, chemical or bio sensors are used throughout the manufacturing process for the detection and identification of contaminants such as heavy metals, residual agrochemicals, toxic metabolites, food borne pathogen, food adulterants etc. The food quality and food safety can be identified by using sensors. In addition to that, it plays a vital role in food package (i.e) smart package/intelligent package also. This smart package includes many components such as Time Temperature Indicators (TTIs), Radio Frequency Identification (RFID) systems, ripeness indicators. RFID tag with variety of sensors used to identify the freshness of meat, packaged milk etc. In future software play a crucial role in sensors by analyzing process data, detecting events that need intervention, optimizing their processes and gathering insights about the factory processes. This paper gives an overview of various types of sensors used in food industry and food packaging and scope of future in the field.

Keywords: Sensor, food processing, intelligent package, RFID, software



IMPROVEMENT OF RHEOLOGICAL PROPERTIES OF FOOD PRODUCTS

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ABSTRACT

Rheology deals with the deformation characteristics of the materials under the action of stress. Many food materials are soft materials which have higher market acceptability if their rheological properties are improved. Many dairy products and confectionary products indeed find higher market acceptability if the value addition is imparted them especially to improve rheological properties. Use of appropriate additives and adoption of certain processing routes while maintaining optimum processing conditions really help to control the rheology of the final product. The magnitude of the loss modulus and elastic modulus helps predicting the viscoelastic behaviour of the food material. Comparison of the loss tangent values of different materials also provides the comparative characteristics. Use of certain ingredients in the continuous phase really help to maintain the consistency and stability of food products. Rheological tests including frequency sweep test and stress-strain relation of the food materials are very useful for the study of their deformation properties. The present paper discusses various rheological tests showing the improved characteristics of the food materials.

Keywords: Food product, frequency sweep, non-newtonian fluid, rheology, soft material



GIDALARIN KURUTULMASINDA YENİLİKÇİ YÖNTEMLER VE ÖN İŞLEMLER

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ÖZET

Kurutulmuş gıdalar, zengin besin içeriği, düşük nem içeriği, yüksek depolama özellikleri ve taşıma kolaylığı açısından işlem görmüş gıdalar içinde önemli bir yere sahiptir. Kurutma, gıdaların muhafazasında kullanılan başlıca dayandırma yöntemleri arasında yer almaktadır. Uygun bir kurutmanın sağlanması için, kurutmaya etki eden faktörlerin gıdanın özelliklerine bağlı olarak kontrol altına alınması gerekmektedir. Bu faktörler arasında gıdanın fiziksel ve kimyasal yapısı, şekli gibi faktörlerin yanında kurutma yöntemi ve uygulanan ön işlemler de bulunmaktadır. Geçmişten günümüze kadar birçok kurutma yöntemi geliştirilmiş olup en yaygın bilinen güneşte kurutma aynı zamanda en ekonomik yöntemlerden de birisidir. Ancak bazı olumsuz yönleri nedeni ile farklı kurutma yöntemlerine ihtiyaç duyulmuştur. Sıcak hava ile kurutma yaygın olarak kullanılan bir teknik olup, bu yöntemle kurutulan gıdalarda besin ve aroma bileşenlerinde meydana gelen kayıpların yanı sıra, büzüşme, sertleşme ve renk değişimi gibi olumsuzluklar da gözlenmektedir. Bu olumsuzlukları ortadan kaldırmak ve kurutulmuş gıdanın kalitesini korumak için, yenilikçi kurutma teknolojileri geliştirilmiştir. Bu yeni teknolojiler arasında, patlatmalı puf, kırınım pencereli, radyo frekans, mikrodalga, kızılötesi, çalkalamalı ince film, adropsiyon aracılı, hava çarpmalı, darbeli vakum ve elektrohidrokinamik kurutma yer almaktadır. Bununla birlikte birden fazla kurutma tekniğinin beraber kullanıldığı kombine yöntemler üzerine çalışmaların arttığı görülmektedir. Bu yöntemlerden hangisinin kullanılması gerektiği kurutulacak gıdaya, kurutucunun ekonomikliğine ve yatırım maliyetine göre değişmektedir. Yenilikçi kurutma teknolojileri sayesinde kuruma süresinde kısalma gözlenmekte, ürün kalitesi ve rehidrasyon kapasitesi artmakta, işletme maliyetleri düşmekte, enerji tüketimi azalmakta ve düşük sera gazı salınımı sağlanmaktadır. Kurutma teknolojisinde, kurutma etkinliğinin artırılması amacıyla, kurutma öncesinde gıdalara bazı ön işlemler uygulanmaktadır. Gıdalara uygulanan yenilikçi ön işlemler sayesinde hücre zarı etkilendiği için üründe bulunan suyun çıkışı kolaylaşmakta, besin, renk ve lezzet kaybı en aza indirilmekte, kuruma hızı artarak enerji tüketim kaybı önlenmektedir. Gıdaların kurutulmasında kullanılan yenilikçi ön işlemler; vakum impregnasyon, ultrasonikasyon, elektroplazmoliz ve soğuk plazma olarak sıralanabilir. Gelecekte, yenilikçi kurutma teknolojilerinin ve ön işlemlerin gıda proseslerinde daha etkin ve yaygın bir şekilde kullanılacağı düşünülmektedir. Bu çalışmada kurutma teknolojisi alanındaki yeni teknolojiler ve uygulamalar incelenmiştir.

Anahtar Kelimeler: Kurutma, ön işlem, yenilikçi teknolojiler, kuruma hızı



NOVEL METHODS AND PRETREATMENTS ON THE DRYING OF FOODS

ABSTRACT

The dried foods have importance in processed foods due to high nutritional value, low moisture content, long storage time and easy transportation. Drying or dehydration is one of the most common food preservation methods. To provide proper drying process, factors affecting drying needs to be kept under control depending on food properties. Drying methods or pretreatments are effective on drying process as well factors such as physical and chemical properties and form of foods. Up to now, several drying methods have been developed and sun drying, that is the most known method, is one of the cheapest methods. However, different drying methods were improved because of some issues of the sun drying. Among these methods, hot-air drying is one of the most preferred and can cause chemically losses nutritional values and flavor, physically shrinkage, stiffening and color degradation. To prevent these shortcomings and preserve food quality, novel drying technologies have been developed. These novel methods are explosion puffing, refractive window, radio frequency, microwave, infrared, agitated thin film, adsorption, air impingement, pulsed vacuum and electrohydrodynamic drying. Additionally, studies on combine methods that more than one drying method can be used together, showed increment. The selection of these methods depends on food, economics of dryer and investment cost. Shortening in drying time, increment in product quality, improvement of rehydration capacity, decrement in costs, saving energy and lower greenhouse gas emission can be provided by the novel technologies. In drying technology, some pretreatments have been used to foods prior to drying to increase drying efficiency. Thanks to the innovative pretreatments applied to foods, as the cell membrane is affected, the water in the product is easier to exit, the loss of nutrients, color and flavor is minimized, drying rate increases, and energy consumption loss is prevented. Novel pretreatments can be ordered as vacuum impregnation, ultrasonication, electroporation and cold plasma. In the future, it is thought that novel drying techniques and pretreatments will be more effectively used in food drying. In this study, novel drying technologies and pretreatments were investigated.

Keywords: Drying, pretreatment, novel technologies, drying rate



APPLICATION OF CLAM SHELL RECYCLING IN PREPARATION OF HIGH-DENSITY POLYETHYLENE ANTIBACTERIAL BIO-COMPOSITES

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ABSTRACT

Clam shell is a kind of food waste. If it can be recycled and applied effectively, it can reduce environmental pollution and create economic value. In this study, the clam shell was recycled and treated to prepare an antibacterial bio matrix material, and then the bio matrix material was compounded with high density polyethylene (HDPE) to prepare a multifunctional bio matrix composite. The results showed that the treated clam shell powder (TCSP) could enhance the high strength of HDPE and give the antibacterial property of HDPE. With the increase of TCSP content, the antibacterial property of HDPE was better. However, excessive TCSP will lead to the degradation of HDPE properties, so appropriate TCSP content is helpful to improve the comprehensive properties of the composites. On the other hand, TCSP can also improve the thermal stability of HDPE. This new biological matrix composite can be used in food packaging materials, or medical supplies, and has great commercial potential.

Keywords: Application, recycling



SOFRALIK YEŞİL ZEYTİNLERİN ANTOSİYANİNLERCE ZENGİNLEŞTİRİLMESİ

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ÖZET

Sofralık zeytin, belirli olgunluktaki zeytinin temel acılık bileşeni olan oleuropeinin uzaklaştırılması ve ardından farklı yöntemlerin uygulanması sonucu üretilen fermente bir üründür. Türkiye zeytin çeşitliliği açısından oldukça zengin bir ülkedir. Ancak ülkemiz zeytinleri ile ilgili yapılan araştırmalar çok yeterli değildir. Bu nedenle sofralık zeytin üretimi ile çalışmaların artırılması gerekmektedir. Bu çalışmanın amacı, tuzlu salamura yöntemiyle sofralık yeşil zeytin üretiminde kırmızı pancar ve siyah havuç kullanılarak, yeşil zeytinlerin antosiyaninlerce zenginleştirilmesini sağlamaktır. Bu amaçla, fermantasyon süresi (5,10,15, 20 gün), meyve tipi (kırmızı pancar, siyah havuç) ve meyve oranı (%10-20 w/w) faktör olarak dikkate alınarak faktöriyel deneme deseni oluşturulmuştur. Bu plana göre, Kalamata tipi zeytin kullanılarak 19 farklı sofralık zeytin fermantasyonu gerçekleştirilmiştir. Fermentasyon süresinin ve salamuraya eklenen meyve tipinin ve oranının, zeytinlerde fenolik bileşenler miktarını nasıl değiştirdiği gözlemlenmiştir. Bu amaçla, deneme deseninde belirtilen sürelerin sonunda salamura suyuna ve zeytin meyvesine birtakım kimyasal analizler uygulanmıştır. Bu analizler, pH ölçümü, tuz tayini, renk analizi, toplam fenolik madde analizi, monomerik antosiyanin madde analizi, toplam antioksidan kapasitesinin belirlenmesidir. Elde edilen veriler, varyans analizi (ANOVA) ve temel bileşenler analizi (PCA) ile istatistiksel olarak yorumlanmıştır. Fermantasyon süresince zeytinin acılık bileşenleri salamuraya geçerken, salamurada bulunan siyah havuç ve kırmızı pancardan ileri gelen antosiyaninlerin ise zeytine difüzyonu gerçekleşmiştir. Fermentasyon süresince, zeytinlerin toplam monomerik antosiyanin miktarında önemli artışlar olduğu tespit edilmiştir. Fermentasyonun 10. gününde salamurada %20 oranında kırmızı pancar içeren zeytinlerin toplam monomerik antosiyanin miktarı (TMA) 149,87 mg/L'ye, aynı oranda siyah havuç içeren örneklerin TMA değeri ise 154,05 mg/L'ye yükselmiştir. Kullanılan meyve tipinden bağımsız olarak tüm zeytinlerin toplam fenolik madde miktarlarında ve antioksidan aktivitelerinde de artış olduğu gözlemlenmiştir. Ayrıca, fermentasyonun sonlarına doğru zeytinlerde kırmızı rengin arttığı da görülmüştür. Bu çalışma sayesinde sofralık yeşil zeytin üretiminde yeni bir teknik geliştirilmiş ve fermente yeşil zeytinin fonksiyonel pek çok özelliği geliştirilmiştir. Belirlenen en uygun üretim parametreleri ile antosiyaninlerce zenginleştirilmiş fermente yeşil zeytinin endüstriyel ölçekte üretimi gerçekleştirilebilir.

Anahtar Kelimeler: Oleuropein, antosiyanin, kalamata zeytini, kırmızı pancar, siyah havuç, fermantasyon



ENRICHMENT OF TABLE GREEN OLIVES BY ANTHOCYANINS

ABSTRACT

Table olive production starts with debittering stage by removal of oleuropein, and continues with fermentation process with applying different methods. Turkey is a very rich country in terms of olive varieties. However, studies about table olives are not sufficient. For this reason, the researches should more focus on olive and table olive production. The aim of this study is, enrichment of green olives with anthocyanins by using red beet and black carrot in the fermentation media. For this purpose, a full factorial design was constructed by considering the fermentation time (5,10,15,20 days) , fruit type (red beet, black carrot) and ratio (% 10-20 w/w) as processing factors. According to the design table, 19 different table olive fermentations were carried out with Kalamata olive. The changes in phenolic components of samples at different fermentation times and in different brine concentrations were monitored. Some chemical analyzes were applied both the brine and olive. These analyzes were pH measurement, salt content, color analysis, total phenolic content analysis, monomeric anthocyanin analysis, determination of total antioxidant capacity. During fermentation, while phenolic components of olives were transferring to the brine, the anthocyanins originating from the black carrot and red beet diffused into the olive. The data were analyzed by ANOVA and principal component analysis (PCA) to investigate the differences regarding fermentation time, fruit type and concentration. The total monomeric anthocyanin content (TMA) of samples significantly increased throughout fermentation period. At the 10th day of fermentation, while the TMA content of samples including %20 red beet in brine was ascended to 149.87 mg/L , TMA of olives with %20 black carrot in brine was rised to 154.05 mg/L. Total phenolic content and antioxidant capacity of olives were improved regardless of fruit type. Moreover, the color of olives turned to red towards to end of fermentation. A new production technic for table olive was developed and functional properties of olives were advanced simlulteanously. With the most suitable production parameters determined, fermented green olives enriched with anthocyanins can be produced on an industrial scale.

Keywords: Oleuropein, anthocyanins, olive, red beet, black carrot, fermentation



PREPARATION OF MODIFIED OYSTER SHELL AND ITS APPLICATION IN POLYPHENYLENE SULFIDE

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ABSTRACT

Oyster, a kind of mollusk, is popular among Chinese people for its delicious meat and rich nutrition. In recent years, the output of oyster culture industry in China has continued to rise. At the same time, the waste disposal of many oyster shells also continued to solve. The structure of oyster shell is divided into sclerotic protein cuticle (outer layer), prismatic layer (middle layer) and Nacre (inner layer). The main structural component is calcium carbonate, and a small amount of organic matter macromolecules (protein, etc.) form an orderly multiple micro layer structure. Due to the three-layer physical structure of oyster shell, it has various characteristics: large surface area of oyster shell and adsorption capacity of hollow prism layer. In this study, oyster shell powder was modified as an antibacterial filler and mixed with polyphenylene sulfide (PPS) to prepare the composite. Meanwhile, the change of its properties was discussed, and the antibacterial properties of PPS were given, and its mechanical properties were improved, hoping to expand the application of PPS, At the same time, many wastes oyster shell should be properly solved to turn waste into treasure.

Keywords: Preparation, Polyphenylene



GENETIC ADAPTATION TO METABOLISM OF XENOBIOTICS IN RELATION TO FOOD SAFETY

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ABSTRACT

Since the beginning of agriculture and animal husbandry humans have been exposed to the significant changes both in diet and lifestyle that took place too fast to allow the fixation of genetic adaptations in the populations. The current increase in the prevalence of the so-called “diseases of civilization” may be the result of discordance between the human gastrointestinal system and modern diets. We used genetic polymorphisms data and bioinformatics tools for analysis of acetylation status in the indigenous populations of Northern Siberia. Using the online bioinformatics tools we analyzed the current data set related to the metabolism of xenobiotics, mediated by N-acetyltransferase 2 (NAT2) gene. The study of allelic polymorphism of the NAT2 gene has prognostic value, allowing to determine the risk of a number of oncological diseases, the degree of increased risk due to smoking and exposure to chemical carcinogens, including drugs. We have studied the frequencies of two important “slow” variants of the NAT2 gene, which significantly affect the rate of xenobiotic acetylation among the indigenous Nenets population of Northern Siberia. The obtained frequencies of polymorphic variants have an intermediate value between those for Europeans and Asians, which might indicate specific features of adaptation. To search for new targets of therapy, it is necessary to reconstruct the gene network of the disease, and identify the interaction of genes, proteins and drug compounds. We present a model of the distribution of two polymorphic variants of the NAT2 gene involved in the biotransformation of xenobiotics to study the characteristics of their metabolism. An application for the modeling of xenobiotics metabolism related to food safety is discussed. The work was supported by Russian Science Foundation (grant 19-15-00219).

Keywords: Biology, food safety, sequencing, nucleotide polymorphisms



DERİN ÖTEKTİK ÇÖZELTİLERİN ESNEK GIDA FİLMLERİNDE PLASTİKLEŞTİRİCİ OLARAK KULLANIM OLANAKLARININ ARAŞTIRILMASI

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ÖZET

Yeşil kimyanın önemle üzerinde durduğu konu başlıklarından birisi, geleneksel olarak kullanılan ve toksik etkileri bilinen çözeltilerin yerine çevre dostu ve birçok kimyasal proste görev alabilecek yeni nesil çözeltiler alternatifleri geliştirilmiştir. Yeşil çözeltiler olarak adlandırılan bu çözeltiler; süperkritik akışkanlar (supercritical fluid; SCF), iyonik sıvılar (ionic liquids; IL) ve derin ötektik çözeltiler (Deep eutectic solvents; DES) olarak sınıflandırılabilir. Bunlardan DES'ler; amonyum veya fosforyum organik tuzları gibi hidrojen bağı alıcısı (HBA) ile alkol, asit veya amit gibi hidrojen bağı vericisi (HBD) arasındaki bağı ile oluşturabilen iki veya üç ucuz, yenilenebilir ve biyolojik olarak parçalanabilir bileşenin karıştırılmasıyla elde edilirler. DES'lerin hazırlanması sürecinde HBA olarak kullanılan en popüler bileşen, çok ucuz, biyolojik olarak parçalanabilen, oldukça higroskopik olan ve toksik olmayan bir kuarterner amonyum tuzu olan kolin klorürdür (ChCl). Üre, organik asitler (malonik, sitrik, benzoik, süksinik, okzalik, tartarik, laktik), yağ asitleri (oktanoik, nonanoik, dekanonik, dodekanoik asit) veya yenilenebilir polioller (örn. gliserol, etilen glikol) gibi HBD ile DES oluşturabilir. Bu şekilde çeşitli ve farklı kombinasyonlarda HBD ve HBA kullanılarak değişik polarite, pH, donma noktası, viskozite, iletkenlik vb. gibi farklı fizikokimyasal özelliklere sahip DES'ler hazırlamak mümkündür. Plastikleştiriciler; polimerleri jelleştiren, ergime, camsı geçiş sıcaklığı ve elastik modülünü düşürerek proses edilebilirliğini geliştiren, esneklik ve elastiklik sağlayan katkı maddeleridir. Bu katkı maddeleri plastik ile uyumlu olmalı, çok iyi karışabilmeli ve yapı içinde kalabilmelidir. Özellikle esnek gıda ambalajı olarak kullanılan polietilen (PE), polipropilen (PP), polivinil klorür (PVC) ve polietilen tereftalat (PET) gibi başlıca petrol türevi sentetik plastiklerde yoğun bir şekilde fitalat ve adipat gibi toksik etkileri bulunan plastikleştiriciler kullanılmaktadır. İnsan sağlığı üzerine olumsuz birçok etkisi bulunan bu maddeler yerine toksik etkisi bulunmayan ancak benzer teknik özelliklere sahip DES bileşiklerinin kullanımı önem arz etmektedir. Bu çalışma ile esnek gıda ambalajı olarak kullanılan sentetik veya doğal polimerlerde, DES bileşiklerinin plastikleştirici olarak kullanımı ile ilgili literatür araştırması yapılmıştır.

Anahtar Kelimeler: Derin ötektik çözücü, plastikleştirici, polimer, film



INVESTIGATION OF THE USE OF DEEP EUTECTIC SOLVENTS AS PLASTICIZERS IN FLEXIBLE FOOD FILMS

ABSTRACT

One of the topics that green chemistry focuses on is to develop new solvent alternatives that are environmentally friendly and can take part in many chemical processes instead of solvent systems that are traditionally used and whose toxic effects are known. Called green solvents, these solvents can be classified as supercritical fluids (SCF), ionic liquids (IL) and deep eutectic solvents (DES). DESs are formed by the bond between the hydrogen bond acceptor (HBA), such as ammonium or phosphonium organic salts, and the hydrogen bond transmitter (HBD), such as alcohol, acid, or amide and they are obtained by mixing two or three cheap, renewable and biodegradable components. The most popular ingredient used as HBA in the preparation process of DESs is Choline Chloride (ChCl), a quaternary ammonium salt that is very cheap, biodegradable, highly hygroscopic and non-toxic. Also it can form DES with HBDs such as urea, organic acids (malonic, citric, benzoic, succinic, oxalic, tartaric, lactic), fatty acids (octanoic, nonanoic, decanoic, dodecanoic acid) or renewable polyols (glycerol, ethylene glycol). In this way, using HBD and HBA in various and different combinations, it is possible to prepare DESs with different physicochemical properties such as polarity, pH, freezing point, viscosity, conductivity, etc. Plasticizers are additives that gel polymers, improve processability by reducing melting, glass transition temperature and elastic modulus, and provide flexibility and elasticity. These additives must be compatible with plastic, can mix very well and remain in the structure. Especially used in flexible food packaging, in petroleum-derived synthetic plastics such as polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC) and polyethylene terephthalate (PET), plasticizers (phthalate and adipate) with toxic effects are used extensively. Instead of these substances, which have many negative effects on human health, it is important to use DES compounds that do not have toxic effects but have similar technical properties. In this study, literature research was conducted on the use of DES compounds as plasticizers in synthetic or natural polymers used as flexible food packaging.

Keywords: Deep eutectic solvent, plasticizer, polymer, film



PRESENTATION AND EVALUATION OF THE AGRICULTURAL POLICIES FOR FOOD SECURITY IN ALGERIA, MOROCCO AND TUNISIA

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ABSTRACT

After the liberation movement that various developing countries experienced during the 1960s, different economic approaches were adopted, depending on the ideological nature of the socialist or liberal approach, Algeria, Morocco and Tunisia, like the rest of the Third World, After their independence from European colonialism, they inherited an economic base exhausted by the editorial wars they had fought, The agricultural sector is one of the most affected sectors. They have therefore sought to develop this sector by pursuing several policies and strategies with a view to making the best use of their means to increase their production. The achievement of food security is one of the most important elements of development, especially since the food deficit problem is no longer an agricultural economic problem, but it becomes a regional strategic issue linked to national and regional security. Food has become a strategic weapon for producing and exporting countries to put pressure on importing countries. We will therefore try, through this paper, to present the most important policies that these countries have adopted to achieve their food security and to explain the main reasons for their failure or success using an analytic approach.

Keywords: Agricultural Policies, Food security, Algeria, Morocco, Tunisia



**AN EMINENT ROLE OF NANOTECHNOLOGY IN AGRICULTURE
AND FOOD INDUSTRY**

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ABSTRACT

Nanotechnology plays a critical role in many industries such as food, automobile, textile, electronics etc. This is due to the possibility of tailoring the structures of materials at small scales to achieve special properties. Using nanotechnology, materials can effectively be made stronger, lighter, more durable more reactive, more sieve-like or better electrical conductors, among many other traits. In our day-to-day life we have come across nanotechnology in various ways. Nanotechnology plays a key role in agriculture. It can increase crop productivity and some applications include nano formulations of agrochemicals for applying pesticides and fertilizers for crop improvement, nano sensors used in crop protection for the identification of disease and residues of agrochemicals, nano devices used in genetic engineering in plants etc. This technology plays a vital role in food processing and packaging. It increases the security of manufacturing, processing and shipping of food products through sensors for detecting pathogens and contaminants. This paper gives an overview of the role of nanotechnology in agriculture, food processing and packaging.

Keywords: Nano technology, agriculture, food processing, food packaging



ROLE OF NANOTECHNOLOGY IN FOOD SAFETY

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ABSTRACT

Nanotechnology is an emerging technology which play an eminent role in food processing, food packaging, food safety, functional food development, detection of foodborne pathogens and shelf-life extension of food or food products. The research in nanotechnology showed a great potential to improve packaging materials than a conventional packaging. Packaging has as main functions in the transportation and storage of foods, while protecting it from microorganisms, chemicals, oxygen, moisture, and light aiming at maintaining its quality and safety, and thus increasing shelf life. Polymers are the main materials used in food packaging. These properties of these materials can be improved by incorporating other compounds in the polymer matrix. The incorporation of nanomaterials in packaging materials is supported by their influence in the mechanical (high strength and stiffness) and barrier (low permeability) properties. This paper gives an overview of the role of nano technology and nano materials in food safety.

Keywords: Nanotechnology, food safety, foodborne pathogens



CHİA, KABAK ÇEKİRDEĞİ VE KETEN TOHUMU UN KARIŞIMININ GLUTENSİZ EKMEKLERDE GAMLARA İKAME OLARAK KULLANILMASININ EKMEK KALİTESİ ÜZERİNE ETKİSİ

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ÖZET

Ticari glutensiz ekmek üretiminde glutenin hamura sağladığı fiziksel ve fonksiyonel özellikleri kazandırmak için çeşitli gamlar yaygın olarak kullanılmaktadır. Bu gamlarla üretilen ekmeklerin protein değeri düşüktür. Ayrıca ekmekte istenen renk ve duyu özellikleri karşılanamamaktadır. Ekmeğin bu özelliklerini iyileştirmek için gluten içermeyen, yüksek protein ve doğal gam içeriğine sahip olduğu olduğu bilinen unlar kullanılabilir. Bu çalışmada da gamlara alternatif olarak eklenen chia, keten ve kabak çekirdeği unları ile hazırlanan karışımının ekmek özellikleri üzerindeki etkisini tespit etmek için kompleks kafes karışım dizaynı ile 10 farklı ekmek formülasyonu oluşturulmuştur. Toplam hamur karışımında bu formülasyonlarla hazırlanan un karışımı miktarı 19,8 g'dır. Bu ekmeklerde renk, sertlik, spesifik hacim ve duyu analiz gerçekleştirilmiş ve gam ilaveli ticari ekmek formülasyonu ile üretilen ekmek ile kıyaslanmıştır. Chia, kabak çekirdeği ve keten tohumu unu içeren ekmeklerin spesifik hacim değerleri 2.60- 3,41 g/cm³ arasında değişiklik gösterirken kontrol ekmeğinin spesifik hacim değeri 3.55 g/cm³ bulunmuştur. En yüksek spesifik hacim değerine sahip 9.9 g kabak çekirdeği unu ve 9.9 g keten tohumu unu içeren ekmek ile kontrol ekmeği arasında anlamlı bir farklılık tespit edilmemiştir. Ekmeklerin 1.gün, 3.gün ve 6.gün sertlik değerleri kontrol edilmiş, un karışımı eklenen ekmeklerden yalnızca 9.9 g kabak çekirdeği unu ve 9.9 g keten tohumu unu içeren ekmek formülasyonu ile üretilen ekmeklerde daha düşük sertlik değeri tespit edilmiştir. Bu ekmek formülasyonu ile üretilen ekmek sertlik değeri 1.gün kontrol ekmeği ile farklılık göstermezken, 3. ve 6. günlerde daha düşük sertlik değerleri tespit edilmiştir. Ekmek içi ve kabuk renkleri incelendiğinde hem ekmek içi hem ekmek kabuğu için en yüksek L* ve ΔE değerleri kontrol ekmeğinde görülmüştür. Duyusal analizde ekmek kabık rengi ve görünümü, ufalanma, gözenek yapısı, çiğnenebilirlik açısından örnekler arasında anlamlı bir farklılık görülmezken, sadece ekmek içi renginde kontrol ekmeği diğer bütün örneklerden daha çok beğenilmiştir. Sonuç olarak özellikle 9.9 g kabak çekirdeği unu ve 9.9 g keten tohumu unu içeren formülasyon kullanılarak protein miktarı yükseltilmiş kontrol ekmeğinin sertlik, spesifik hacim ve duyu özelliklerini taşıyan glutensiz ekmek üretimi gerçekleştirilebileceği görülmüştür.

Anahtar Kelimeler: Glutensiz, ekmek, keten tohumu unu, kabak çekirdeği unu, chia unu



THE EFFECTS OF UTILIZATION OF CHIA, PUMPKIN SEED AND FLAXSEED FLOUR MIXTURE SUBSTITUTED WITH GUMS ON BREAD QUALITY PARAMETERS

ABSTRACT

Various gums are widely used in commercial gluten-free bread production to provide the physical and functional properties that gluten provides to the dough. The protein value of breads with these gums is low. In addition, it does not meet the color and sensory properties of bread. In order to improve these properties of bread, gluten-free flours known to have high protein and natural gum content can be used. In this study, 10 different bread formulations were created with a complex cage mix design to determine the effect of the mixture prepared with chia, flax and pumpkin seed flours added as an alternative to the gums, on the bread properties. The amount of flour mixture produced with these in the total dough mixture is 19, 8 g. Color, hardness, specific volume and sensory analysis were performed in these breads and compared with the bread produced with the commercial bread formulation with gum addition. While the specific volume values of the breads containing chia, pumpkin seed and flaxseed flour varied between 2.60-3.41 g/cm³, the specific volume value of the control bread was found 3.55 g/cm³. No significant difference was detected between the bread containing 9.9 g pumpkin seed flour and 9.9 g flaxseed flour which displayed the highest specific volume value and the control bread. The hardness values of the breads on the 1st, 3rd and 6th days were checked, and a lower hardness value was determined in the breads only produced with the bread formulation containing 9.9 g of pumpkin seed flour and 9.9 g of flaxseed flour among the breads containing added flour mixture. Whereas the hardness value of the bread produced with this bread formulation did not differ from the control bread on the 1st day, lower hardness values were determined on the 3rd and 6th days. When the crumb and crust colors were examined, the highest L* and ΔE values for both the crumb and crust were observed in the control bread. In sensory analysis, there was no significant difference between the samples in terms of crust color and appearance, crumbling, pore structure, and chewiness, while control bread was more appreciated than all other samples in terms of crumb color. As a result, it has been observed that gluten-free bread with increased protein content can be produced by using a formulation containing 9.9 g pumpkin seed flour and 9.9 g flaxseed flour providing similar hardness, specific volume and sensory properties of control bread.

Keywords: Gluten-free, bread, flaxseed flour, pumpkin seed flour, chia flour



SUSTAINABILITY OF FOOD PRODUCTION IN PRESS ARTICLES ON NUTRITION: THE CASE OF THE GERMAN ONLINE MEDIA

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ABSTRACT

Food production and changes in the environment are in a complex relationship of mutual influence. On the one hand, the increment in food production, as a result of the increasing growth of the world's population, has repercussions on the environment, and on the other hand ecological changes have negative effects on agricultural production and the nutrition of a significant part of the world's population, posing a major threat to food and nutrition security on a global-scale. That is why, lately, in the media coverage of the vast issue of nutrition, new topics, approaches and associations have emerged, such as food sovereignty and the sustainability of food production, but also the relationship and interaction between the world's growing population and the environment in a continuous degradation, or the threats that hover over people, but also over the Earth, the living space and the home that shelters humanity. This paper presents the results of an analysis regarding the ways in which the environmental issues and the sustainability of food production are addressed in the German media. More precisely, the press articles dealing with human nutrition were taken into consideration in the in analysis. The paper discusses the extent and ways in which links and correlations are made in the German media between food and environmental issues, to what extent do journalists approach topics such as sustainable food production, food sovereignty, organic and local agriculture, local animal husbandry, as well as the extent to which the German press makes connections between unhealthy nutrition and unsustainable food production, or analyzes and debates on various diets, controversies and social trends related to human nutrition, and the food of the future. The methodology of the study presented in this paper includes thematic content analysis, both quantitative and qualitative, of articles on nutrition published in the period 2014-2016 in the German media in their online form and, in addition, the secondary analysis of this broader research, which aimed at the specific, focused objective of examining quantitatively and qualitatively the media covered aspects regarding the sustainability of food production.

Keywords: Food, nutrition, sustainability of food production, food sovereignty, media coverage, Germany



**EFFECTS OF COLD AND HOT EXTRACTION PROCESSES ON
PHYTOCHEMICAL CONSTITUENTS AND ANTIOXIDANT ACTIVITIES OF
METHANOL EXTRACT OF *Taminalia catappa* LEAVES**

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ABSTRACT

The effects of cold and hot extraction processes on phytochemical constituents and antioxidant activities of methanol extract of *Taminalia catappa* leaves were carried out using standard methods. The qualitative screening of hot methanol extracted sample (HTC) revealed the presence of total phenols, flavonoids, tannins, saponins, alkaloids, reducing sugars, phlobatannins, anthraquinones, glycosides and steroids while cold methanol extracted sample (CTC) showed the presence of all aforementioned phytochemicals except reducing sugars and steroids. Both extracts exhibit percentage scavenging activities of 2, 2-diphenyl-1-picryl hydrazyl radicals (DPPH) in dose dependent manner with the highest percentage in 1000 μ g/mL (70.14 \pm 0.06 and 50.30 \pm 0.24) % and lowest at 125 μ g/mL (62.37 \pm 0.41 and 44.31 \pm 0.21) % for CTC and HTC respectively. The percentage inhibition of lipid peroxidation is significantly high in HTC (84.14 \pm 0.05) % when compared with CTC (70.14 \pm 0.06) % at the concentration of 1000 μ g/mL. Although, the % DPPH scavenging activities of both extracts are not comparable to the Gallic acid at 1000 μ g/mL (77.83 \pm 0.06) % as well as other concentrations (500, 250 and 125 μ g/mL). However, HTC exhibits better percentage inhibition of lipid peroxidation (84.14 \pm 0.05) % compared with Gallic acid (77.62 \pm 0.50) % at 1000 μ g/mL. Therefore, both CTC and HTC can further be explored for the management of oxidative-stress related diseases.

Keywords: *T. catappa*, Antioxidant, DPPH, Lipid peroxidation, Oxidative-stress



YENİLEBİLİR BÖCEK BAZLI GIDA ÜRÜNLERİ VE ÜRETİM YÖNTEMLERİ

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ÖZET

Dünyada en az 2 milyar insanın -küresel nüfusun $\frac{1}{4}$ 'ü- geleneksel diyetlerinin bir parçasını oluşturduğu tahmin edilen yenilebilir böcekler, dünya nüfusundaki dramatik artış, artan çevresel sorunlar, protein talebinin ve hayvansal protein maliyetinin artışı, açlık ve yetersiz beslenme ile mücadele gibi nedenlerle sürdürülebilir gıda kaynağı olarak değerlendirilmektedir. Dolayısıyla üreticiden tüketiciye, regülasyon otoritelerinden gıda sanayine kadar geniş bir kitle açısından giderek artan bir ilgi görmektedir. Geleneksel tüketim alışkanlıklarının haricinde böceklerin yeni gıda ürünlerine dönüştürülmesiyle yani böcek-bazlı ürünlerin geliştirilmesiyle birlikte tüketim şekilleri çeşitlendirilmiştir. Bu dönüşüm ve geliştirme sürecine yönelik olarak böceklerin görünümünü ve istenmeyen tat-kokuyu maskeleyerek için öğütme, dondurma, kurutma, pişirme gibi farklı işlemler uygulanarak, işlenmiş gıda ürünlerinde kullanılmak amacıyla toz, un veya macun şeklinde ingrediyenler üretilmektedir. Ayrıca yenilebilir böcekler önemli bir protein, yağ ve kitin kaynağı olduğundan böceklerden elde edilen bu bileşenlerin ekstraktı da işlenmiş gıda ürünlerinde bir ingrediyen olarak kullanılabilir. Yenilebilir böceklerin tür çeşitliliğinin oldukça fazla olması (1900 yenilebilir tür), böcek bazlı gıda ürünlerinde kullanım şekilleri (toz, un, macun, ekstrakt) ve elde edilen ürün çeşitliliği (burger, atıştırılabilir, ekme vb.) gibi faktörler böcek bazlı ürünlerin geliştirilmesi ve üretimi konusunda yapılabilecek bilimsel çalışmaların çeşitliliğini göstermektedir. Bunlara ek olarak gıda ürününde kullanılmak üzere böcekten üretilen ingrediyenin teknolojik, fizikokimyasal vb. özelliklerinin incelenmesi, kullanıldığı gıda matrisindeki etkileşimi diğer bilimsel çalışma alanlarıdır. Böcekten üretilen ingrediyenin bu özellikleri tüketici tarafından kabul edilebilir nitelikte ürün üretilmesi açısından çok önemli bir çalışma alanı olarak gıda bilimcilerinin ilgisini çekmektedir. Ancak belirtilen alanlardaki bilimsel çalışmalar sınırlıdır. Kuzey Amerika, Kanada ve Avrupa başta olmak üzere dünya çapında artan yenilebilir böcekler ve böcek bazlı gıda ürünleri pazarı için bu çalışmalar artan bir hızla devam etmektedir. Bu pazarda yer alan



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böcek bazlı ürünlerin başında burgerler, köfteler, emülsifiye et ürünleri, fitness/enerji barları, makarnalar, kaplamalı ürünler, ekmekler, krakerler, atıştırma ürünleri, besin takviyeleri gelmektedir. Bu çalışmada böcek bazlı gıda ürünlerinden ve üretim yöntemlerinden bahsedilerek gıda araştırmacıları ve üreticileri için bir gelecek perspektifi sunulmaktadır.

Anahtar Kelimeler: böcek bazlı gıda ürünleri, yenilebilir böcekler, böcek bazlı ingredientler, böcek ürünleri, alternatif protein kaynağı, entomofaji



EDIBLE INSECT-BASED FOOD PRODUCTS AND PRODUCTION METHODS

ABSTRACT

Edible insects, estimated to form part of the traditional diet of at least 2 billion people in the World, people $\frac{1}{4}$ of the global population, are considered a sustainable food source due to the dramatic increase in the world population, increasing environmental problems, the increase in protein demand and the cost of animal protein, the fight against hunger and malnutrition. Therefore, edible insects attract increasing attention from a wide audience, from producers to consumers, from regulatory authorities to the food industry. Besides except traditional consumption habits, consumption patterns have been diversified with the conversion of insects into new food products, that is, with the development of insect-based products. For this transformation and development process, different processes such as grinding, freezing, drying, cooking are applied to mask the appearance of insects and undesirable taste-odor, and ingredients in the form of powder, flour or paste are produced for use in processed food products. In addition, since edible insects are an important source of protein, oil and chitin, the extract of these components obtained from insects can also be used as an ingredient in processed food products. The diversity of species of edible insects (1900 edible species), their use in insect-based food products (powder, flour, paste, extract) and the diversity of products obtained (burger, snack, bread, etc.) show the variety of scientific studies that can be conducted on the development and production of insect-based products. In addition to these, the examination of the technological, physicochemical properties, etc. of the ingredient produced from the insect for use in the food product and the interaction in the food matrix in where it is used are another scientific study fields. These properties of ingredient produced from insects attract the attention of food scientists as a very important field of study in terms of producing products acceptable to the consumer. However, scientific studies in the specified fields are limited. These studies show a rapid increment due to the increasing market for edible insects and insect-based food products worldwide, especially in North America, Canada and Europe. Burgers, meatballs, emulsified meat products, fitness/energy bars, pastas, coated products, breads, crackers, snacks and nutritional supplements are the leading insect-based products in this market. In the current study, insect-based food products and production methods are indicated and a future perspective is presented for food researchers and producers.

Keywords: Insect-based food products, edible insects, insect-based ingredients, insect products, alternative protein source, entomophagy



**PRODUCTION OF WATER-SOLUBLE YELLOW MONASCUS PIGMENTS VIA
ATMOSPHERIC AND ROOM TEMPERATURE PLASMA AND HEAVY ION BEAM
IRRADIATION OF *M. purpureus* IN SUBMERGED FERMENTATION**

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ABSTRACT

Monascus pigments (MPs) are famous for predominant properties of safety, forceful coloring and physiological activity, have been used in the food industry more than two thousand years. According to the tone, MPs are mainly composed of yellow MPs (YMPs), orange MPs (OMPs) and red MPs (RMPs). In this study, a mutant strain *M. purpureus* H14 with high production of YMPs (λ_{\max} at 370 nm) instead of primary alcohol-soluble YMPs (λ_{\max} at 420 nm), OMPs (λ_{\max} at 470 nm) and RMPs (λ_{\max} at 510 nm) produced by the parent strain *M. purpureus* LQ-6 was generated using dual-mutation of atmospheric and room temperature plasma (120 W of dose, treatment time T=160 s) and heavy ion beam irradiation (200Gy of dose, treatment time T=150 s), producing 18.98 U/mL of extracellular YMPs and 2.43 U/mL of intracellular YMPs. According to the compound polarity, we found that the extracellular YMPs were complete water-soluble, and named as water-soluble YMPs (WSYMPs). In addition, the WSYMPs were high stable in the present of heat (30°C~100°C) for 10 h and pH (1~14), metal ions (Na⁺, Mg²⁺, K⁺, Ca²⁺, and Zn²⁺) for 1 h, but less stable to Cu²⁺, Fe³⁺ and Fe²⁺, visible light for 8 h. Furthermore, response surface methodology was applied in submerged fermentation to enhance the WSYMPs production. The result showed that 88.34 U/mL of WSYMPs and 104.67 U/mL of total YMPs were produced with 98.26% validity based on the predicted value under optimal conditions (20 g/L glucose, 12.29 g/L Malt extract, 15 g/L peptone, 5 g/L NaNO₃, 25 g/L KH₂PO₄, 0.4 g/L Vitamin B₅, 1.5 g/L FeSO₄·7H₂O, 1.5 g/L CaCl₂, 0.2 g/L MgSO₄·7H₂O), increased by 365.44% and 388.88% compared with that of the control group, respectively. This strategy may be extended for industrial production of WSMYP by *Monascus*.

Keywords: Water-soluble yellow monascus pigments, stability, mutation, response surface methodology, *M. purpureus*.



**DAĞ ÇİLEĞİ (*Arbutus unedo* L.) VE SARI KANTARON (*Hypericum perforatum* L.)
BİTKİLERİNİN ANTİMİKROBİYAL VE ANTIQUORUM SENSING
AKTİVİTELERİNİN BELİRLENMESİ**

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ÖZET

Gıda güvenliğinin sağlanmasında ve gıdaların raf ömrünün uzatılmasında bitkisel ekstraktların doğal antimikrobiyal olarak kullanım potansiyelleri araştırılmaktadır. Yeterli çoğunluğu algılama (QS) sistemi, hücre yoğunluğuna bağlı belirli gen ekspresyonlarını düzenlemek için kullanılan mikroorganizmalar arası iletişim mekanizmasıdır. Bu nedenle, yeterli çoğunluğu algılama inhibisyonu mekanizması (anti-QS) gıda güvenliğini sağlamak için alternatif bir yaklaşım olarak değerlendirilmektedir. Bu çalışmada, dağ çileği (*Arbutus unedo* L.) yaprağı su ve metanol ekstraktlarının ve sarı kantaron (*Hypericum perforatum* L.) yaprak ve çiçeği etanol ekstraktları ile geleneksel yöntemle hazırlanmış sarı kantaron yağının test kültürleri üzerindeki antimikrobiyal ve anti-QS aktivitelerinin belirlenmesi amaçlanmıştır. Antimikrobiyal aktivite broth mikrodilüsyon yöntemi ile belirlenmiş olup, *Salmonella* Typhimurium ATCC 13311, *Staphylococcus aureus* 6538P, *Bacillus cereus* ATCC 10876, *Escherichia coli* ATCC 25922 ve *Listeria monocytogenes* Scott A test kültürleri olarak kullanılmıştır. Bitkisel ekstraktların anti-QS aktivitesi *Chromobacterium violaceum* biyosensör suşu kullanılarak agar disk difüzyon yöntemi ile belirlenmiştir. Dağ çileği yapraklarının su ve metanol ekstraktları için test kültürlerine karşı minimum inhibisyon konsantrasyonu (MİK) değerleri sırasıyla 1.97-7.90 mg/mL ve 5.16-10.31 mg/mL arasında değişmiştir. Dağ çileği yaprağının en yüksek antimikrobiyal etkisi 1.97 mg/mL MİK değeri ile *S. aureus*'a karşı su ekstraktında elde edilmiştir. Dağ çileği ekstraktlarının test kültürleri üzerinde test edilen konsantrasyonlarda bakterisidal etkisi tespit edilmemiştir. Dağ çileği yaprağı su ekstraktının test kültürleri üzerinde yüksek antibakteriyel etkilere sahip olduğu, metanol ekstraktının ise yüksek anti-QS etkisine sahip olduğu belirlenmiştir. Sarı kantaron yaprak ve çiçek ekstraktlarının MİK değerleri sırasıyla 11.38-22.76 mg/mL ve 17.82-35.64 mg/mL aralığında gözlenmiştir. Sarı kantaron ekstraktlarının test mikroorganizmaları üzerinde en yüksek bakterisidal aktiviteye sahip olduğu bulunmuştur. Minimum bakterisidal konsantrasyon (MBK) değerinin sarı kantaron yaprak ekstraktı için tüm test mikroorganizmalarına karşı 91.04 mg/mL olduğu belirlenmiştir. Ancak, sarı kantaron çiçek ekstraktının 142.55 mg/mL MBK değeri ile test edilen mikroorganizmalar arasında sadece *S. aureus* ve *S. Typhimurium*'a karşı bakterisidal etkisinin olduğu tespit edilmiştir. Geleneksel yöntemle üretilmiş sarı kantaron yağının ise, sarı kantaron ekstraktlarından daha zayıf antimikrobiyal aktivite gösterdiği saptanmış olup, tüm test mikroorganizmalarına karşı MİK değerleri %50 olarak bulunmuştur. Kantaron ve dağ çileği



**3rd INTERNATIONAL CONFERENCE
on FOOD, AGRICULTURE and VETERINARY
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ekstraktları sırasıyla 12-16 ve 20-23 mm arasında deęişen viyolasin inhibisyonu bölgeleri ile yüksek derecede anti-QS aktivitesi göstermiştir. Sonuç olarak, daę çileęi ve sarı kantaron ekstraktlarının test kültürleri üzerinde antimikrobiyal ve anti-QS aktivitelerinin olduęu ve bu ekstraktların gıda endüstrisinde antimikrobiyal ajan olarak kullanım potansiyelinin bulunduęu tespit edilmiştir.

Anahtar Kelimeler: Daę çileęi, sarı kantaron, antimikrobiyal



**DETERMINATION OF ANTIMICROBIAL AND ANTIQUORUM SENSING
ACTIVITIES OF STRAWBERRY TREE (*Arbutus unedo* L.) AND ST. JOHN'S WORT
(*Hypericum perforatum* L.) PLANT MATERIALS**

ABSTRACT

Potential use of plant extracts as natural antimicrobials for ensuring food safety and extending the shelf life of foods are being investigated. Quorum sensing (QS) system is a microbial communication mechanism to regulate gene expressions that depends on cell density. Therefore, the mechanism of quorum sensing inhibition (anti-QS) is being considered as an alternative approach for ensuring food safety. This study aimed to determine the antimicrobial and anti-QS activities of aqueous and methanolic strawberry tree (*Arbutus unedo* L.) leaf extracts and St. John's Wort (*Hypericum perforatum* L.) leaf and flower ethanol extracts and traditionally prepared St. John's Wort oil on test cultures. The antimicrobial activity was determined by using broth microdilution method against test cultures of *Salmonella* Typhimurium ATCC 13311, *Staphylococcus aureus* 6538P, *Bacillus cereus* ATCC 10876, *Escherichia coli* ATCC 25922 and *Listeria monocytogenes* Scott A. The anti-QS activity of plant extracts on *Chromobacterium violaceum* biosensor strain was determined by using the agar disk diffusion method. The results of minimum inhibition concentration (MIC) of strawberry tree leaf aqueous and methanolic extracts against the test microorganisms ranging from 1.97-7.90 mg/mL and 5.16-10.31 mg/mL, respectively. The lowest MIC value of 1.97 mg/mL was obtained against *S.aureus* for strawberry tree aqueous extract. The bactericidal effect of strawberry tree extracts at the tested concentrations was not detected for any of the test microorganism. Strawberry tree aqueous extract was determined to have high antibacterial effects, while the methanol extract had a high anti-QS effect. The MIC values of St. John's Wort leaf and flower extracts were observed ranging between 11.38-22.76 mg/mL and 17.82-35.64 mg/mL, respectively. St. John's Wort extracts were determined to have the highest bactericidal activity on test microorganisms. The minimum bactericidal concentration (MBC) values were determined as 91.04 mg/mL against all test microorganisms for St. John's Wort leaf extracts. However, the MBC values of St. John's Wort flower extract was detected for only *S. aureus* and *S. Typhimurium* among all tested microorganisms at a concentration of 142.55 mg/mL. Traditional St. John's Wort oil showed weaker antimicrobial activity than extracts and the MIC values of St. John's Wort oil were determined at the concentration of 50% (v/v) against all tested microorganisms. St. John's Wort and strawberry tree extracts showed a high degree of anti-QS activity with zones of violacein inhibition ranging from 12-16 and 20-23 mm. As a result, it has been determined that strawberry tree and St. John's Wort extracts have antimicrobial and anti-QS activity on test cultures, and these extracts have the potential use as antimicrobial agents in the food industry.

Keywords: Strawberry tree, St. John's Wort, antimicrobial



EXPLOITATION OF *Tylochromis jentinki*, STEINDACHNER, (1894) AND ITS CONTRIBUTION TO FOOD SECURITY IN IKERE-GORGE, ISEYIN, OYO STATE, NIGERIA

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ABSTRACT

Fish is a reliable source of animal protein and safe for the consumption of all including those with health conditions; thereby contributing to food and nutrition security. Although fish is a renewable resource, care must be taken not to exceed expected sustainable exploitation limit. *Tylochromis jentinki* is one of the commercial fish species in Ikere-gorge, Iseyin, Oyo State, Nigeria. It contributes significantly to the catch of artisanal fisher folks in the gorge. This study aims to estimate growth and mortality parameters of *T. jentinki* in Ikere-gorge needed for its sustainable exploitation. Estimates of population parameters of *T. jentinki* were obtained from length-frequency data of 1018 individual collected monthly for a period of 24 months from January 2017 to December 2018. The estimated growth parameters were: asymptotic length (L_{∞}) = 35.7cm; growth coefficient (K) = 1.2/year; Overall growth performance index (ϕ') = 3.19. It was observed that Length at first capture (L_c = 14.21cm) is far less than Length at maturity (L_m = 20.7cm) and optimum length (L_{opt}) cm = 22.07cm. But Reproductive load (L_m/L_{∞}) was 0.57. The estimated mortality parameters were: Total mortality of fish per year (Z/yr) = 3.98/year; Natural mortality of fish per year (M/yr) = 1.95/year; Fishing mortality of fish per year (F/yr) = 2.03/year; Exploitation rate per year = 0.51/year; Z/K = 3.42; M/K = 1.63 and Longevity = 2.5. The result showed that exploitation of *T. jentinki* is not sustainable. *T. jentinki* were not allowed to reproduce at least once before vulnerable to fishing gears and this can lead to growth overfishing. This shows indiscriminate exploitation and use of fishing gears in Ikere-gorge; which can impede sustainable food security.

Keywords: Growth, overfishing, fishing, gears, sustainable



KOLAJENİN GIDA ENDÜSTRİSİNDE KULLANIM ALANLARI, İNSAN BESLENMESİ VE SAĞLIĞI AÇISINDAN ÖNEMİ

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ÖZET

Kolajenler, memelilerdeki toplam proteinin yaklaşık %30'unu oluşturan, hayvansal kökenli ve yaygın olarak bulunan bir proteindir. Kolajen esas olarak hayvan derisi, kemik, kıkırdak, tendon ve kan damarları dahil olmak üzere tüm bağ dokularında bulunur. Kolajen tekstüre etme, koyulaştırma, jel oluşumu, yüksek su bağlama kapasitesi, emülsiyon ve köpük oluşturma, stabilizasyon, yapışma ve kohezyon, koruyucu kolloid işlevi ve film oluşturma gibi özelliklere sahiptir. Mükemmel biyolojik uyumluluğu ve parçalanabilirliği, zayıf antijenisitesi sayesinde, gıda, farmakoloji, kozmetik, biyomedikal, doku mühendisliği ve film endüstrilerinde yaygın olarak kullanılmaktadır. Kolajenin sağlık üzerinde önemli etkilerinin ortaya konulması kollajen takviyeleri endüstrisinin kurulmasına katkı sağlamıştır. İyi bir nem bağlayıcı olması, kolajen ve fraksiyonlarının, insan diyetlerinin oluşturulmasında değerli bir lif ve protein kaynağı olarak önemli bir işlevi olduğunu göstermiştir. İnsan yaşlandıkça, kolajen sentezi azalmakta ve dokular daha ince, daha zayıf ve daha az esnek hale gelmektedir. Kolajen takviyeleri, insanlarda cilt, saç, tırnak ve vücut dokularını korumaya yönelik olarak gittikçe yaygın olarak üretilmekte ve kullanılmaktadır. Bu derlemede, kolajenlerin insan sağlığı üzerindeki etkileri ve gıda endüstrisinde kullanım alanları hakkında bilgi verilmiştir.

Anahtar Kelimeler: Kolajen, gıda endüstrisi, sağlık, insan



USAGE AREAS OF COLLAGEN IN FOOD INDUSTRY, ITS IMPORTANCE IN TERMS OF HUMAN NUTRITION AND HEALTH

ABSTRACT

Collagen is a widely available protein of animal origin, accounting for approximately 30% of the total protein in mammals. Collagen is mainly found in all connective tissues, including animal skin, bone, cartilage, tendon, and blood vessels. Collagen has properties such as texturing, thickening, gel formation, high water binding capacity, emulsion and foaming, stabilization, adhesion and cohesion, protective colloid function and film forming. Thanks to its excellent biocompatibility and degradability, weak antigenicity, it is widely used in the food, pharmacology, cosmetics, biomedical, tissue engineering and film industries. Demonstrating the important effects of collagen on health contributed to the establishment of the collagen supplements industry. Being a good moisture binder, collagen and its fractions have demonstrated an important function as a valuable source of fiber and protein in the creation of human diets. As a person ages, collagen synthesis decreases and tissues become thinner, weaker and less flexible. Collagen supplements are increasingly being produced and used to protect skin, hair, nails and body tissues in humans. In this review, information is given about the effects of collagen on human health and its use in the food industry.

Keywords: Collagen, food industry, health, human



EXPERIMENTAL ANALYSIS OF HEAT-AFFECTED ZONE (HAZ) IN LASER CUTTING OF SUGAR PALM FIBER REINFORCED UNSATURATED POLYESTER COMPOSITES

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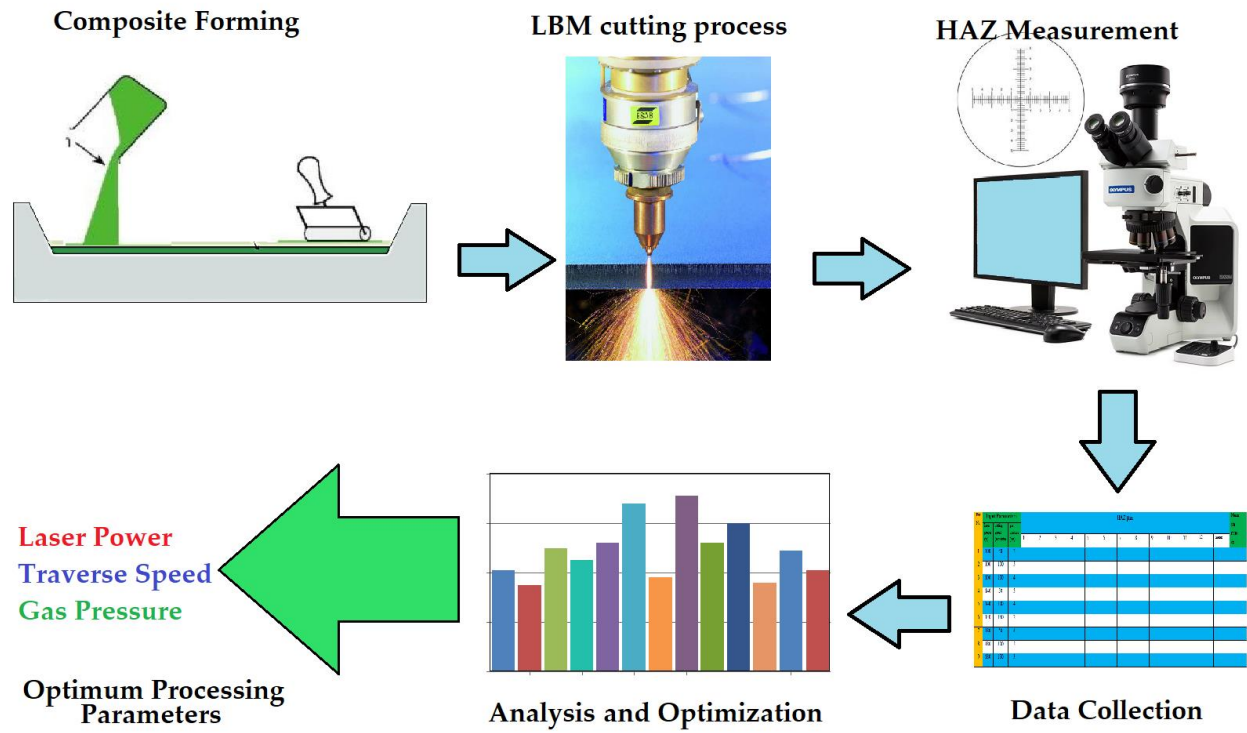
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ABSTRACT

In this paper, the influence of processing input parameters on the heat-affected zone (HAZ) of three different material thicknesses of sugar palm fiber reinforced unsaturated polyester (SPF-UPE) composites cut with a CO₂ laser was investigated. Laser power, traverse speed, and gas pressure were selected as the most influential input parameters on the HAZ to optimize the HAZ response with fixing all of the other input parameters. Taguchi's method was used to determine the levels of parameters that give the best response to the HAZ. The significance of input parameters was also determined by calculating the max-min variance of the average of the signal-to-noise ratio (S/N) ratio for each parameter. Analysis of variation (ANOVA) was used to determine each input parameter's contribution to the influence on HAZ depth. The general results show that the minimum levels of laser power and the highest levels of traverse speed and gas pressure gave the optimum response to the HAZ. Gas pressure had the most significant effect on the HAZ, with contribution decreases as the material thickness increased, followed by the traverse speed with contribution increases with the increase in material thickness. Laser power came third, with a minimal contribution to the effect on the HAZ, and it did not show a clear relationship with the change in material thickness. By applying the optimum parameters, the desired HAZ depth could be obtained at relatively low values.



Keywords: Experimental, laser



ISOLATION AND EXTRACTION OF SURFACE LAYER PROTEINS FROM LACTOBACILLUS SPECIES OF FERMENTED FOODSTUFFS LIKE KEFIR MILK

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ABSTRACT

The most commonly known outermost regularly structured layer of cell envelopes of some Lactic acid producing bacterial species, their strains, and their families have promoted the adherence to tissue surfaces with their molecular masses ranging from 45-210 KDa. The lactobacillus species is mainly employed for the fermentation of foodstuffs like milk, curd and cheese. One such example of the fermented milk is the Kefir milk which has been consumed for thousands of years and is being also utilized as a potential probiotic drink, since the lactic acid bacteria imparts some inhibitory effect against other lethal (pathogenic) microorganisms by anti-microbial substance production or competitive inhibition. The main objective of this research work is to gain an insight into the isolation and extraction procedures utilized to study the structure, function and other physio-chemical and biological properties of the surface-layer proteins of the group of bacteria that convert sugars to lactic acid. The lactic acid producing bacteria secrete three types of proteins of varying molecular weights. The common taxonomic groups in which their presence is detected are the single celled killed by normal concentrations of oxygen microorganisms whose structure is similar to bacteria layer protein A has an exhibited job in attachment to intestinal epithelial cells in vitro. The various structural sub-units are held together by the non-covalent attractions and they seem to contain low amounts of the amino acid residues. The charges embedded in the proteins have been found to majorly concentrated in the outer cell wall. In the current scenario, advancement of a standard lithium chloride S-layer extraction uncovered 27 proteins were solubilized from the S-layer wash division. Of these, 35 have anticipated cleavage destinations for emission, 24 are anticipated to be extracellular, six are lipid-secured, three have N-terminal hydrophobic layer traversing locales. These proteins of this particular bacterial species have gained widespread importance in the field of the novel drugs and other immunological domains delivering promising results in the world.

Keywords: Surface layer proteins, lactobacillus, lactic acid bacteria, biotechnology



ROLE OF DAIRY INDUSTRY IN RURAL DEVELOPMENT - A CASE OF OMFED IN ODISHA

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ABSTRACT

Odisha is a State in India with more than 85% of its population lives in rural areas. Dairy farming offers multiple opportunities to people and leave a sustainable impact on society, environment and economy. Sudden boost in the demand for dairy products in developing nation has given impetus to dairy industry in India. This industry is extended from the milk producers in the rural areas to the consumers in the urban areas all the way through performing various interim processes. The growth of dairy activities in Odisha with the support of OMFED plays as influential role for up-gradation of socio-economic status of the rural poor. In this paper, we study the role of dairy farming in rural development by providing alternative employment opportunity and assess the support system for development of this sector. The major challenges for the growth and development of this sector is non-availability of proper infrastructure and technology for processing and marketing of milk. This, in turn, becomes non-remunerative to the people engaged in this industry. The present study is a descriptive one; based on both primary and secondary data. The annual reports of OMFED and Economic Survey of Odisha constitute the major secondary data source and opinion of 200 persons involved in procuring, chilling, processing and distribution of milk and milk products are to be collected through a structured interview schedule. An objective based analysis was done by using both descriptive and inferential statistics. Dairy sector in Odisha offers an immense opportunity to increase employment, incomes and livelihoods in rural areas specifically for the migratory labour. To provide better value and attract more members, dairy industry in Odisha needs collective efforts of stakeholders, including milk producers, processors, supporting institutions, service providers and dairy professionals towards achieving this sector socially, economically and environmentally sustainable.

Keywords: OMFED, sustainable rural development, employment opportunity



CHIA MEAL AND HYDROXYTYROSOL ON THE NUTRITIONAL QUALITY OF BROILER CHICKEN MEAT

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ABSTRACT

In poultry production, the composition of the diet directly influences the meat quality of birds. The ultimate goal is to obtain a functional food with direct benefits for the consumer. In this sense, it is highlighted the use of different sources that provide high levels of omega n-3 polyunsaturated fatty acids (n-3 PUFA) in order to modify the lipid profile of the meat. However, rising the degree of unsaturation strongly increases susceptibility to lipid peroxidation and free radicals formation with negative effects on meat quality. The addition of an antioxidant is proposed as a novel technology regarding this problem. The objective of these research deals with the effect of the addition in the diet of two by-products, chia meal (*Salvia hispánica* L.; DESUS S.A, Argentine) and/or an olive antioxidant (hydroxytyrosol; GENOSA I+D, Spain), on fatty acids profile, lipids indices and ratios in breast muscle. Ninety-six, 1-d-old, Cobb-500 broiler chicks were randomly divided into 16 groups of 6 animals, which were distributed in 4 blocks. In each block experimental treatments were randomly allocated 1) C: control (without chia meal (CM), without hydroxytyrosol (HT)); 2) CM: diet with 10% chia meal; 3) CM+HT: diet with 10% chia meal + hydroxytyrosol and 4) HT: diet with hydroxytyrosol. The experimental period lasted from day 22 to day 46, at which the slaughter was carried out and breast samples were obtained from two males/ block/treatment. The dietary chia meal increased ($p<0.01$) total PUFA, total n-3 PUFA, alpha-linolenic acid, and improved ($p<0.05$) unsaturated/saturated FA ratio, omega n-6/n-3 ratio, unsaturation index and thrombogenicity index, with a slight increase in the generation of free radicals. The addition of hydroxytyrosol combined with chia meal seems to be an effective way to enhance ($p<0.01$) the stability of n-3 PUFA through oxidative damage and alpha-linolenic level, providing improvements in the meat nutritional quality, with consequent health benefits for its consumers. Hydroxytyrosol is also a good alternative to other antioxidants.

Keywords: avian, mono-phenolic, C18:3n-3, enriched products



KULUÇKA SICAKLIĞININ ETLİK PİLİÇLERDE BAĞIRSAK GELİŞİMİNE ETKİSİ

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ÖZET

Kuluçkanın 15. gününden itibaren embriyoda bağırsak ağırlığı, villus morfolojisi, enzim ve besin taşıyıcılarının aktiviteleri hızla gelişir. İnce bağırsağın emilim kapasitesi villusların boyutu ve yüzey alanıyla ilişkili olup, bağırsak gelişimi civcivlerin ileri yaşlardaki performansını etkilemektedir. Kuluçka sırasında çevresel faktörler örneğin kuluçka sıcaklığı embriyo gelişimini etkilerken, bağırsak gelişimi üzerine etkileri ise net olarak ortaya konmamıştır. Bu çalışmada, kuluçka sıcaklığında belirli günler ve süreyle yapılan manipülasyonun ince bağırsakta villus uzunluk ve genişliği üzerine etkisi incelenmiştir. Çalışma etlik piliç yetiştiriciliğinde yaygın olarak kullanılan iki genotip üzerinde yürütülerek genotip etkisinin de ortaya konması amaçlanmıştır. Cobb ve Ross genotiplerinden 98 adet yumurta her biri 196 yumurta kapasiteli 4 kuluçka makinesine, her bir makinada 24-25 yumurta olacak şekilde rastgele yerleştirilmiştir. Kuluçka makinelerinden ikisi kontrol diğer ikisi deneme grubu (ısıtma) olarak ayrılmış, kontrol grubu yumurtalar 0-18 günler arasında 37.8°C'de kuluçkalanırken; ısıtma grubu 10-14. günler arasında 6 saat/gün süreyle 38.8°C sıcaklığa maruz bırakılmış, diğer günlerde kontrol grubu ile aynı kuluçka sıcaklığı uygulanmıştır. Her iki kuluçka grubunda da 0-18 günler arasında nem düzeyi %56-60 arasında değişmiş; 18-21 günler arasında makinelerde sıcaklık ve nem sırasıyla 37.2°C ve %70 olarak korunmuştur. Kuluçka döneminde 19.günde ve çıkışta (21.gün) her gruptan rastgele örneklenen 3'er adet embriyo ve civcivden çıkarılan ince bağırsağın Meckel's diverticulum'dan alınan örnekler Hematoksilen Eosin boyama prosedürü uygulanarak mikroskop ile görüntülenmiş, villus uzunluk ve genişlikleri SigmaScan Pro programı kullanılarak ölçülmüştür. Verilerin istatistik analizi için JMP programı kullanılmıştır. Kuluçkanın 19.gününden 21.gününe kadar villus uzunluğu ve genişliği artmıştır ($P<0.001$). Villus uzunluğu için gün x hat x kuluçka interaksyonu istatistik olarak önemli bulunmuştur ($P=0.048$). Bu interaksyon, ısıtmanın villus uzunluğuna etkisinin 19. günde önemsiz olduğunu ancak 21.günde ısıtma gruplarında villus uzunluğunun gerilediğini göstermiştir. Ayrıca, Cobb genotipinden civcivlerde villus uzunluğu Ross'a göre daha fazla olmasına rağmen ısıtma ile bu fark ortadan kalkmıştır. Villuslar Cobb grubunda Ross'a göre daha geniş bulunmuştur. Villus genişliği için gün x kuluçka interaksyonu istatistik olarak önemli olup ($P<0.0001$), ısıtma grubunda 19.günde kontrole göre villuslar daha geniş bulunmuş ancak 21.günde ısıtma grubu ile kontrol grubunda villus



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genişlikleri benzer olmuştur. Bu çalışmanın bulguları, genotiplerin kuluçka sıcaklığına verdikleri tepkinin değişebileceğini ve 10-14 günler arasında 6 saat/gün süreyle 38.8°C'lik sıcaklığın kuluçkadan çıkan civcivlerin villus uzunluğunu olumsuz etkileyebileceğini göstermektedir. Kesin yargıya varabilmek için bağırsak gelişimine ait ölçümlerin büyütme döneminde de tekrarlanması gerektiği yargısına varılmıştır.

Anahtar Kelimeler: etlik piliç, kuluçka, termal manipülasyon, villus



EFFECT OF INCUBATION TEMPERATURE ON INTESTINE DEVELOPMENT OF BROILER CHICKS

ABSTRACT

From the 15th day of incubation, intestinal weight, villus morphology, enzyme activities, and nutrient transporters rapidly develop in the embryo. The absorptive capacity of the small intestine is related to the size and surface area of the villi, and intestinal development affects the performance of chicks at later ages. Although environmental factors such as incubation temperature affect embryo development, the effects of incubation temperature on intestinal development have not been clearly demonstrated. This study investigated the effect of manipulation of incubation temperature during certain days on the villus length and width of the jejunum of broiler embryos. It was also aimed to reveal the genotype effect by conducting the study on two genotypes commonly used in broiler production. A total of 98 eggs obtained from the Cobb and Ross genotypes were randomly placed into 4 incubators with a capacity of 196 eggs. The genotypes were represented with 24-25 eggs in each machine. Two of the incubators were kept as control while the other two as the experimental group (heated). The eggs in the control incubator were incubated at 37.8°C between 0 and 18 days of incubation. The heated group was exposed to 38.8°C for 6 hours/day between 10 and 14 days. The same incubation temperature as the control group was applied on the other days. Relative humidity was kept between 56 and 60% from 0 to 18 days of incubation. From 18 to 21 days, the temperature and humidity were maintained at 37.2°C and 70%, respectively, in the incubators. On day 19 of the incubation and at day of the hatch (day 21), Meckel's diverticulum of the small intestine was sampled from randomly selected 3 embryos/chicks from each group, stained with Hematoxylin and Eosin procedure, examined by the light microscope, and the length and width of the villus was measured using the SigmaScan Pro program. The data were analysed by using JMP software. From day 19 to 21 of incubation, the villus length and width increased ($P < 0.001$). A significant day x strain x incubation interaction was found for villus length ($P = 0.048$). This interaction showed that the effect of incubation temperature on villus length did not significant at 19 days, but the high incubation temperature decreased villus length at the hatch (21 days). Moreover, although the villus length of Cobb was longer than those from Ross, this difference disappeared when eggs were exposed to high temperature. Cobb embryos and chicks had larger villus compared to Ross. The interaction between day and incubation was significant for villus width ($P < 0.0001$). Although heated incubation increased villus width compared to control on day 19, villi were found to be wider in the warming group compared to the control on day 19, villus widths were similar in the heated and control groups on day 21. The findings of this study showed that the response of strains to hatching temperature may vary and 38.8°C for 6 hours/day between 10 and 14 days of incubation may negatively affect the villus length of hatched chicks. It was concluded that intestinal measurements should be repeated during the rearing period to better understand the effect of incubation temperature on intestinal development.

Keywords: broiler, incubation, thermal manipulation, villi



PRODUCTS AND BY-PRODUCTS OF THE OLIVE INDUSTRY IN BROILER DIET A BIBLIOMETRIC APPROACH ON THEIR EVOLUTION OVER TIME

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ABSTRACT

Diet is a fundamental pillar in broiler production. The investigation of possible alternatives in its management could translate into benefits on animal production, as well as obtaining products with higher nutritional quality and hygienically safe for the consumer. The olive industry generates considerable quantities of products (olives, oils) and by-products (wastewater, pomace, cakes) rich in polyphenols, which are bioactive molecules with high antioxidant and antimicrobial potential. Therefore, the use of these products and by-products as a source of nutrients in animal feed is a viable alternative. The present study aims to identify, through bibliometric techniques, the evolution in the use of these nutrients in broiler diet. Through a search in the Core Collection database of Web of Science (WoS), scientific articles of the desired topic were selected. Then, using the VOSviewer version 1.6.15 networking software, an analysis of the most relevant keywords in the documents and their variation over time was performed. The results indicate that the effect produced by olive products and by-products on the fatty acid profile and post-mortem oxidation of meat, and how these processes affected its quality, were studied from the 1990s until 2016. However, since 2017 with the discovery that polyphenols had, in addition to their recognized antioxidant power, antimicrobial and anti-inflammatory properties, recent research has focused its work on the effects that these nutrients have on growth and animal health. These studies suggest that polyphenols enriched diets are safe and present potential benefits to animal growth. These results would lay the groundwork for further studies on this subject. It is worth highlighting that this research proposal is innovative since there is no previous bibliometric evidence that analyzes the use of products and by-products of the olive industry in broiler diet.

Keywords: Poultry, hydroxytyrosol, meat quality, performance



INTEGRATION OF DIGITAL TWIN' MODELS FOR PRODUCTION INTO PLM PROCESSES IN THE FOOD AND BEVERAGE INDUSTRY

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ABSTRACT

The digital twin is a virtual replica of a real-world process operation. It is linked to the actual world via sensor data and powerful big data analytics from the field to the customer for the Food and Beverage Industry. Digital twins' models for production are being adopted by increasingly more industries. A digital twin is a digital representation of a production system that duplicates the physical system, interacts with it, and may be used to design, monitor, and optimize its performance, as described in the also context of Industry 4.0. Creating a digital twin and implementing the Product Lifecycle Management (PLM) Processes successfully would require a multidisciplinary approach while all ingredients are available for implementing digital twins. However, it is unclear that the sector is attempting to include digital twins into its operations. In this study, we examined the extent of the adoption of digital twin models and implementation to PLM processes in the food and beverage industry. We reported a literature review of digital twins in the Food and Beverage Industry, covering different fields in the sector. And we compared reported benefits, field, used categories, and technology readiness levels to assess the level of digital twin adoption to the Product Lifecycle Management (PLM) processes into the Food and Beverage Industry. The modelling difficulties, advantages, and unique characteristics that set the food and beverage industry apart from other process industries are also discussed. The potential benefits from implementing a digital twin on food and beverage industry processes are presented with the help of previous research.

Keywords: Food and beverage industries, digital twins, process simulation, digitalization, industry 4.0



NUTRITIONAL IMPROVEMENT OF TOMATO FRUITS USING A CRISPR/CAS9 SYSTEM

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ABSTRACT

The cultivated tomato is one of the most widespread horticultural species in the world and constitutes one of the major products of the agri-food industry. According to the most recent data FAO (FAOSTAT 2019), in the world are produced about 180 million tonnes. Tomato fruits are usually recommended for daily diets, due to the high content of carotenoids, vitamins, flavonoids, folates, fibers and minerals. Nonetheless tomato allergy is an important health problem that is gradually increasing with an allergenic frequency ranging between 1,5 and 20,0 % in different populations of patients with specific IgE. Moreover, tomato has some anti-nutritional substances such as glycoalkaloids, secondary metabolites toxic to human health. The main purpose of the paper is to eliminate or decrease some of these allergenic and anti-nutritional molecules, using one of the modern technologies of genome editing: the CRISPR/Cas9 system. Having, since 2012, the tomato genome fully sequenced, it was possible



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designed specific small guides for the genes of interest: Sola l 4 that is one of the major allergens in tomato and the GLYCOALKALOD METABOLISM 4 (GAME4) that is involved in a key step in the glycoalkaloid biosynthetic pathway. These small guides were inserted into a plasmid using GoldenBraid technology. Then the plasmid was used to transform tomato plants, cultivar Moneymaker, by *A. tumefaciens*. We obtain genetically stable plants for mutations in both genes. The analysis at the metabolic level show a reduction of glycoalkaloid content in leaves and fruits by up to 90% compared to control plants. Furthermore, in three lines the formation of a stop codon generated a truncated form of allergen Sola l 4 not detectable by western blot analysis with polyclonal antibody. This study demonstrates how the CRISPR / Cas9 system can be used in the genetic improvement of agri-food species of interest.

Keywords: Solanum lycopersicum, New Plant Breeding Techniques, Genome editing, Allergens, Glycoalkaloids



TOPRAKSIZ KÜLTÜRDE SÜRDÜRÜLEBİLİR BESİN SOLÜSYONU: FERMENTE GÜBRE

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ÖZET

Su kaynaklarının gün geçtikçe azalması nedeniyle kısıtlı kullanımının ön plana çıktığı son yıllarda, topraksız tarım ve bitki yetiştirme sistemleri, bitkisel gelişiminin verimli bir şekilde ilerlemesini ve elde edilecek ürününün kontrollü olarak yetiştirilmesini sağlayan önemli bir tekniktir. Özellikle toprak yapısının uygun olmadığı ve gübreleme etkinliğinin artırılması gerektiği koşullarda kullanımı büyük önem taşıyan bu teknikte, topraksız kültürde yetiştirilen bitkiler, besinlerini toprak yerine özel olarak hazırlanmış besin solüsyonlarından karşılamaktadır. Bununla birlikte, topraksız kültür gübre, sulama ve kimyasallarla bağlantılı yüksek oranda fosil yakıt girdileri içermektedir. Bu nedenle, topraksız kültür uygulamalarında bitkilerin ihtiyaç duydukları besin ve mineralleri sağlayabilecek sürdürülebilir ve çevre dostu çözümlere ihtiyaç vardır. Fermente gübre, biyogaz üretim sürecinde gerçekleşen farklı biyokimyasal ve mikrobiyolojik faaliyetler sonucu birincil ürün olarak üretilmektedir. Anaerobik fermentasyon sonucu elde edilen fermente gübre kullanımının, bitki yetiştiriciliğinde verimi arttırdığı bilinmektedir. Ayrıca, fermente gübrenin toprağın fiziksel özelliklerinin iyileştirilmesi, pH tamponlama kapasitesinin artırılması ve erozyonun önlenmesi gibi önemli yararları da bulunmaktadır. Bu çalışmada, topraksız tarım uygulamalarında fermente gübre kullanımının etkileri incelenerek, sürdürülebilirliği ve uygulamaya aktarılması konusunda geleneksel yöntemlerle kıyaslanması amaçlanmıştır. İlk olarak fermente gübre, 1 saat boyunca 70°C sıcaklık koşullarında, 1 litre çalışma hacmine sahip reaktörler içerisinde, açık ve kapalı sistem olmak üzere iki farklı şekilde sanite edilmiştir. Daha sonra kontrollü



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koşullarda, bazı agronomik parametreler (uçucu katı, toplam katı, iz elementler, toplam Kjeldahl azotu, amonyum, pH, EC) açısından fermente gübre ile ilgili incelemeler yapılmıştır. Denemelerden elde edilen sonuçlar doğrultusunda, topraksız kültürde bitki büyümesinin gerçekleştirilmesinde, sürdürülebilir ve alternatif besin maddesi çözümü olarak fermente gübrenin kullanılabilirliği tartışılmıştır.

Anahtar Kelimeler: Fermente gübre, tarım, topraksız kültür, hidroponik



SUSTAINABLE NUTRIENT SOLUTION IN SOILLESS CULTURE: A BIOGAS SLURRY

ABSTRACT

Recently, the limited utilization of water resources has come to the fore due to the decrease in water resources day by day, soilless agriculture and plant growing systems are an important technique that ensures efficient progress of plant development and controlled cultivation of the product. Plants that are grown in soilless culture absorb their nutrients from specially prepared nutrient solutions instead of soil in this approach, which is especially important in conditions when soil structure is inadequate and fertilization efficiency needs to be increased. However, soilless culture involves a higher degree of fossil fuel inputs linked to fertilizer, irrigation, and chemicals. Therefore, there is a need for sustainable and eco-friendly solutions that can provide plants with the nutrients and minerals they necessitate in soilless culture applications. The biogas slurry is produced as a primary product of different biochemical and microbiological activities that occur throughout the biogas production process. It is known that the utilization of biogas slurry obtained as a result of anaerobic fermentation provides an increase in yield in agricultural and plant production. The biogas slurry is produced as a primary product of different biochemical and microbiological activities that occur throughout the biogas production process. It is known that the utilization of biogas slurry obtained as a result of anaerobic fermentation provides an increase in yield in agricultural and plant production. In addition, biogas slurry has many benefits such as improve the physical properties of the soil, increases the pH buffering capacity, and prevents soil erosion. This study, it is aimed to examine the effects of fermentation in soilless agricultural practices and to compare it with traditional methods in terms of sustainability and transfer to practice. Firstly, biogas slurry was sanitized in two different ways as open and closed systems, in reactors with a working volume of 1 liter, at 70°C for 1 hour. Then, trials were set up to compare fermented fertilizers in terms of agronomic parameters under controlled conditions. According to the results obtained from experiments, the utilization of biogas slurry which is a sustainable and alternative nutrient solution to produce plant growth in soilless culture is discussed.

Keywords: Biogas slurry, fermented fertilizer, agriculture, soilless culture, hydroponic



PUBLIC PARTICIPATION AND SUSTAINABLE URBAN FOOD SYSTEMS PLANNING: THE NARRATIVE ON IBADAN REGION, OYO STATE, NIGERIA

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ABSTRACT

The literature on urban food systems planning are few and the few focuses mostly on urban architecture and design for urban agricultural production, allotted certain percentage of land to agricultural uses or particular components of urban agricultural systems. It is therefore imperative to assess public participation in sustainable urban food systems planning a case of Ibadan, Oyo state headquarters, Nigeria. The objectives of the study include to: 1. assess where food eaten in cities is produced, processed and sold; 2. investigate how the public participates in the urban food systems policies/plans and at what planning stage; and 3. to determine the perception of the public about urban food system planning. This paper explored system theory, concept of public participation and sustainable urban food system planning. Data were obtained from both the primary and secondary sources. The primary data were sourced through the use of questionnaire/interview guides and Focus Group Discussion. Systematic random sampling was used and descriptive statistics was used to analyse every data collected. Findings revealed that food production in the Ibadan region is done in the peri-urban LGAs and the immediate regions (Ibarapa and Oke-Ogun regions); major distribution and selling were done in the urban LGAs; and public participation in urban food systems planning was inadequate or indirect. It was recommended that allowing direct public participation from the inception to the end of the urban food systems planning will guarantee sustainable urban food system in the region; and the scope of urban master should include food plans.

Keywords: Public participation, planning, urban food system, sustainable and ibadan region



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ÖZET

Meyan, dünyadaki en eski ve en popüler bitkisel ilaçlardan biridir. Anti-inflamatuar, antialerjik, antidepresif, antiviral, antioksidan, antimikrobiyal, antidiyabetik, antiastım ve antikanser aktivitelerinin yanı sıra immünomodülatör, mide koruyucu, hepatoprotektif, nöroprotektif ve kardiyoprotektif etkileri dahil olmak üzere çeşitli farmakolojik özelliklere sahip 20'den fazla triterpenoid ve 300 flavonoid *Glycyrrhiza* türlerinden izole edilmiştir. İzole edilen bu biyoaktif maddeler içerisinde glisirizin, glisiritinik asit, likuritin ve karbenoksolon sahip oldukları farmakolojik özellikler bakımından büyük önem taşımaktadır. Mikroenkapsülasyon işlemi, biyoaktif gıda bileşiklerinin stabilizasyonunu artırarak, toz formda gıda sistemlerinde kullanımına olanak sağlayan etkili bir yöntemdir. Bu teknik ile biyoaktif bileşikler yüksek nem, ısı, ışık, asitlik, oksijen varlığı veya sindirim enzimleri gibi olumsuz çevresel faktörlerden korunmaktadır. Mikroenkapsülasyon teknikleri arasında püskürtmeli kurutma, stabil ve fonksiyonel bir ürün eldesi açısından bilinen en iyi tekniklerden biridir. Bu çalışmada, klasik ekstraksiyon yöntemi uygulanarak elde edilen meyan (*G. glabra*) ekstraktı, püskürtmeli kurutma yöntemi ile enkapsüle edilerek toz haline getirilmiştir. Püskürtmeli kurutma prosesi uygulaması sırasında Cevap Yüzey Yöntemi- Merkezi Kompozit Dizaynı (CYY-MKD) kullanılarak enkapsülasyon parametreleri optimize edilmiştir. Bu yöntemle elde edilen deney deseninde; glisirizin, glisiritinik asit, likuritin ve karbenoksolon biyoaktif maddeleri ile verim bağımlı değişkenler olarak belirlenmiştir. Toz içeceğin biyoaktif madde içerikleri LC-ESI-MS/MS kullanılarak tespit edilmiştir. Buna karşılık, kaplama maddesinin kaplanan maddeye oranı, inlet sıcaklığı ve hava akışı ise bağımsız değişkenler olarak tasarlanmıştır. Gerçekleştirilen püskürtmeli kurutma ile enkapsülasyon prosesinde kaplama maddesi olarak maltodekstrin (MD) kullanılmıştır. 20 deneme ile gerçekleştirilen deney tasarımına göre, püskürtmeli kurutma yöntemi için optimum enkapsülasyon koşulları; 3,38 MD: KM, inlet sıcaklığı 148,50 °C, hava hızı ise 44,90 mL dk⁻¹'dir. Optimum enkapsülasyon istenilirlik değeri; %74 'dür. Bu değerde, elde edilen glisirizin, glisiritinik asit, likuritin ve karbenoksolon miktarları ile verim sırasıyla; 6,8 g L⁻¹, 81,1 mg L⁻¹, 24,7 mg L⁻¹, 0,79 g L⁻¹ ve %30,95'dir. Belirlenen optimum koşullar neticesinde elde edilen ürünle, glisirizin, glisiritinik asit, likuritin ve karbenoksolon içeriği standardize edilmiş fonksiyonel toz içecek üretimi gerçekleştirilmiştir.

Anahtar Kelimeler: Meyan, mikroenkapsülasyon, optimizasyon, biyoaktif madde, LC-ESI-MS/MS



PRODUCTION OF FUNCTIONAL POWDER BEVERAGE FROM LICORICE (GLYCYRRHIZA GLABRA) BY SPRAY DRYING METHOD

ABSTRACT

Licorice is one of the oldest and most popular herbal medicines in the world. More than 20 triterpenoids and 300 flavonoids, which have several pharmacological properties including anti-inflammatory, antiallergic, antidepressive, antiviral, antioxidative, antimicrobial, antidiabetic, antiasthma, and anticancer activities as well as immunomodulatory, gastroprotective, hepatoprotective, neuroprotective, and cardioprotective effects, have been isolated from *Glycyrrhiza* species. Among these isolated bioactive substances, glycyrrhizin, glycyrrhetic acid, liquiritin and carbenoxolone are of great importance in terms of their pharmacological properties. Microencapsulation is an effective method that increases the stabilization of bioactive food compounds and allows their use in powder form in food systems. With this technique, bioactive compounds are protected from adverse environmental factors such as high humidity, heat, light, acidity, presence of oxygen or digestive enzymes. Among the microencapsulation techniques, spray drying is one of the best known techniques in terms of obtaining a stable and functional product. In this study, licorice (*G. glabra*) extract obtained by applying the classical extraction method was turned into powder by encapsulating with spray drying method. During the spray drying process application, encapsulation parameters were optimized by using the Response Surface Methodology-Central Composite Design (RSM-CCD). In the experimental design obtained by this method; glycyrrhizin, glycyrrhetic acid, liquiritin and carbenoxolone bioactives and yield were determined as dependent variables. The bioactive substance contents of the powder beverage were determined by LC-ESI-MS/MS. In contrast, the ratio of coating material to coated material, inlet temperature and air flow were designed as independent variables. Maltodextrin (MD) was used as the coating material in the encapsulation process by spray drying. According to the experimental design carried out with 20 trials, the optimum encapsulation conditions for the spray drying method; 3.38 MD: KM, 148.50 °C inlet temperature, 44.90 mL min⁻¹ air velocity. Optimum encapsulation desirability value is 74%. At this value, the obtained amounts of glycyrrhizin, glycyrrhetic acid, liquiritin, carbenoxolone and yield, respectively; 6.8 g L⁻¹ is 81.1 mg L⁻¹, 24.7 mg L⁻¹ is 0.79 g L⁻¹ and 30.95%. With the obtained product as a result of the determined optimum conditions, functional powder beverage production was carried out with standardized glycyrrhizin, glycyrrhetic acid, liquiritin and carbenoxolone contents.

Keywords: Licorice, microencapsulation, optimization, bioactive substance, LC-ESI-MS/MS.



EFFECT OF SUPPLEMENTING ACIDIFIER AND ARBUCEL TO THE DIET AT REARING ON PERFORMANCE AND GASTROINTESTINAL CHANGES OF BROILER CHICKENS

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ABSTRACT

Adding the insoluble fibers to the diet of the broiler chickens could lead to development in different parts of the GIT of birds. At the same time, acidity is a factor contributing to the replacement of beneficial bacteria with low pH consistency in the gastrointestinal tract (Clements et al. 1981). However, the fermentation of the dietary fiber in the hindgut leading to inhibiting the growth of microbial pathogens, increasing absorption of minerals and proliferating enterocytes. Therefore, the present study investigated the effect of adding Arbucel as insoluble fibers in combination with an acidifier, on the development of the digestive system and performance of the broiler chickens. 500 male Arbor Acres Plus (Aviagen) broilers were used in a completely randomized design with 4 treatments, 5 replications and 25 chickens each. Experimental treatments were included: 1- Control) the basal control group (pellet feed from 0 to 42 days), 2- Acidifier) a basal diet with acidifier from 0 to 42 days, 3- Arbucel) a basal diet with 0.7% Arbucel from 0-42 days, 4- Arbucel+ Acidifier) basal diet with 0.7% arbucel + acidifier from 0 to 42 days. One g/kg acidifier was added to the diet. The organic acid used contained propionic acid, formic acid, sodium butyrate, ammonium propionate, calcium formate, calcium lactate, ammonium formate, and calcium propionate. The average daily feed intake, daily gain and FCR were not significantly affected by dietary treatments during the starter, grower, finisher, and total period. Also, there was no significant difference in the survival rate and the relative weight of the digestive organs (Gizzard, Proventriculus, Duodenum, Jejunum, Ileum and Caecum) of the treatments. Feeding birds with Arbucel and Arbucel+ Acidifier resulted in a higher length of the jejunum (as relative to live body weight) than control and the Acidifier ($P<0.05$). At 24 days of age, the greater villi width was related to the acidifier treatment ($P<0.05$). Furthermore, the birds fed with control had the thickest muscularis layer ($P<0.05$). There was no significant difference in the villi length, crypt depth, villus height to crypt depth ratio and villus surface area between treatments at 24 days of age. At 42 days of age, the longest villi were related to the control and acidifier groups, the lower depth of the crypt was related to the birds fed with Arbucel ($P<0.05$). The highest ileum pH was related to the control treatment ($P<0.01$). Although broiler chicks treated with acidifier had a higher *Lactobacillus* population than control treatment ($P<0.05$), there was no significant difference between the treatments in the *E. coli* population. In conclusion, dietary insoluble fiber and its combination with an acidifier did not show a significant effect on the productive performance of broilers. However, the Arbucel and acidifier could decrease the pH of the Ileum and consequently resulted in the higher *Lactobacillus* bacteria.

Keywords: Arbucel, Acidifier, Insoluble fiber, Gastrointestinal tract



**COMPARISON THE EFFECT TWO STRAIN OF SACCHAROMYCES,
CEREVISIEA & ELIPSIDEUS ON PERFORMANCE, BIO-CHEMICAL AND
IMMUNO BLOOD FACTORS IN DAIRY CALVES**

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ABSTRACT

In this study 32 calves Holstien (10 ± 1 days old) with an average weights of 43.5 ± 7 kg were assigned randomly to one of three treatments with eight replicate in a complete randomized block design (RCBD) for 49 days. Compared the effect of supplementation of Saccharomyces Cerevisiea (as a probiotic), Cerevisiea strain as Bakers' Yeast, and Elipsideus strain as Brewer's Yeast on performance, glucose, albomin, total protein, BHBA, eosinophil, neutrophil, monocyte and lymphocyte concentration. The diets were formulated base on starter nutrient requirement and milk. Treatments consisted calve starter containing 0%(control), 2% yeast(bakers' yeast) and 1% yeast(brewer's yeast), supplemental as a perecentage of DM. The results of this study showed that average daily gain (ADG), Dry Matter Intake (DMI) and feed efficiency (FCR) differ significantly among treatments ($p < 0.05$). 1% yeast treatment had highest final weight. Also ADG at the second, fourth. Fifth and sixth weeks were highest in 1% yeast treatment. Average daily feed intake at third, fourth and fifth times were the lowest in 2% yeast treatment. Also this difference were significant ($p < 0.05$). AT the second, third, fourth, fifth and sixth weeks, 1% yeast treatment had the best and control treatments had the worst feed efficiency. Differences were significant ($p < 0.05$). Results showed that yeasts did not significant effect on glucose, eosinophil, neutrophil, monocyte, lymphocyte concentration ($p > 0.05$). Albomin, total protein and BHBA were the highest in 1% yeast treatment ($p < 0.05$). Results of current study showed that brewer's yeast led to best results of final weight, BWG, FCR, BHBA and blood protein. Therefore can concluded supplement of brewer's yeast to starter ration in 1% level, could have highest benefit affects at comparison with bakers' yeast and Cause early weaning as a result reduce breeding costs of dairy calves .

Keywords: Saccharomyces, yeast, probiotic, calve, performance, immuno blood factor, breeding costs, BHBA



RAFOXANİDE İLAÇ ETKEN MADDESİNİN ELEKTROKİMYASAL DAVRANIŞINI MODİFİYE ELEKTROTLA İNCELENMESİ

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ÖZET

Rafoxanide, antelmintik olarak kullanılan bir salisilaniliddir. Koyun ve sığır gibi geviş getiren hayvanlarda *Fasciola hepatica* ve *Fasciola gigantica* türlerinin yetişkin karaciğer parazitlerini tedavi etmek için yaygın olarak kullanılan veteriner ilaç etken maddesidir. Toksisitesi ılıman olmasına rağmen yüksek dozlarda kullanıldığında insan ve hayvan sağlığına etki etmektedir. Bu nedenle rafoxanide antelmintik ilaç etken maddesinin doğal ve farmasötik numunelerinde hassas, doğru, kesin ve güvenilir yeni analitik yöntemlere ihtiyaç duyulmaktadır. Literatür taramasında Rafoxanide'nin doğal ve farmasötik dozaj numunelerindeki tayinine yönelik UV-vis spektrofotometrik, HPLC, HPCL/MS ve LC/MS-MS gibi kromatografik yöntemler kullanıldığı görülmüştür. Bu analitik yöntemler çok fazla organik çözücü kullanılması, uzun ön işlem gerektirmesi, pahalı cihaz gereksinimi ve uzun analiz süreleri gibi dezavantajları nedeniyle daha hızlı, ucuz, seçici, hassas ve güvenilir yeni analitik yöntemlere ihtiyaç duyulmaktadır. Literatür araştırmasına göre Rafoxanide tayinine yönelik herhangi bir elektroanalitik yöntemlere rastlanmamıştır. Bu çalışmada, ilk defa Rafoxanide ilaç etken maddesinin elektrokimyasal davranışının dönüşümlü voltametri (CV), diferansiyel puls voltametri (DPV) ve kare dalga voltametri (SWV) gibi elektroanalitik tekniklerle incelendi. Rafoxanide ilaç etken maddesi tersinmez proses ve yükseltgenebilen (anodik) elektro aktif olduğu tespit edildi. Bu çalışmada indikatör elektrot için yalın çok duvarlı karbon nanotüp pasta elektrot (Yalın-MWCNTPE) ile TiO₂ ve CeO₂ nanopartiküllerle modifiye edilmiş çok duvarlı karbon nanotüp pasta elektrotlarla (TiO₂& CeO₂-MWCNTPE) Rafoxanide'nin tayini için daha



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19-20 June, Izmir-TURKEY



hassas bir sensör geliştirildi. Daha sonra, pik akım ve pik potansiyeline ekti eden pH, tarama hızı, basamak potansiyeli ve puls genliği gibi parametreler tek tek optimize edilerek en hassas elektroanalitik yöntem belirlendi. Çalışma aralığı, tayin limitleri ve diğer validasyon parametreleri araştırıldı. Sonuç olarak ilk defa Rafoxanide ilaç etken maddesinin elektrokimyasal davranışının incelenmesi ve doğal örneklerde tayini için valide edilmiş yeni bir elektroanalitik yöntem geliştirildi.

Anahtar Kelimeler: Rafoxanide, Tayin, Elektroanalitik, Sensör, Karbon nanomalzeme



INVESTIGATION OF THE ELECTROCHEMICAL BEHAVIOR OF RAFOXANIDE BY MODIFIED ELECTRODE

ABSTRACT

Rafoxanide is a salicylanilide used as an anthelmintic. It is a veterinary drug active ingredient widely used to treat adult liver parasites of *Fasciola hepatica* and *Fasciola gigantica* species in ruminant animals such as sheep and cattle. Although its toxicity is mild, it affects human and animal health when used in high doses. Therefore, sensitive, accurate, precise and reliable new analytical methods are needed in natural and pharmaceutical samples of rafoxanide anthelmintic drug active ingredient. In the literature research, it was seen that chromatographic methods such as UV-vis spectrophotometric, HPLC, HPCL/MS and LC/MS-MS were used for the determination of Rafoxanide in natural and pharmaceutical dosage samples. Due to the disadvantages such as the use of too many organic solvents in these analytical methods, the need for long preprocessing, the need for expensive equipment and long analysis times, faster, cheaper, selective, sensitive and reliable new analytical methods are needed. According to the literature search, no electroanalytical methods were found for the determination of Rafoxanide. In this study, the electrochemical behavior of Rafoxanide drug substance was investigated for the first time by electroanalytical techniques such as reversible voltammetry (CV), differential pulse voltammetry (DPV) and square wave voltammetry (SWV). Rafoxanide drug active ingredient was determined to be irreversible process and oxidation (anodic) electroactive. In this study, a more sensitive sensor was developed for the determination of Rafoxanide with a bare multi-walled carbon nanotube paste electrode (Bare-MWCNTPE) and multi-walled carbon nanotube paste electrodes (TiO₂ & CeO₂-MWCNTPE) modified with TiO₂ and CeO₂ nanoparticles for the indicator electrode. Then, the most sensitive electroanalytical method was determined by optimizing the parameters such as pH, scanning rate, step potential and pulse amplitude that affect the peak current and peak potential. The working range, detection limits, and other validation parameters were investigated. As a result, a new validated electroanalytical method was developed for the investigation of the electrochemical behavior of Rafoxanide drug substance and its determination in natural samples at the first time.

Keywords: Rafoxanide, determination, electroanalytical, sensor, carbon nanomaterial



EFFECT OF pH ON THE HEAT-INDUCED GELATION OF EGG YOLK ACIDULATED WITH CITRIC ACID

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ABSTRACT

Eggs are considered excellent nutritional ingredients as they provide an inexpensive and low-calorie source of high-quality protein and several important nutrients. Besides that, eggs are used worldwide as a multifunctional ingredient in many food products. This is due to their excellent functional properties for the manufacture of foams, emulsions and gels, where proteins are the dominant component contributing to this functionality. However, environmental conditions as pH value and the presence of anions can modify the functional properties of food systems. This research aims to assess the influence of citric acid on the rheological properties and microstructure of chicken egg yolk dispersions and their heat-set gels. Egg yolk is obtained from fresh, grade A and class L hen's eggs using Harrison and Cunningham method and egg yolk dispersions at pH desired are prepared by adding water or citric acid solution up to obtain a technical yolk (45 %wt in solids). Viscoelastic measurements are carried out using parallel plate geometry, performing three different kinds of tests: (i) Strain (or stress) sweep tests at different frequencies; (ii) Temperature ramp tests within a thermal cycle; (iii) frequency sweep tests at 20 °C, preceding and following the thermal cycle. The microstructure of gels is also evaluated by Scanning Electronic Microscopy (SEM). Egg yolk dispersions are greatly influenced by pH. An evolution of viscoelastic properties of egg yolk dispersions from fluid-like to gel-like behaviour may be observed as pH value decreased until 2. This behaviour can be explained in terms of the formation of a heterogeneous gel from linear aggregates as observed in SEM images. The profile of viscoelastic properties along the thermal cycle applied is modified to a great extent as a function of pH value. All the system studied show a net structural reinforcement, which are also strongly dependent on the pH value.

Keywords: Egg yolk, viscoelasticity, citric acid, heat-set gels, scanning electron microscopy



GLÜTENSİZ EKMEK ÜRETİMİNDE EKŞİ HAMUR LAKTİK ASİT BAKTERİLERİNİN ROLÜ

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ÖZET

Tahıl ve tahıl ürünleri hızlı yaşam koşulları ve değişen beslenme alışkanlıklarına rağmen günlük beslenmede halen önemini korumaktadır. Bu besin grubu insanlarda bazı hastalıklara neden olabilmektedir. Bu hastalıkların en önemlilerinden biri de çölyak hastalığıdır. Çölyak hastalığı, buğday, çavdar, arpa ve bazen yulaf ürünlerinin tüketimi sonucu ortaya çıkan otoimmün karakterli bir besin hastalığıdır. Hastalığın asıl nedeni bu tahıllarda bulunan gluten proteininin gliadin adlı alt fraksiyonu olup glutenin bağırsaktaki villuslar tarafından sindirilememesidir. Bunun sonucunda vitamin, mineral ve vücudun ihtiyaç duyduğu diğer besin öğelerinin emilimi azalmaktadır. Erken yaşlarda görülebilen bu hastalık hayatın herhangi bir döneminde de ortaya çıkabilmektedir. Hastalığın tek tedavi yöntemi ise glutensiz beslenme şeklidir. Bu açıdan glutensiz ekmek çölyak hastalığı ve gluten intoleransı olan bireylerin beslenmesinde oldukça önemlidir. Glutensiz ekmek üretiminde mısır, pirinç, karabuğday unu gibi gluten içermeyen çeşitli unlar kullanılmaktadır. Fakat ekmek üretilirken buğday kalıntıları üretim hattına karışabilmektedir. Çok düşük miktardaki bu kalıntılar çölyak hastaları için risk oluşturabilmektedir. Bu zamana kadar yapılan birçok çalışmada ekşi hamurda bulunan laktik asit bakterilerinin gluteni parçalama özelliğinin bulunduğu ortaya çıkarılmıştır. Bu nedenle ekşi hamur ekmeği laktik asit bakterileri kalıntı gluteni parçalayarak bu riski en aza indirmektedir. Ekşi hamur ekmeği, içinde laktik asit bakterileri ve mayaları bulunduran bir ekmek çeşididir. Ekmekte bu mikrobiyel ekosistemin bulunması ile gerçekleşen fermantasyon ekmeğe aroma kazandırmakta, ekmeğin besin değerini artırmakta ve raf ömrünü uzatmaktadır. Bakterilerin gluteni parçalama yetenekleri, onları endüstriyel glutensiz ekmek üretiminde oldukça önemli hale getirmekte ve bu ekmeği çölyak hastalarının veya başka nedenlerle gluten tüketiminden kaçınan bireylerin tüketebileceği bir besin haline getirmektedir. Bu çalışmada ekşi hamur laktik asit bakterilerinin glutensiz ekmek üretimindeki önemi anlatılmaya çalışılmıştır.

Anahtar Kelimeler: Glutensiz ekmek, ekşi hamur laktik asit bakterisi



THE ROLE OF SOURDOUGH LACTIC ACID BACTERIA IN GLUTEN-FREE BREAD PRODUCTION

ABSTRACT

Cereals and cereal products still maintain their importance in daily nutrition despite fast living conditions and changing nutritional habits. This food group can cause some diseases in humans. One of the most important of these diseases is celiac disease. Celiac disease is an autoimmune food disease that occurs as a result of consumption of wheat, rye, barley and sometimes oat products. The main cause of the disease is the sub-fraction of the gluten protein gliadin found in these grains, and gluten cannot be digested by the villi in the intestine. As a result, the absorption of vitamins, minerals and other nutrients needed by the body decreases. This disease which can be seen at an early age, can occur any period of life. The only treatment method for this disease is gluten-free diet. In this respect gluten-free bread is very important in the nutrition of individuals with celiac disease or gluten intolerance. Various gluten-free flours such as corn, rice, buckwheat flour are used in the production of gluten-free bread. However, wheat residues can get into the production line while bread is being produced. These very low amounts of residues can be risk for celiac patients. It has been revealed in many studies conducted so far that some lactic acid bacteria found in sourdough have the ability to break down gluten. Therefore, sourdough lactic acid bacteria break down residual gluten, minimizing this risk. Sourdough bread is a type of bread that contains lactic acid bacteria and yeasts. Fermentation with the presence of this microbial ecosystem in bread adds aroma to the bread, increases the nutritional value of bread and extends its shelf life. The ability of bacteria to break down gluten makes them very important in the production of industrial gluten-free bread, making this bread a food that can be consumed by celiac patients or individuals who avoid gluten consumption for other reasons. The importance of sourdough lactic acid bacteria in gluten-free bread production is tried to explained in this study.

Keywords: Gluten-free bread, sourdough lactic acid bacteria



**ENVIRONMENTAL AND BIOLOGICAL CHARACTERISTICS AND USE OF
MEDICINAL PLANTS THE MIKOLOJI SECURITY POLICIES**

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ABSTRACT

In Azerbaijan, many plants, including medicinal ones, have become subject of research of different nature, and they are different (botanical, pharmacological, etc.) has been studied to some extent in aspects. However, the species of medicinal plants belonging to the flora of Azerbaijan and being introduced did not become a subject of systematic Mycological, including Phytopathological research, and only in some studies it is possible to come across the names of these plants when the mushroom settlements are indicated. Although, as a result of diseases caused by fungi every year, the productivity of this or that species decreases sufficiently, many are destroyed, and as a result, the number of individuals in the population decreases [1, 2]. In order to prevent these, i.e. to identify complex measures to eliminate the negative effects observed, it is necessary to use a comprehensive (type composition, Ecological relations, frequency of occurrence, metabolic activity, etc.) of mycobiotas of medicinal plants, in particular its pathogenic representatives.) research, clarification of the form of relations between the mushroom-owning plant is very important and one of the issues that is distinguished by its actuality. Another argument that substantiates the urgency of the issue is that many medicinal plants are used in folk medicine without being subjected to thermal treatment, and their finishing or dressing, collection and preparation for use are carried out in the open system. This makes it inevitable for them to be characterized at the same time as an open system for the collection of various microorganisms, including fungi themselves and their metabolites. The fact that among the fungi, which are recorded in the distribution of medicinal plants in the conducted studies, there are enough toxins, allergens, as well as pathogens, especially conventional pathogens and enrichment of these plants with mycotoxins of fungi, as well as substances that people take for various purposes (food and medical) are also sources of transmission of various diseases [3, 4].

Keywords: Mycobiota medicinal plants, pharmacological activity, safety mycological



MEYVE VE SEBZE ATIKLARININ ET ÜRÜNLERİNDE KULLANILMASI

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ÖZET

Gıda atıkları hasat, üretim, işleme veya tüketim gibi farklı aşamalarda ortaya çıkabilmektedir. Gıda endüstrisi her yıl önemli miktarda atık üretmekte bu da gıda israfı ve çevre kirliliği gibi problemleri beraberinde getirmektedir. Özellikle tüketim için olgunluğu aşan meyve ve sebzeler ve bunların tüketilmeyen kısımları (çekirdek, kabuk, çiçek ve kök) gibi tarım endüstrisi kaynaklı atıklar gıda atıklarının önemli bir bölümünü oluşturmaktadır. Meyve ve sebze kaynaklı söz konusu atıklar antioksidan, antimikrobiyal ve lezzet artırıcı özellikteki bazı biyoaktif bileşenlerin zengin bir kaynağı olarak bilinmektedir. Polifenoller, organik asitler, yağ asitleri, terpenler, karotenoidler, proteinler, mineraller ve lif gibi eklendikleri gıdaların besin içeriğini ve kalite özelliklerini zenginleştiren bileşikler önemli miktarda içeren meyve ve sebze atıkları tüm bu özellikleri nedeniyle çeşitli gıda formülasyonlarında farklı amaçlarla kullanılabilir. Et ve et ürünleri besleyici değeri yüksek gıda grupları arasında yer aldıklarından sağlıklı bir diyetle tüketiciler tarafından sıklıkla tercih edilmektedir. Ancak taze veya işlenmiş et ürünleri yapısı gereği diğer birçok gıda grubundan daha kolay bozulma eğilimindedir. Dolayısıyla işleme, depolama ve taşıma sırasında et ve et ürünlerinde yağ ve protein oksidasyonu gibi biyokimyasal değişimler ve mikrobiyal gelişmeler meydana gelebilmekte ve söz konusu ürünlerde renk, doku ve nem gibi fizikokimyasal özellikler ve görünüş, koku ve tat gibi duyu kalite karakteristikleri olumsuz yönde etkilenebilmektedir. Günümüz tüketicilerinin besin değeri yüksek, fonksiyonel özellikleri geliştirilmiş ve kimyasal katkı maddeleri içermeyen sağlıklı ve uzun raf ömrüne sahip yüksek kaliteli gıdaları talep etmesi ile ilişkili olarak meyve ve sebze atıklarının et ve et ürünlerinde kullanılmasına yönelik çalışmalar da hızla artmaktadır. Bu çalışmada taze veya işlenmiş et ürünleri formülasyonlarında meyve ve sebze atıklarından elde edilen doğal kaynaklı bileşiklerin koruyucu, yağ ikamesi, et analogu ve fonksiyonel gıda olarak veya kalıntı nitrit içeriğini azaltmak ve duyu kalite modifikasyonlar sağlamak amacıyla kullanılması ile ilgili çalışmalar hakkında bilgi verilmesi amaçlanmıştır.

Anahtar Kelimeler: Meyve ve sebzeler, atık, et ürünleri



USE OF FRUIT AND VEGETABLE WASTES IN MEAT PRODUCTS

ABSTRACT

Food waste can occur at different stages, such as harvesting, production, processing or consumption. The food industry produces a significant amount of waste every year, which leads to problems such as food waste and environmental pollution. Particularly, agricultural industry-derived wastes such as fruits and vegetables that exceed maturity for consumption and their non-consumable parts (seed, peel, flower and root) constitute an important part of food waste. Fruit and vegetable wastes are known as rich source of bioactive components such as antioxidants, antimicrobials and flavorings. The waste of fruit and vegetable that contain a significant amount of compounds such as polyphenols, organic acids, fatty acids, terpenes, carotenoids, proteins, minerals and fiber, which enrich the nutritional content and quality properties of the foods to which they are added can be used for different purposes in various food formulations because of these properties. Meat and meat products are often preferred by consumers in a healthy diet because they are among the food groups with high nutritional value. However fresh or processed meat products tend to deteriorate more easily than many other food groups because of their structure. Therefore, biochemical changes such as fat and protein oxidation and microbial growth can occur in meat and meat products during processing, storage and transportation, and physicochemical properties of these products such as color, texture and moisture and sensory quality characteristics such as appearance, smell and taste can be adversely affected. Studies on the use of fruit and vegetable wastes in meat and meat products are increasing rapidly due to the demand of today's consumers for high quality foods with high nutritional value, improved functional properties, free of chemical additives, healthy and with long shelf life. In this study, information was given about the use of natural origin compounds obtained from fruit and vegetable waste as preservatives, fat substitutes, meat analogues and functional foods or their use in fresh or processed meat product formulations to reduce residual nitrite content and provide sensory modifications.

Keywords: Fruit and vegetables, waste, meat products



**PHYTOCHEMICAL STUDY OF HYDRO-ETHANOLIC EXTRACT OF ALGERIAN
Ficus carica. L FRUIT AND EVALUATION OF HIS ANTI-INFLAMMATORY
ACTIVITY IN VIVO**

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ABSTRACT

Throughout the history, medicinal plants have an important place in human lifestyle. The treatment of the inflammation by the medicinal drugs and herbal remedies is very old and date back to Babylonian and Assyrian physicians. In the last decade medicinal plants have gained their reputation Because of negative side effects of some chemicals used in daily life. Many researchers interest to produce biological active compounds from natural sources. with these aims, and also to replace chemical preservatives in natural products, we are interested to evaluate the chemical coupounds and the anti-inflammatory effect of hydro-ethanolic extract of Algerian *Ficus carica*. L fruit, a plant belonging to the family of Moraceae. The extract was screened for his polyphenolic, flavonoids and condensed tannins compounds by using the Folin-ciocalteu, Aluminum chloride and vanillin-Hcl assay respectively and the anti-inflammatory activity was evaluated using carrageenan induced paw edema in expremental mice. It was observed that the contents of total phenolics, total flavonoids and condensed tannins were important (403.669 mg GAE/100g of extract, 24.649 mg EQ/100g and 277.77 mg CE/100g of extract respectevly). The results showed that oral administration of the extract at doses of (250-350 and 500mg/kg) suppressed the swelling in the paw significantly with dose dependent way. the results obtained in this study show the richness of *Ficus carica*. L fruit in chemical substances which could represent a new potential source of bioactive molecules in therapy and humain diet.

Keywords: *Ficus carica*. L, chemical coupounds, anti-inflammatory activity, hydro-ethanolic extract, in vivo



FARKLI ÖNİŞLEMLER UYGULANMIŞ NOHUT UNLARININ ÇEŞİTLİ ÖZELLİKLERİ

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ÖZET

İnsan beslenmesinde tahıllar ve baklagillerin önemli bir yeri bulunmaktadır. Baklagiller arasında nohut, buğdaya göre protein, vitamin, mineral ve koruyucu fitokimyasallar bakımından daha zengindir. Bazıları geleneksel olarak uzun yıllardır uygulanmakla birlikte, tahıllar ve baklagillere, teknolojik ve besinsel kalitelerini iyileştirmek amacıyla son yıllarda çimlendirme, fermantasyon ve ekstrüzyon gibi önışlemler uygulanmaya başlanmıştır. Bu çalışmada, buğday ununa (kontrol) yer değiştirme yaklaşımıyla farklı oranlarda (%10 ve %20) öğütme hariç hiçbir önışlem görmemiş ve bazı önışlemler (çimlendirme, fermantasyon ve ekstrüzyon) uygulanmış nohut unu katılarak; elde edilen katkılı unların nem, su aktivitesi, yağ, kül, protein, toplam karbonhidrat, zedelenmiş nişasta, düşme sayısı, sedimantasyon, renk (L^*) ve hamur yoğurma özellikleri incelenmiştir. Un özelliklerinin katkıya göre değişkenlik gösterdiği saptanmıştır. Kontrol ve katkılı unların nem, su aktivitesi, yağ, kül, protein, toplam karbonhidrat, zedelenmiş nişasta, düşme sayısı, sedimantasyon ve renk (L^*) değerleri sırasıyla % 11.6-12.5, %0.47-0.52, % 1.76-2.82 (km), %0.97-1.33 (km), % 12.5-14.3 (km), %81.8-84.8 (km), %5.86-6.63, 376-420 saniye, 12.1-25.2 ml ve 87.0-88.3 aralığında değişmiştir. Unların hamur yoğurma özellikleri Miksolab cihazı ile ölçülmüş; optimum su absorpsiyonu, optimum yoğurma süresi ve yoğurma stabilitesi verileri sırasıyla %56.4-58.6, 1.15-4.30 dakika ve 4.32-8.50 dakika aralığında değişim göstermiştir. Elde edilen sonuçlara göre, ekmeçlik buğday ununa nohut unlarının ilavesi unların yağ, kül ve protein içeriklerini önemli ölçüde artırmış, nem, su aktivitesi ve karbonhidrat değerlerini ise azaltmıştır ($p<0.05$). Un karışımlarının fizikokimyasal özelliklerine bakıldığında; nohut unu ilavesinin sedimantasyon değerini düşürdüğü, çimlendirilmiş, fermente ve ekstrüze edilmiş nohut katkılı unlarda zedelenmiş nişasta içeriğini artırırken, düşme sayısı içeriğini azalttığı gözlenmiştir ($p<0.05$). Katkılı unların yoğurma süresi ve stabilitesinde (%10 nohut unu hariç) düşmeye yol açtığı gözlenmiştir. Son yıllarda insanların işlem görmemiş ya da daha az işlenmiş gıdaya talebi artmış, yapılan çalışmalar ise çimlendirme, fermantasyon ve ekstrüzyon işlemlerinin, tahılların ve baklagillerin duysal ve besinsel kalitesini artırmada etkili olduğunu ortaya koymuştur. Bu çalışmada, besleyici değeri daha yüksek olan farklı önışlemler uygulanmış nohut unlarının çeşitli gıdalara eklenmesiyle tüketicilere alternatif ürünler kazandırılarak daha yararlı fonksiyonel gıdalar geliştirilebileceği vurgulanmaktadır.

Anahtar Kelimeler: Nohut unu, çimlendirme, ekstrüzyon, fermantasyon, kalite



VARIOUS PROPERTIES OF CHICKPEA FLOURS APPLIED WITH DIFFERENT PRETREATMENT

ABSTRACT

Cereals and legumes have an important place in human nutrition. Among legumes chickpeas are richer in proteins, vitamins, minerals and protective phytochemicals than wheat. Although some of them have traditionally been applied for many years, in recent years, pretreatments such as germination, fermentation and extrusion have been applied to cereals and legumes in order to improve their technological and nutritional quality. In this study, chickpea flour which has not been subjected to any pretreatment except grinding, and which has been applied some pretreatments (germination, fermentation and extrusion) was added to the wheat flour at different rates (10% and 20%) with the displacement approach; moisture, water activity, oil, ash, protein, total carbohydrate, damaged starch, falling number, sedimentation, color (L^*) and dough kneading properties of the flour with additives were investigated. It has been determined that flour properties vary according to the additive. Moisture, water activity, oil, ash, protein, total carbohydrate, damaged starch, falling number, sedimentation and color (L^*) values of the control and added flours ranged respectively from 11.6-12.5%, 0.47-0.52%, 1.76-2.82% (dm), 0.97-1.33% (dm), 12.5-14.3% (dm), 81.8-84.8% (dm), 5.86-6.63%, 376-420 seconds, 12.1-25.2 ml and 87.0-88.3. The dough kneading properties of the flours were characterized by the Mixolab device. The optimum water absorption level, optimum kneading time and kneading stability for the flours were 56.4-58.6%, 1.15-4.30 minutes and 4.32-8.50 minutes, respectively. According to the results, the addition of chickpea flours to bread wheat flour significantly increased the oil, ash and protein contents of the flours, and decreased the moisture, water activity and carbohydrate values ($p < 0.05$). Considering the physicochemical properties of flour mixes; It was observed that the addition of chickpea flour decreased the sedimentation value, while increasing the damaged starch content in germinated, fermented and extruded chickpea added flours, it decreased the falling number content ($p < 0.05$). It was observed that flour with additives caused a decrease in kneading time and kneading stability (except 10% chickpea flour). In recent years, people's demand for unprocessed or less processed food has increased, and studies have shown that germination, fermentation and extrusion processes are effective in increasing the sensory and nutritional quality of grains and legumes. In this study, it is emphasized that more useful functional foods can be developed by being recruited alternative products to consumers by adding chickpea flours with different pretreatments which have higher nutritional value to various foods.

Keywords: Chickpea flour, germination, extrusion, fermentation, quality



MENTHOL AFFORDS CARDIOPROTECTION BY ALLEVIATING OXIDATIVE STRESS AND APOPTOSIS IN STREPTOZOTOCIN INDUCED DIABETIC RATS

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ABSTRACT

Cardiovascular complications are the leading causes of morbidity and mortality in diabetes mellitus. Hyperglycemia induced oxidative stress is an inevitable factor for the pathogenesis of cardiovascular diseases. Menthol is a natural bioactive compound having potent pharmacological activities. The objective of the present study is to investigate the cardioprotective effect of menthol on streptozotocin induced diabetic rats. Diabetes was induced in male Sprague-Dawley rats by single intraperitoneal injection of streptozotocin ((40mg/kg body weight). Menthol was administered orally at a dose of 50 mg/Kg body weight for 60 days. The levels of plasma insulin, glucose, glycated hemoglobin, toxicity markers, serum lipids, lipid peroxidation products, cardiac antioxidant enzymes, non enzymatic antioxidant reduced glutathione, and mRNA expressions of apoptotic genes were evaluated. Results were compared with diabetic rats supplemented with standard drug metformin(100mg/kg body weight). Supplementation of menthol to diabetic rats at a dose of 50mg/kg body weight significantly ameliorated hyperglycemia, elevated insulin levels, decreased HbA1c and toxicity markers, restored lipid levels, and reduced the level of thiobarbituric acid reactive substances (TBARS), conjugated dienes and lipid hydroperoxides. In addition, menthol enhanced the activities of cardiac antioxidant enzymes, superoxide dismutase, catalase, glutathione reductase, glutathione peroxidase, and non enzymatic antioxidant reduced glutathione content. Moreover, supplementation of menthol downregulated the expression of proapoptotic markers Bax, caspase3, and caspase9 and upregulated the expression of antiapoptotic marker Bcl2. These findings suggest that menthol may confer cardioprotection by attenuating oxidative stress and apoptosis in streptozotocin induced diabetic rats.

Keywords: Menthol, cardioprotection, oxidative stress, apoptosis



ROMANOV KOYUNLARDA CİNSİYET, GÖZ TARAFI VE GÜNLÜK VARYASYONLARIN GÖZ İÇİ BASINÇ ÜZERİNE ETKİLERİ

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ÖZET

Bu çalışmada bir yaşından küçük sağlıklı Romanov koyunlarda rebound tonometresi kullanılarak göz içi basıncın (GİB) belirlenmesi amaçlanmıştır. Diğer bir amaç ise hayvanların cinsiyeti, göz tarafı ve günün saatine göre göz içi basıncı değerlerinde farklılıklar olup olmadığını değerlendirmektir. Çalışma toplam 28 (14 dişi, 14 erkek) koyun üzerinde yürütüldü. GİB ölçümleri sabah (8:00) ve gece (8:00) yapıldı. Tüm koyunlarda ortalama GİB değerleri sabah 15.27 ± 2.24 mmHg, gece 14.39 ± 2.01 olarak ölçüldü ve bu iki zaman noktası arasındaki fark istatistiksel olarak anlamlı bulundu ($P < 0.05$). Ortalama GİB erkeklerde 16.43 ± 2.21 mmHg, dişilerde 17.27 ± 2.41 mmHg olarak ölçüldü ve aralarında istatistiksel olarak anlamlı ($P < 0.05$) bir fark vardı. Ortalama GİB değerleri sağ gözde 16.55 ± 2.58 mmHg, sol gözde 16.27 ± 2.67 mmHg ve aradaki bu fark istatistiksel olarak anlamsızdı ($P > 0.05$). Çalışma sonunda bir yaşından küçük koyunlarda ortalama GİB 16.29 ± 2.11 mmHg olarak belirlendi.

Anahtar Kelimeler: Göz içi basınç, tonometre, romanov sheep



EFFECTS OF SEX, EYE-SIDE, DIURNAL VARIATION ON INTRAOCULAR PRESSURE IN ROMANOV SHEEP

ABSTRACT

In this study, it was aimed to determine intraocular pressure (IOP) using rebound tonometry in healthy Romanov sheep less than one year old. Another aim was to evaluate whether there were differences in intraocular pressure values according to the animals' sex, eye side and time of day. The study was carried out on a total of 28 (14 female, 14 male) sheep. IOP measurements were made in the morning (8:00) and at night (8:00). Mean IOP values in all sheep were 15.27 ± 2.24 mmHg in the morning and 14.39 ± 2.01 at night, and the difference between these two time points was statistically significant ($P < 0.05$). Mean IOP was 16.43 ± 2.21 mmHg in males and 17.27 ± 2.41 mmHg in females, with a statistically significant difference between them ($P < 0.05$). Mean IOP values were 16.55 ± 2.58 mmHg in the right eye and 16.27 ± 2.67 mmHg in the left eye, and this difference was statistically insignificant ($P > 0.05$). At the end of the study, mean IOP in sheep less than one year old was determined as 16.29 ± 2.11 mmHg.

Keywords: Intraocular pressure, tonometry, romanov sheep



INFUNDIBULAR CYST IN ALGERIAN DROMEDARY CAMEL POPULATION: CROSS SECTIONAL STUDY AND HISTOPATHOLOGIC DESCRIPTION

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ABSTRACT

The present study was conducted over a whole year on a total of 165 female one humped camels (*Camelus dromedarius*) as a survey on genital disorders of culled animals. The prevalence of camels with pathologies of their genital tract was 20%. The incidence of females with bursal abnormalities was 18.2%. Two cases of bursitis and four cases of hydrobursitis were identified with prevalence of 1.2% and 2.4%, respectively. Among these conditions, four cases of associations with other genital pathologies namely hydrobursitis - hemorrhagic cyst, hydrobursitis - oviduct torsion, hydrobursitis - tubo-ovarian adhesion and hydrobursitis - oophoritis - periuterin adhesion. The exhaustive histopathological analysis revealed various elementary lesions i.e. multiple extensive foci of congestion and infiltration by inflammatory cells of mixed histiocytic and lymphocytic type, tissue disorganization forms pseudo-glandular dilations, hemorrhagic foci and macrophages loaded with hemosiderin and edematous stroma with degeneration and vacuolation of the cell layer. Finally, only one female camel with hydrobursitis was found to have histologically an adenomyosis. This is the first case report of adenomyosis of the infundibular cystic in dromedary camel.

Keywords: Algeria, camel, histopathology, infundibular cyst, prevalence



KARADENİZ BÖLGESİNDE KOLONİ KAYIBINDAN ETKİLENEN ARILIKLARDA AMERİKAN YAVRU ÇÜRÜKLÜĞÜ HASTALIĞININ ROLÜ

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ÖZET

Ülkemiz, koloni varlığı ve bal verimi bakımından dünyanın ilk üç ülkesinden biri olmasına rağmen kovan başına ortalama bal üretimi 14 kg dolayında olup dünya ortalaması olan 20 kg'ın altındadır. Hem dünya bal ticaretindeki payımız hem de koloni başına bal üretimimiz dikkate alındığında, ülkemizin sahip olduğu mevcut arıcılık potansiyelinden yeteri kadar faydalanamadığımız ortaya çıkmaktadır. Bunun nedenleri arasından en önemlilerden birisi ekonomik kayba ve yüksek düzeyde koloni ölümlerine sebep olan arı hastalığı ve zararlılarıdır. Amerikan Yavru Çürüklüğü hastalığı bal arısı larvalarında görülen ve larvaların ölümüne yol açan çok tehlikeli ve salgın bir yavru hastalığıdır. Dünyada en çok korkulan arı hastalıkları arasında yer almaktadır. Etkeni *Paenibacillus larvae* (P. larvae) olup, vejetatif ve spor formu olmak üzere iki formu bulunmaktadır. Ülkemizde ihbari Mecburi Hastalıklar arasında yer almaktadır. Bu çalışma; 2018-2020 yılları arasında Karadeniz bölgesinde Koloni kayıpları gözlenen arı işletmelerindeki kovanlardan yapılmıştır. 2018 yılında 64, 2019 yılından 65 ve 2020 yılından 50 kovandan olmak üzere toplam 179 adet kovana ait numunelerden Amerikan Yavru Çürüklüğü Hastalığının (AYÇ) varlığı araştırıldı. Arı ve petek numunelerinden Amerikan Yavru Çürüklüğü Hastalığının etkeni olan *Paenibacillus larvae*'nin izolasyonu ve identifikasyonu yapıldı. P. larvae'nın izolasyonu için; BHIT Agar (Brain Heart Infusion broth thiamin ilavesi ile) ve CSA (Colombia sheep blood agar) ve MYPG agar (Mueller-Hinton broth, Yeast extract, Potassium phosphate, Glucose, Pyruvate, Nalidixic acide/ Pipedimic acide ilave edilmiş) kullanıldı. P.larvae'nin identifikasyonu için Gram boyama, Carbol fuchsin, Nigrosin boyama yapıldı ve ışık mikroskopunda incelendi. Teşhis için bazı biyokimyasal testlerde (katalaz) yapıldı. Çalışma sonucunda; 179 arı işletmesinin, 23'ünün (%12,8) P. larvae tarafından enfekte olduğu tespit edilmiştir. AYÇ Hastalığının Koloni kayıplarında önemli bir rol oynadığı bilinmektedir. Bu çalışmada da AYÇ Hastalığının koloni kayıplarında önemli bir rol oynadığı belirlenmiştir. Ülkemizde ihbari mecburi bir hastalık olan AYÇ hastalığı ile mücadelede en kesin ve etkili yöntem, hastalıklı kolonilerin imha edilip, kovanlardaki hijyenik ve sağlık tedbirlerini riayet edilmesidir. Böylece hastalığın diğer kolonilere bulaşması önlenmiş olacaktır.

Anahtar Kelimeler: Arı, Amerikan Yavru Çürüklüğü, P. larvae, Besiyeri



**THE ROLE OF AMERICAN FOULBROOD DISEASE IN BEES AFFECTED BY
COLONY LOSSES IN THE BLACK SEA REGION**

ABSTRACT

Although our country is one of the top three countries in the world in terms of colony presence and honey yield, the average honey production per hive is around 14 kg and is below the world average of 20 kg. When both our share in world honey trade and honey production per colony are taken into account, it becomes clear that we cannot sufficiently benefit from the current beekeeping potential of our country. One of the most important reasons for this is bee diseases and pests, which cause economic loss and high colony deaths. American Foulbrood Disease is a very dangerous and epidemic brood disease in honey bee larvae that causes the larvae to die and stink. It is among the most feared bee diseases in the world. The causative agent is *Paenibacillus larvae* (*P. larvae*), and it has two forms: vegetative and spore form. It is among the compulsory notifiable diseases in our country. This work was made from the beehives in the bee enterprises where Colony losses were observed in the Black Sea region between 2018-2020. The presence of American Foulbrood Disease (AFD) was investigated from the samples of a total of 179 hives, 64 from 2018, 65 from 2019 and 50 from 2020. Isolation and identification of *Paenibacillus larvae*, the causative agent of American Foulbrood Disease, were performed from bee and honeycomb samples. For the isolation of *P. larvae*; BHIT Agar (Brain Heart Infusion broth with thiamin addition) and CSA (Colombia sheep blood agar) and MYPG agar (Mueller-Hinton broth, Yeast extract, Potassium phosphate, Glucose, Pyruvate, Nalidixic acide/ Pipedimic acid added) were used. Gram stain, Carbol fuchsin, Nigrosin staining were performed for the identification of *P. larvae* and examined under a light microscope. For diagnosis, some biochemical tests (catalase) were performed. In the results of working; It was determined that 23 (12.8%) of 179 bee holdings were infected by *P. larvae*. It is known that AFD plays an important role in Colony losses. In this study, it was determined that AFD played an important role in colony losses. The most precise and effective method in the fight against AFD, which is a compulsory notifiable disease in our country, is to destroy the diseased colonies and to comply with the hygienic and health measures in the hives. Thus, the transmission of the disease to other colonies will be prevented.

Keywords: Bee, American Foulbrood, *P. larvae*, Medium



APPLICATION OF ENCAPSULATED ANTIOXIDANTS IN CRYOPRESERVATION OF SPERM

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ABSTRACT

This study was designed to compare the effects encapsulated and free glutathione (GSH) on cryosurvival of Bull spermatozoa. Ejaculates were collected from six Holstein bull using artificial vagina and diluted with eight lecithin-based extenders contain different levels of encapsulated (E0, E1, E2.5 and E5mM) and free (F0, F1, F2.5 and F5mM) GSH. In this study, total glutathione content was determined in bull spermatozoa before and after cryopreservation. Total GSH in fresh semen was 4.8 ± 0.2 nmol/108 cells. Following semen cryopreservation, GSH decreased to 1.4 ± 0.2 nmol/108 cells, a 70.8% reduction ($p < 0.05$). This decrease in GSH content was associated with a decrease in sperm quality. Results showed that addition of E2.5 mM GSH to the freezing extender increased sperm quality (higher total and progressive motility). In conclusion, using 2.5mM encapsulated GSH in semen dilution could improve sperm cryosurvival of bull.

Keywords: Bull, cryosurvival, glutathione, nanoliposome, sperm cryopreservatio



PATHOLOGICAL CHANGES OF THE BLOOD SYSTEM AT BABESIOSIS IN ANIMALS

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ABSTRACT

Babesiosis or piroplasmosis is an invasive vector-borne disease caused by intracellular protozoa of the genus *Babesia* (*Babesia* spp). *Babesia canis rossi* and *Babesia gibsoni*, which are transmitted through the bites of ixodid ticks, are most often found in the middle lane. The work provides general information about the pathogenesis of this disease, its effect on the animal organism. It was found that the active reproduction of babesia in erythrocytes leads to hemolytic anemia. Red blood cells infected with babesia are destroyed by the microorganisms themselves and the body's immune system. The level of anemicity of the animal may not correlated with the level of parasitemia. One of the serious complications of canine babesiosis is disseminated intravascular coagulation. Also, infection with babesiosis leads to intravascular hemolysis, anemia, which cause hypoxia of the body. Hypoxia causes lactic acidosis. The action of pyrogens is accompanied by hyperthermia of the animal. Adaptive-compensatory reactions of the body are characterized by moderate normocytic normochromic anemia in the first few days. With the progression of the disease, anemia becomes macrocytic hypochromic and regenerative. The number of reticulocytes in the blood depends on the degree of anemia. Macrothrombocytosis (megakaryocytes are immature forms of platelets) means the active participation of the bone marrow in thrombopoiesis. Blood disorders also include leukocytosis, lymphocytosis, eosinophilia. Babesiosis is also characterized by stagnation of blood in the capillary bed with the loss of parts of the capillary network from the bloodstream and impaired hemodynamics. The causes of thrombocytopenia are still not fully understood. Changes in biochemical parameters include hyperbilirubinemia, bilirubinuria, hemoglobinemia, proteinuria, thrombocytopenia. Some animals have high hematocrit levels. These animals are at risk of developing acute renal failure or cerebral damage. Pathological changes in the circulatory system in babesiosis lead to general intoxication of the body, hypoxia, splenomegaly, pancreatitis, hepatopathies, nephropathies and other related complications. The disease leads to negative consequences for the body, and without treatment, death. This work aims to study the pathological changes in the blood system in babesiosis in more detail.

Keywords: Babesiosis, piroplasmosis, hemolytic anemia, thrombocytopenia, hypoxia



BALIK YAN ÜRÜN/ATIKLARININ DEĞERLENDİRİLMESİ İÇİN MOBİL BALIK UNU VE YAĞI ÜRETİM ÜNİTESİ DİZAYNI

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ÖZET

Ülkelerin sürdürülebilir kalkınma hedeflerine ulaşabilmesi için küresel çapta gıda israfının önlenmesi ve bu gıdaların üretimi esnasında ortaya çıkan atıkların çevreye olan olumsuz etkilerini en aza indirmesi önemli bir rol oynamaktadır. Sürdürülebilirlik ve bu tür çevresel problemlerin azaltılmasının bir yolu da sürdürülebilir gıda ve atık değerlendirme politikaları ile bu atıkları yeniden değerlendirip ekonomiye katma değer olarak kazandırılması ile sağlanabilir. Su ürünleri sektöründe bir balığın insan gıdası olarak tüketilebilir kısımları balığın ortalama %50-55'lik bir kısmını oluşturmaktadır. Geriye kalan ve azımsanmayacak bir miktar olan %45-50'lik bir kısmı (baş, iç organlar, deri, vs.) atık/yan ürün olarak değerlendirilmektedir. Ülkemizdeki büyük işletmelerin bazıları bu tür atıkları değerlendirebilmektedir (balık unu, balık yağı ve hayvansal besin olarak). Ancak küçük işletmeler ve şehir merkezlerindeki balık satış yerleri ise bu tür atıkların değerlendirilmesi ve geri dönüşümü hakkında yüksek maliyet ve iş yükünden dolayı bu atıkları çöp olarak değerlendirmektedir. Bu yaklaşımda uzun vadede ekonomik kayıp ve çevre kirliliği olarak karşımıza çıkmaktadır. Bu kapsamda yapmış olduğumuz çalışma ile balık atıklarının çöp olarak çevreye atılmasını önleyip ekonomik bir değere dönüştürebilen mobil balık unu ve balık yağı ünitesinin tasarımı gerçekleştirilmiştir. Mobil araç kasası üzerine konumlandırılan kompakt işleme ünitesi, özellikle perakende balık satış pazarlarına, yüksek balık tüketim kapasitesine sahip su ürünleri restoranlarına veya liman bölgelerine zamandan bağımsız olarak ihtiyaç halinde nakledilerek balık atıklarının işlenerek ekonomiye kazandırılması sağlanacaktır. Mobil balık unu ve balık yağı üretim sistemi; kara aracı üzerine montajlanan modüler parçaların bir bütünüdür. Tır dorsesi üzerindeki ana platform en temel haliyle, fazla suyun atıktan arındırıldığı ayrıştırıcı modülü, atıkların pişirildiği fırın modülü, pres, seperatör ve kurutucu/değirmen modüllerinden oluşmaktadır. 400 kg/saat atık işleme kapasite ile tasarlanan sistem için bilgisayar destekli yazılımlar (Solidworks v2018) kullanılarak makine ekipmanın gerçek ölçülerinde yerleşim planlaması ve sistemin genel tasarımı gerçekleştirilmiştir. Proses hattına dahil olacak balık atıkları ayrıştırıcı ünitesinden fazla suyu süzülerek fırınlara aktarılır. 90°C ve 60 dakikalık pişirme süresini takiben atık presleme ünitesinden yağ ve katı maddeler ayrıştırılarak kurutucu ve değirmen görevi gören üniteye atıklar aktarılır. Preslerin sıvı çıkışından alınacak olan akışkan 19000devir/dak hıza ulaşabilen santifürj seperatör ünitesine aktarılarak yağ ve sıvıdan ayrıştırılır. Sistemin harcayacağı saatlik güç tüketimi yaklaşık olarak 10-12 kW arasında olup bu enerji dış ünitelerden temin edilebileceği gibi kasa üstü jeneratör sistemlerinden de üretilebilecektir.

Anahtar Kelimeler: Su ürünleri işlemede inovasyon, yan ürünler, sürdürülebilirlik



DESIGN A MOBILE FISH MEAL AND OIL PRODUCTION UNIT FOR UTILIZING FISH BY-PRODUCTS/WASTE

ABSTRACT

Preventing food waste on a global scale and minimizing the negative effects of the wastes generated during the production on the environment play an important role in achieving the countries' sustainable development goals. Sustainability and one way of reducing such environmental problems can be achieved by re-evaluating these wastes and bringing them as an added value to the economy with sustainable food and waste recycling policies. In the seafood sector, the parts of a fish used for human food consumption constitute an average of 50-55% of the fish. The remaining 45-50% (head, guts, skin, etc.) of it is a substantial amount and is considered a waste/by-product. Some of the large companies in this country can recover and utilize such wastes (as fish meal, fish oil, and animal food). However, small businesses and retail fish marketers in city centers consider these wastes as trash due to the high cost and workload associated with evaluating and recycling such wastes. In this approach, we come across as economic loss and environmental pollution in the long run. In this study, the design of the mobile fish meal and fish oil unit has been carried out to prevent the fish waste from being thrown into the environment as garbage while turning them into an economic value. The compact processing unit positioned on the mobile vehicle chassis can able to be transported to retail fish markets, seafood restaurants with high fish consumption capacity, or port areas, regardless of time, and the fish wastes will be processed and brought into the economy. The mobile fishmeal and fish oil production system; is a set of modular parts mounted on the land vehicle. In its most basic form, the main platform on the truck trailer consists of the separator module where the excess water is removed from the waste, the furnace module where the wastes are cooked, the press, the separator, and the dryer/mill modules. For the system designed with a waste processing capacity of 400 kg/hour, computer-aided software (Solidworks v2018) was used to make the layout planning of the machine equipment in real dimensions and the general design of the system. Excess water from the fish waste separator unit to be included in the process line is filtered and transferred to the furnaces. After 90oC and 60 minutes of cooking time, oil and solid materials are separated from the waste pressing unit and the wastes are transferred to the unit that acts as a dryer and mill. The fluid to be taken from the liquid outlet of the presses is transferred to the centrifuge separator unit, which can reach a speed of 19000 rpm, and is separated from the oil and liquid. The hourly power consumption of the system is approximately 10-12 kW and this energy will be produced by a generator on the chassis or available external energy systems.

Keywords: Innovation in fish processing, by-product, sustainability



ANIMAL VIRAL METAGENOMICS: DISCOVERY OF NOVEL VIRUSES

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ABSTRACT

After yellow fever virus described in 1901, viruses recognized as life-threatening organisms. Viruses have the ability to infect all living organisms without any discrimination and they are on every surface also air. Last 15 years, this field has gained increased attention because of the 2009 influenza pandemic, Ebola, SARS, MERS, Zika virus outbreak, and recently COVID-19 pandemic. At the same time period, molecular biology technics such as Next-generation sequencing have an enormous role to research novel virus discoveries. In the 20th- century, virus discovery studies used electromicroscopy, serology, cell culture, and animal experiment, following years polymerase chain reaction and cloning helped to understand viral genome structure, diversity, and similarity. Fifteen years ago Next-generation sequencing (NGS) has been adapted for novel virus discoveries for viral metagenomics studies. NGS has allowed the researcher to unbiased pathogen discovery and to understand known viruses' evolution. Viral metagenomics opened a way for to researcher directly characterizes the genetic material of viruses bypassing the need for prior virus-specific in vitro or in vivo amplification and this way has been accelerated to virus discovery studies in the last decade. The goal of this presentation is to explain the state-of-the-art in virome studies in various animals and in different specimens with different methodologies such as next-generation sequencing with different taqmentation reagents and analyses total raw data in different pipeline. As a result virus discovery has an important role in animal and human science and to learn methods in this area gives privilege to researchers as well as countries, which may eventually become the epicenter of a new and unpredicted novel virus someday.

Keywords: Virome, next-generation sequencing, novel virus discovery



GENTAMİSİNE BAĞLI NEFROTOKSİSİTEYİ ÖNLEME POTANSİYELİ OLAN TEDAVİLERİN DEĞERLENDİRİLMESİ

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ÖZET

Aminoglikozitler, düşük maliyetleri, yüksek etkinlikleri ve nispeten düşük bakteri direnci nedeniyle çok sık kullanılan antibiyotiklerdendir. Fakat böbrek proksimal tübüllerinde birikerek nefrotoksositeye neden olmaları kullanımları konusunda tereddütler yaratmaktadır. Uzun yıllardır deney hayvanlarında aminoglikozit kullanımına bağlı oluşan nefrotoksositeyi önleyebilmek için koruyucu tedavi arayışları sürmektedir. Deneysel hayvan modellerinde nefrotoksosite oluşturmak için en sık kullanılan aminoglikozit gentamisinidir. Deneysel çalışmalarda, gentamisin hasarına karşı böbreği koruyucu etkiye sahip olması ümidiyle birçok konvansiyonel ilaç kullanılmıştır. Ayrıca, hormonlar, vitaminler, mineraller ve birçok bitkisel ajan da denenmiştir. Konvansiyonel ilaçlardan kalsiyum kanal blokörleri, HMGCoA redüktaz inhibitörleri, Ang II reseptör blokörleri ve N-asetil sistein en çok çalışılan ilaçlardır. Verapamil ve nifedipin gibi kalsiyum kanal blokörleri gentamisin nefrotoksitesine karşı koruyucu etki göstermiş, bu etkinin kalsiyum antagonistlerinin preglomerular ve postglomerular damarlar üzerine yaptıkları güçlü vazodilatatör etkiden kaynaklandığı açıklanmıştır. HMGCoA redüktaz inhibitörlerinden atorvastatin, çeşitli hücre sinyal yollarının inhibisyonu yoluyla serbest radikalleri azaltarak gentamisin kaynaklı nefrotoksositeye karşı potansiyel koruyucu etki göstermiştir. Ang II reseptör blokörü losartan, gentamisine bağlı artan idrar hacmini, mikroalbuminüriyi ve ayrıca serum BUN ve Cr düzeylerini ve oksidatif stres belirteçlerini önemli ölçüde azaltmış, renal tübüler hasarı önlemiştir. Güçlü bir sülfidril kaynağı olan N-asetil sistein ise gentamisine bağlı bozulan Cr klirensi, plazmadaki üre konsantrasyonları, idrarla atılan toplam protein, N-asetil-beta-D glukozaminidaz seviyelerini iyileştirmiş ve yapısal değişiklikleri önlemiştir. Kurkumin, öjenol, ginseng, kuersetin gibi birçok farklı bitkisel kökenli bileşik de denenmiş ve birçoğunun antioksidan yanıtların indüklenmesi ve oksidatif stresin önlenmesi yoluyla böbrek dokusu üzerinde koruyucu etkisi olduğu bulunmuştur. Çalışmaların önemli bir kısmında ağızdan uygulanan ürünler intraperitoneal yolla uygulanan ürünlerden daha etkili olmuştur. Bu durumun klinikte uygulamayı kolaylaştırabileceği düşünülmektedir. Ayrıca, bazı araştırmalarda çalışılan ajanlar



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19-20 June, Izmir-TURKEY



aminoglikozit tedavisi öncesinde ve / veya eşzamanlı olarak verilmiştir. Bir kısmında önceden başlanan tedavi daha etkin olmuştur. Fakat bu durum her zaman geçerli değildir. Koruyucu etkinliği değerlendirmek için genellikle böbrek fonksiyonları, oksidatif stres, inflamasyon ve apoptoz belirteçleri kullanılmıştır. Denenen birçok ajan kreatinin sonuçlarına göre aminoglikozid nefrotoksisitesinde bir iyileşme sağlamıştır. Dahası hem kreatinin hem de BUN'da doza bağlı bir koruyucu etki de gözlenmiştir. Birçok çalışmada bu belirteçlerden bir kısmında muhtemel koruyucu etkiler görülse bile tam manasıyla koruyucu bir ajan bulunamamıştır. Sonuçta, sadece kullanılan ajan değil, uygulama yolu, zamanı ve süresine göre de sonuçların değişebildiği görülmektedir. Elimizde konuyla ilgili çok sayıda çalışma olmasına rağmen, sağlam ve kesin sonuçlar elde etmek için daha fazla araştırma yapılması gerekmektedir. Bu çalışma, daha önce yapılmış araştırmaları gözden geçirmeyi ve bu konuda gelecekte yapılacak araştırmalara kapsamlı bir kaynak sağlamayı amaçlamaktadır.

Anahtar Kelimeler: Aminoglikozit, gentamisin, nefrotoksisite, oksidatif stres



EVALUATION OF POTENTIAL TREATMENTS TO PREVENT GENTAMICIN-INDUCED NEFROTOXICITY

ABSTRACT

Aminoglycosides are among the most commonly used antibiotics due to their low cost, high efficacy, and relatively low bacterial resistance. However, they cause nephrotoxicity by accumulating in the kidney proximal tubules, which raises doubts about their use. In order to prevent nephrotoxicity due to the use of aminoglycosides, studies on experimental animals have been in search of preventive treatment for many years now. Gentamicin is the most commonly used aminoglycoside to induce nephrotoxicity in experimental animal models. In experimental studies, many conventional drugs have been used in the hope of protecting the kidney against gentamicin damage. In addition, hormones, vitamins, minerals, and many herbal agents have also been tried. Calcium channel blockers, HMG-CoA reductase inhibitors, Ang II receptor blockers, and N-acetyl cysteine are among the most studied conventional drugs. Calcium channel blockers such as verapamil and nifedipine have shown a protective effect against gentamicin nephrotoxicity, and it has been explained that this effect is due to the strong vasodilator effect of calcium antagonists on preglomerular and postglomerular vessels. Atorvastatin, one of the HMGCoA reductase inhibitors, has shown a potential protective effect against gentamicin-induced nephrotoxicity by reducing free radicals through inhibition of various cell signaling pathways. Ang II receptor blocker losartan significantly reduced gentamicin-induced increased urine volume, microalbuminuria, as well as serum BUN, and Cr levels and markers of oxidative stress, preventing renal tubular damage. N-acetyl cysteine, which is a strong source of sulfhydryl, improved gentamicin-induced impaired Cr clearance, plasma urea concentrations, total protein excreted in the urine, N-acetyl-beta-D glucosaminidase levels, and prevented structural changes. Many different plant-derived compounds such as curcumin, eugenol, ginseng, quercetin have also been tested and many of them have been found to have a protective effect on kidney tissue by inducing antioxidant responses and preventing oxidative stress. In a significant part of the studies, orally administered products were more effective than intraperitoneal products. It is thought that this situation may facilitate clinical application. In addition, agents studied in some studies were given prior to and/or concomitantly with aminoglycoside therapy. In some of the studies, starting treatment earlier was more effective. But this is not always the case. In studies, kidney function, oxidative stress, inflammation, and apoptosis markers were generally used to evaluate protective efficacy. Many tested agents have improved aminoglycoside nephrotoxicity according to creatinine results. Moreover, a dose-dependent protective effect was also observed in both creatinine and BUN. Although possible protective effects are seen in some of these markers in many studies, no protective agent has been found in the full sense. As a result, it is seen that the results may vary not only according to the agent used but also according to the route, time, and duration of administration. Although we have a large number of study data on the subject, more research is needed to obtain robust and conclusive results. This study aims to review previous research and to provide a comprehensive resource for future research on this subject.

Keywords: Aminoglycoside, gentamicin, nephrotoxicity, oxidative stress



WORLD EXPERIENCE IN APPLICATION OF BRACHYTHERAPY IN THE TREATMENT OF SMALL ANIMALS' ONCOLOGICAL DISEASES: A REVIEW

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Аннотация

В данной статье рассматривается брахитерапия как метод лучевой терапии онкологических заболеваний. Учитывая явные преимущества данного способа локального облучения опухоли по сравнению с методами телетерапии и хирургическими вмешательствами, брахитерапия признана одним из ведущих и эффективных способов лечения онкологических заболеваний у мелких домашних животных. Данный обзор изучает существующие исследования и научные статьи, посвященные применению внутритканевой брахитерапии иридием-192. Именно внутритканевая брахитерапия признана более оптимальной и лабильной в качестве метода терапии различных видов опухолей, поэтому и является наиболее распространенной. Что же касается иридия-192, он является идеальным радиоизотопом для внутритканевой брахитерапии из-за его относительно малого периода полураспада 74,2 дня, гамма-излучения средней энергии (0,35 МэВ), умеренных требований к экранированию, низкой стоимости и возможности адаптации к большинству конфигураций опухолей. Результаты изучения показали, что внутритканевая брахитерапия имеет высокую эффективность при лечении постинъекционной саркомы кошек, опухолей носовой полости и пазух у собак и кошек, а также мастоцитом у мелких домашних животных. Более того, такие заболевания как карциномы, хондросаркомы, остеобластные остеосаркомы, плоскоклеточный рак, переходно-клеточные карциномы, саркомы мягких тканей, плоскоклеточные карциномы, мастоцитомы, плазмоцитомы, гемангиосаркомы, меланомы, карциномы анального мешка и многие другие также эффективно лечатся с помощью высокомошной и низкомошной брахитерапии. Таким образом, анализ результатов показывает положительное влияние внутритканевой брахитерапии на онкологические заболевания у мелких домашних животных.

Ключевые слова: Брахитерапия, Онкология, Опухоль, Домашние Животные, Лучевая Терапия, Иридий-192



**IN SITU DIALYSIS CULTURE SYSTEM FOR NATURAL PHYTOPLANKTON
COMMUNITIES**

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ABSTRACT

Estimation of in situ growth rates of natural phytoplankton populations is considered somewhat problematic due to the difficulties of maintaining natural growth conditions. Various methods were used to estimate phytoplankton growth rates in laboratories; however, these methods do not explain species interactions within natural communities. Moreover, natural conditions are almost impossible to mimic in the laboratory conditions. The method of in situ incubation of natural phytoplankton communities inside semi-permeable dialysis bags has been considered as a reliable method to demonstrate the growth rates of marine phytoplankton. The success of this method is based on the fact that dialysis bags allow the transfer of only smaller molecules than proteins. Bags used in these experiments allow the maintenance of physical and chemical contact between the enclosed phytoplankton and the surrounding medium. Therefore, incubation in dialysis membranes provide the cells an environment as close to the natural conditions as possible. In this study the growth rate of natural phytoplankton communities in the ambient sea water was compared with the natural phytoplankton communities inside the dialysis membrane bags in a fish farm located in Çandarlı in İzmir. The bags used in the experiment were made of Spectra/por 1 dialysis membrane tubing with a molecular weight cut off 6-8 kD. The comparisons were based on the chlorophyll-a concentrations measured from both inside the dialysis membrane bags and ambient sea water after the incubation period. According to the findings of the experiment, chlorophyll-a concentrations inside the dialysis membrane bags greatly exceeded the ambient water chlorophyll-a concentrations. This particular experimental design proved very useful to monitor natural systems since the observed growth dynamics resemble the natural conditions.

Keywords: Dialysis membrane bags, phytoplankton, growth



**EVOLUTION OF BODY CONDITION, MILK PRODUCTION METABOLIC
PROFILING DURING THE POSTPARTUM PERIOD IN DAIRY COWS**

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ABSTRACT

The aim of this study was to evaluate the effect of the season on some blood metabolites and Body condition Score (BCS) in dairy cows during postpartum period. Blood samples were collected from 74 clinically healthy dairy cows of 10 semi-intensive Algerian dairy herds during a whole year and allotted to four different seasons i.e. the winter, the spring and the summer. Albumin, urea, glucose, total cholesterol, calcium, phosphorus and magnesium were analysed. One-way repeated measures analysis of variance (ANOVA) showed a significant effect of the season ($P < 0.05$, $P < 0.01$ and at $P < 0.001$) on all studied parameters, except to the BCS. Apparently, the plasmatic concentrations Urea nitrogen, Albumin, Total Cholesterol, Phosphorus was us most increased during the summer. However, calcium has decreased during this period. A significant negative correlation was found between the diverse reproduction parameters with blood glucose, total cholesterol and phosphorus during winter calving, urea nitrogen at spring calving and magnesium and calcium at summer calving. These results indicated the influence of the season on blood metabolites in dairy cows during postpartum period, and reduced fertility are the main signs of nutrient deficiency in nutritional components from season to the other.

Keywords: Biochemical profile, body condition score, season, semi-arid, postpartum



SÜT VE SÜT ÜRÜNLERİNDE *CAMPYLOBACTER* SPP. İLE TOKSİNLERİNİN YOL AÇTIĞI GIDA KAYNAKLI ENFEKSİYONLAR

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ÖZET

Günümüzde gıda enfeksiyonlarına neden olan patojen mikroorganizmaların birçoğu konusunda yeterli kaynak ve çalışmalara ulaşılabilmektedir. Ancak, gıda zehirlenmelerine neden olan patojenler arasında çoğunlukla ilk sıralarda literatür çalışmalarında yer edinen *Salmonella* spp. ve/veya *Listeria monocytogenes* gelmekte olup gıda güvenliği ve dolayısı ile halk sağlığı bakımından risk teşkil eden *Campylobacter* spp. ile özellikle toksinlerinin tespiti konusunda yapılan çalışmaların ya gıda ürünü bakımından belirli gıdalarla sınırlı olduğu ya da toksinleri üzerine çalışmalar konusunun kısıtlı kaldığı görülmektedir. İnsanlarda gastroenteritis başta olmak üzere Guillain Barre Sendromu (GBS), Miller Fisher Sendromu (MFS), Hemolitik Üremik Sendrom (HUS), Reiter Sendromu, reaktif artrit gibi karşılaşılan birçok komplikasyon nedenlerinden biri olarak son zamanlarda yapılan çalışmalar ile keşfedilen ve gıda kaynaklı enfeksiyon etkenleri olarak daha çok sorumlu olan *Campylobacter jejuni*, *C. coli*, *C. lari* sıklıkla, *C. upsaliensis*, *C. concisus* ve *C. hyointestinalis* ise daha nadir olarak hayvansal gıdaların kontaminasyonları sonucunda insanlarda hastalık oluşumuna neden olan bazı *Campylobacter* türleridir. *Campylobacter* spp. sadece suş düzeyinde değil daha da önemlisi suşlarının oluşturduğu HeLa hücrelerini aktive etmesine rağmen Vera hücrelerini aktive edemeyen 70kDa büyüklüğündeki toksin, HeLa ve Vero hücrelerini aktive eden sitotoksin, hemolitik etki gösteren sitotoksinler, Shiga benzeri toksin, cytolethal distending toksin (cdt A- cdt B- cdt C) ve hepatotoksinler gibi bir dizi toksin üretebilmektedirler. *Campylobacter* spp.'nin memeliler ile kanatlı hayvanların gastrointesinal sistemlerinde bulunması gıda enfeksiyonlarının başlıca nedenini oluşturmaktadır. Çoğunlukla tavuk ve hindi eti gibi kanatlı et ve ürünleri ile kırmızı et üzerine çalışmaların bulunduğu *Campylobacter* spp.ve suşlarının aslında bir mastitis etkeni olarak ya da dışkı vasıtasıyla çiğ süt ve süt ürünleri ile yeterince pastörizasyon işlemi uygulanmamış süt ve ürünlerinde, kontamine sularda, bazı çalışmalara göre ise sebzelerde bile kontaminasyonun şekillenmesiyle gıda enfeksiyonlarında rol aldıkları görülmektedir. Bu derlemede, küçüğünden büyüğüne her dönemde çeşitli şekilleri ile sıklıkla tüketilmekte olan süt ve süt ürünlerinin *Campylobacter* spp. ve toksinleri bakımından önemi vurgulanacak olup, tespit metotları hakkında bilgi verilmesi amaçlanmıştır.

Anahtar Kelimeler: *Campylobacter* spp., toksin, süt ve süt ürünleri, halk sağlığı



**FOODBORNE INFECTIONS IN MILK AND DAIRY PRODUCTS CAUSED BY
CAMPYLOBACTER SPP. AND TOXINS**

ABSTRACT

Today sufficient resources and studies on most of the pathogenic microorganisms causing foodborne infections could be accessed. However, among pathogens that cause foodborne poisoning, usually *Salmonella* spp. and/or *Listeria monocytogenes* come forward in studies in the literature while studies on *Campylobacter* spp. and especially detection of its toxins that cause risk in terms of food safety, thus public health remain limited to certain food types or studies on toxins remain limited. Discovered in recent studies to be one of the causes of many complications in humans such as gastroenteritis primarily together with Guillain Barre Syndrome (GBS), Miller Fisher Syndrome (MFS), Hemolytic Uremic Syndrome (HUS), Reiter Syndrome, and reactive arthritis *Campylobacter jejuni*, *C. coli*, *C. lari* are some *Campylobacter* types that frequently cause diseases in humans while *C. upsaliensis*, *C. concisus*, and *C. hyointestinalis* cause diseases to a lesser extent as foodborne infection factors, as a result of contamination of food from animal origin. *Campylobacter* spp. can create a series of toxins such as toxin at 70kDa size that activates not just at the level of strains but more importantly HeLa cells created by strains while it cannot activate Vera cells, cytotoxin that activates HeLa and Vero cells, cytotoxins that made hemolytic effect, Shiga-like toxin, cytolethal distending toxin (cdt A- cdt B- cdt C), and hepatotoxins. Existence of *Campylobacter* spp. in gastrointestinal systems of mammals and poultry animals is the main cause of foodborne infections. Studies on *Campylobacter* spp. and strains are mostly conducted on meat and products of poultry animals such as chicken and turkey together with red meat. However, *Campylobacter* spp. and strains most frequently play role as a mastitis factor or through feces in raw milk and milk products and milk and milk products that are not subjected to sufficient pasteurization process, contaminated waters and according to some studies even in vegetables with embodiment of contamination. Purpose of this compilation is emphasizing significance of milk and milk products that are frequently consumed large and small in every period and in various types in terms of *Campylobacter* spp. and toxins and providing information on detection methods.

Keywords: *Campylobacter* spp., toxin, milk and milk product, public health



**IONIC LIQUID DOPED POLYMER ELECTROLYTE (ILDPE): A NOVEL
ELECTROLYTE FOR ELECTROCHEMICAL DEVICES**

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ABSTRACT

Ionic liquids (IL) are well known recent material attracts researcher all over world. Apart from novel alternative as solvent it proves its safe place as electrolytes in electrochemical applications like Batteries, Solar Cells, Fuel Cells, Supercapacitors etc. Variety of low viscosity ionic liquid, like 1-ethyl -3-methyl imidazolium dicyanamide (EmImdcn, viscosity 28 cP at 20 °C) and a polymers, *i.e.* polyvinyl alcohol (PVA), Polyethylene oxide (PEO) have been prepared using solution cast technique and characterized by impedance spectroscopy, optical microscopy (OM), differential scanning calorimetry, x-ray diffraction (XRD), and fourier transform infrared spectroscopy (FTIR). Mixing ionic liquid with polymer matrix supresses the crystallinity of polymer matrix and enhancement in electrical conductivity was noted. Highly efficient supercapacitors and dye sensitized solar cell using these ILDPE already proves its suitability for various energy devices.

Keywords: Polymer, ionic liquid, conductivity, energy devices



KURŞUN NİTRAT VE KADMIYUM KLORİD'İN RAT AKCİĞER DOKUSU ÜZERİNE TOKSİK ETKİSİ VE SESAMOL'ÜN KORUYUCU ROLÜ

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ÖZET

Ağır metaller tüm dünyada endüstrinin birçok alanında kullanılmaktadır. Çevresel kirlenmeler olarak kabul edilen ve biyolojik olarak parçalanamayan kurşun ve kadmiyum, hem insanlar hem de hayvanlar için toksik ağır metallerdir. Eritme ve madencilik, pil ve seramik üretimi ile ilgili endüstriler kurşun ve kadmiyumun yayılmasına neden olmaktadır. İnsanlar, kurşun ve kadmiyuma tek tek veya karışımlar halinde maruz kalmaktadır. Kurşun ve kadmiyuma maruz kalmanın böbrekleri, karaciğeri, kardiyovasküler sistemi, merkezi ve periferik sinir sistemlerini, hemopoietik sistemi ve üreme sistemlerini etkilediği bilinmektedir. Ayrıca, bu ağır metaller oksidan/antioksidan dengesini bozar ve oksidatif strese neden olur. Sesamol, susam yağının bir bileşeni olan güçlü bir fenolik antioksidandır. Bu çalışma, rat akciğer dokusunda tek tek ve kombinasyon halinde uygulanan kurşun nitrat ve kadmiyum kloridin sebep olduğu toksisite üzerine sesamolün potansiyel koruyucu etkilerini değerlendirmeyi amaçlamıştır. Yapılan deneysel çalışma protokolü Gazi Üniversitesi Hayvan Deneyle Yerel Etik Komitesi tarafından onaylanmıştır (G.U.ET-17.086). Bu çalışmada, Wistar albino ratlar 28 gün boyunca gavaj yoluyla kurşun nitrat, kadmiyum klorid ve sesamole maruz bırakılmıştır. 48 rat sekiz gruba (her grupta altı deney hayvanı) ayrılmıştır. Çalışma grupları; kontrol grubu, sesamol (50 mg/kg v.a. gün) uygulanan grup, kurşun nitrat (90 mg/kg v.a. gün) uygulanan grup, kadmiyum klorid (3 mg/kg v.a. gün) uygulanan grup, kurşun nitrat + kadmiyum klorid uygulanan grup, kurşun nitrat + sesamol uygulanan grup, kadmiyum klorid+ sesamol uygulanan grup ve kurşun nitrat + kadmiyum klorid + sesamol uygulanan gruplardan oluşmaktadır. 28 günlük deney sürecinin sonunda, ratların akciğer dokusunda malondialdehit (MDA) seviyesi ve antioksidan enzim aktiviteleri [süperoksit dismutaz (SOD), katalaz (CAT), glutatyon peroksidaz (GPx), glutatyon-S-transferaz (GST)] kontrol grubu ile karşılaştırılarak değerlendirilmiştir. Tek tek ve kombinasyon halinde uygulanan kurşun nitrat ve kadmiyum klorid maruziyeti, kontrol grubuna kıyasla ratların akciğer dokusunda antioksidan enzimlerin aktivitelerini azaltırken, MDA düzeylerini önemli ölçüde artırmıştır. Sesamolün, kurşun nitrat ve kadmiyum kloride maruz kalan sıçanlara oral yoldan verilmesi, MDA seviyelerini önemli ölçüde azaltırken, antioksidan enzimlerin aktivitelerini artırmıştır. Işık mikroskopik incelemeler, 4 haftalık kurşun nitrat ve kadmiyum klorid maruziyetinin ratların akciğer dokusunda histopatolojik değişikliklere neden olduğunu ortaya koydu. Bu çalışmada sesamol uygulaması kurşun nitrat ve kadmiyum kloridin neden olduğu akciğer toksisitesine karşı koruma sağlarken toksisiteyi tamamen önlememiştir.

Anahtar Kelimeler: Kurşun nitrat, kadmiyum klorid, sesamol, akciğer



**TOXIC EFFECTS OF LEAD NITRATE AND CADMIUM CHLORIDE ON RAT
LUNG TISSUES AND PROTECTIVE ROLE OF SESAMOL**

ABSTRACT

Heavy metals are used in many areas of industry all over the world. Lead and cadmium, which are considered environmental pollutants and are not biodegradable, are heavy metals that are toxic to both humans and animals. Industries related to smelting and mining, battery and ceramics manufacturing cause emissions of lead and cadmium. Humans are exposed to lead and cadmium individually or in mixtures. Exposure to lead and cadmium is known to affect the kidneys, liver, cardiovascular system, central and peripheral nervous systems, hemopoietic system, and reproductive systems. In addition, these heavy metals disrupt the oxidant/antioxidant balance and cause oxidative stress. Sesamol is a powerful phenolic antioxidant, a component of sesame oil. This study aimed to evaluate the potential protective effects of sesamol on toxicity caused by lead nitrate and cadmium chloride administered individually and in combination in rat lung tissues. The experimental study protocol was approved by Gazi University Animal Experiments Local Ethics Committee (G.U.ET-17.086). In this study, Wistar albino rats were exposed to lead nitrate, cadmium chloride and sesamol by gavage for 28 days. 48 rats were divided into eight groups (six experimental animals in each group). Experimental groups; control group, sesamol (50 mg/kg bw per day) treated group, lead nitrate (90 mg/kg bw per day) treated group, cadmium chloride (3 mg/kg bw per day), treated group, lead nitrate plus cadmium chloride treated group, lead nitrate plus sesamol treated group, cadmium chloride plus sesamol treated group and lead nitrate plus cadmium chloride plus sesamol treated groups. At the end of the 28-day experiment period, malondialdehyde (MDA) level and antioxidant enzyme activities [superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-S-transferase (GST)] in lung tissue of rats were compared with the control group. Exposure to lead nitrate and cadmium chloride administered individually and in combination significantly increased MDA levels while decreasing the antioxidant enzymes activities in the lung tissues of rats compared to the control group. Oral administration of sesamol to rats exposed to lead nitrate and cadmium chloride significantly decreased MDA levels while increasing the activities of antioxidant enzymes. Light microscopic examinations revealed that 4 weeks of exposure to lead nitrate and cadmium chloride caused histopathological changes in rat lung tissues. In this study, while sesamol administration protected against lung toxicity caused by lead nitrate and cadmium chloride, it did not completely prevent toxicity.

Keywords: Lead nitrate, cadmium chloride, sesamol, lung



**MODERN AND CONVENTIONAL APPROACHES FOR FLAX LIGNAN
EXTRACTION**

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ABSTRACT

The flaxseed has been characterized as raw material with potential edible oil contents, industrial ingredient as curing agent, high fiber production and seed enriched with value-added nutritional components. The whole grain flaxseed and defatted flaxseed meal has been recognized as one of the richest sources of lignans. Different conventional and modern techniques have been adopted to extract the flax lignans as macromolecule. In a conventional way, flax lignans are extracted using hydrolysis process of the glycoside with hydrolytic enzymes such as glucuronidases. The lignan macromolecule can be extracted from flax raw material with alcohols and the secoisolariciresinol diglucoside (SDG) can be released from it by alkaline hydrolysis. Alkaline hydrolysis breaks ester linkages. The acid hydrolysis process has also been practiced on industrial scale. Strong acid hydrolysis breaks ester linkages and glycosidic bonds. Modern techniques involve microwave and ultrasound assisted extraction. Conversion to volatile derivatives is required for the analysis of the resulting aglycones (SEC and MAT) using High-performance liquid chromatography (HPLC) and Gas-chromatography mass spectrometry (GC-MS). SDG is always part of a complex lignan macromolecule, in which, it is ester linked to 3-hydroxy-3-methylglutaric acid (HMGA). The SDG molecules in the lignan



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19-20 June, Izmir-TURKEY**



macromolecule ranges from 1 to 7 but usually it presents in number 3. Defatted flaxseed flour contains up to 1-3% SDG of its composition. The lignan macromolecule also includes herbacetin diglucoside, p-coumaric acid glucoside, caffeic acid and ferulic acid glucoside. High amounts of starch increase the viscosity of the raw samples and complicates further sample treatment. Therefore, viscosity is reduced by using extraction solvents. Preferable way is to use starch-free sample extract for lignan extraction with maximum yield.

Keywords: Flaxseed, Lignans, SDG, Extraction, HPLC, GC-MS



**PİYASAYA SUNULAN ET VE ET ÜRÜNLERİNDE *Toxoplasma gondii* VE
SARCOCYSTIS SPP. DOKU KİSTLERİNİN PERCOLL GRADIENT YÖNTEMİYLE
ARAŞTIRILMASI**

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ÖZET

Bu çalışmanın amacı Kırıkkale ve Ankara’da perakende satışa sunulan kuzu eti, sığır eti, kasap köfte ve sucuklardaki *Toxoplasma gondii* ve *Sarcocystis* spp. doku kistlerinin Percoll gradient yöntemiyle mikroskopik olarak incelenmesidir. Bu amaçla Kırıkkale ve Ankara’daki kasap ve marketlere gidilerek, bahsedilen her bir et ürününden 50’şer adet (toplam 200 adet) alınmıştır. Alınan örnekler soğuk zincir kurallarına uyularak Kırıkkale Üniversitesi Veteriner Fakültesi Parazitoloji Anabilim Dalı Rutin ve Epidemiyoloji laboratuvarına alınmıştır. Alınan örneklerin her birinden 5 g örnek tartılmıştır. Tartılan örnekler steril plastik kaplara alınmış ve üzerine 20 ml steril fosfat buffer saline (PBS) solüsyonu eklenmiştir. Örnekler bir homojenizatör (OMNI Tip, Amerika) yardımı ile parçalanarak tamamen homojen bir solüsyon elde edilmiştir. Elde edilen solüsyon bir süzgeç yardımıyla santrifüj tüplerine süzöldükten sonra, tüpler 500 g’de 20 dk santrifüj edilmiştir. Santrifüjden sonra üstteki süpernatant atıldı. Daha sonra santrifüj tüplerine sırasıyla %90 ve %30’luk percoll solüsyonlarından 1’er ml tabaka oluşturacak şekilde eklenmiştir. Bu percoll solüsyonlarının üzerine her bir örnekten percalle karışmayacak ve tabaka oluşturacak şekilde yavaşça 4 ml doku homojenatı eklenmiştir. Bu tüpler 4000 g’de 20 dk santrifüj edilmiştir. İşlem sonunda percoll dilüsyon tabakaları arasında kalan alan pasteur pipeti yardımıyla dikkatli bir şekilde alınarak 1.5 ml’lik mikrotüplere aktarılmıştır. Her bir numuneden 10 adet lamel sahası *T. gondii* ve *Sarcocystis* spp. doku kistlerinin varlığı yönünden ışık mikroskobu altında incelenmiştir. İncelenen 200 örneğin %78.5’inde en az bir parazitin doku kistine rastlanmıştır. Toplam örneklerin %2.5’inde *T. gondii*, %56.5’inde *Sarcocystis* spp. doku kistlerine tek olarak ve %19.5’inde *T. gondii*+*Sarcocystis* spp. doku kistleri miks şekilde tespit edilmiştir. İncelenen kuzu etlerinin %94’ü, Sığır etlerinin %62’si, Kasap köftenin %90’ı ve Sucuk’un %68’i en az bir tür ile enfekte bulunmuştur. Sonuç olarak Ankara ve Kırıkkale’de satışa sunulan et ve et ürünlerinde yoğun olarak *T. gondii* ve *Sarcocystis* spp. doku kistlerine rastlanmıştır. *T. gondii*’nin zoonoz özellikte olması nedeniyle et ve et ürünlerinin iyi pişirildikten sonra tüketilmesi halk sağlığı açısından büyük önem arz etmektedir. Et ve et ürünlerinde *Sarcocystis* spp. doku kistlerinin oranını azaltmak için, hayvanların etkenle enfekte olmaması için gerekli kontrol ve korunma tedbirlerinin alınması gerekmektedir.

Anahtar Kelimeler: Et ürünleri, percoll gradient, *sarcocystis*, *Toxoplasma gondii*



INVESTIGATION OF TOXOPLASMA GONDII AND SARCOCYSTIS SPP. TISSUE CYSTS IN MEAT AND MEAT PRODUCTS AVAILABLE TO THE MARKET BY PERCOLL GRADIENT METHOD

ABSTRACT

Purpose of this study is microscopic examination of *Toxoplasma gondii* and *Sarcocystis* spp. in lamb meat, beef, meatball and sausages launched for retail sale in Ankara and Kırıkkale using Percoll Gradient method. By visiting butchers in Ankara and Kırıkkale 50 pieces of each meat products (200 total) were purchased. The samples that are taken, carried to Kırıkkale University, Faculty of Veterinary Medicine, Department of Parasitology, Routin and Epidemiology Laboratory in cold chain. 5 grams of sample were taken from each piece. Weighed samples were taken to sterile containers filled with 20 ml of phosphate buffer saline (PBS). Samples were turned to a completely homogeneous solution by a homogenizer (OMNI type, America). Obtained solution were transferred to centrifuge tubes and centrifuged for 20 minutes in 500 g. After that the supernatant separated and then respectively %90 and %30 percoll solutions were added to centrifuge tubes as 1 ml of layers. Onto this percoll solutions 4 ml of tissue homogenate added without interfering with percoll solution. Afterwards these tubes were centrifuged for 20 minutes in 4000g. At the end of this process the samples are collected by a pasteur pipette from between percoll dilution layers and transferred to 1.5 ml microtubes. Ten coverslip areas from each sample were examined under the light microscope for the presence of *T. gondii* and *Sarcocystis* spp. tissue cysts. In %78.5 of the 200 samples that examined there was at least one parasite species tissue cyst. In %2.5 of total samples had *T. gondii* and %56.5 had *Sarcocystis* spp. and %19.5 had both *T. gondii*+*Sarcocystis* spp. tissue cysts. %95 of lamb meats, %62 of beef, %90 of meatballs and %68 of sausages were found to be infected with at least one species. In conclusion, *T. gondii* and *Sarcocystis* spp. tissue cysts were found on meat products that launched in Kırıkkale and Ankara. Because of the zoonotic feature of *T.gondii* it is highly important to consume meat products after cooked well for public health. And for prevent meat products from getting *Sarcocystis* spp. tissue cysts, it is important to take cautions for our animals to not get infected.

Keywords: Meat products, percoll gradient, *sarcocystis*, *Toxoplasma gondii*



**THE USE OF FARM AND GARDEN PLANTS BY TRADITIONAL HEALERS AS
TRADITIONAL MEDICINES TO CURE DIFFERENT HEALTH-RELATED
PROBLEMS OR AILMENTS, IN GREATER SEKHUKHUNE DISTRICT
MUNICIPALITY, LIMPOPO PROVINCE IN SOUTH AFRICA**

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ABSTRACT

Conservation of farm and garden plants is important to traditional healers in Greater Sekhukhune District Municipality – Limpopo province in South Africa. These plants are used for ritual and medicinal purposes. The leaves, barks and roots of these plants are used to cure different health related problems or ailments. The present study investigated issues of interest and of historical meaning in the philosophy of traditional healing practice among traditional healers in the Bapedi society. The primary source for data collection was oral interviews. Secondary sources included observations, publications and records. Other methods included video recordings and photographing of different farm and garden plants, as well as traditional medicines used by traditional healers in their healing practice. The following interrelated research questions therefore guided this study: 1) Are Bapedi people sufficiently interested in traditional medicines and traditional healing processes? 2) Do traditional medicines benefit both traditional healers and Bapedi people?; 3) Do traditional medicinal plants have the potential to satisfy the varied health care needs of Bapedi people? and 4) What is the cultural relevance of traditional healing in contemporary Bapedi society? The results demonstrated that a large percentage of Bapedi people consult with traditional healers for survival and to strengthen their indigenous beliefs and practices, and to adhere to their traditional lifestyle. From this study, it appears that traditional medicines are seen to benefit both traditional healers and Bapedi people by encompassing their way of life and living environment. It was concluded that conservation of natural resources such as garden and farm plants should be taken seriously, as the use of some of these indigenous medicinal plants have proven to treat a considerable number of health related problems or ailments, and have the potential to satisfy the varied health care needs of Bapedi people.

Keywords: Farm and garden plants, traditional healers, traditional medicines, Greater Sekhukhune District Municipality, Limpopo province, South Africa



KOYUNLARIN GASTROİNTESTİNAL NEMATODLARININ TEDAVİSİNDE KULLANILAN ANTELMENTİKLERE KARŞI ŞEKİLLENEN DİRENÇ VE ALTERNATİF TEDAVİLER

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ÖZET

Gastrointestinal nematodlar (GIN), küçük ruminantların en yaygın ve ciddi parazitleridir ve belirgin ekonomik kayıplara neden olabildikleri için her zaman önemli bir endişe kaynağı olmuştur. GIN enfeksiyonlarının kontrolünde başlıca strateji benzimidazoller, imidazotiazoller ve makrosiklik laktonlar sınıfı antelmantik ilaçların kullanımı olmuştur. Antelmantik seçeneklerinin sayısı az olduğu gibi; sınırlı sayıda yeni bileşiklerin keşfi hem yavaş ilerlemekte, hem de çok umut verici sonuçlar alınmamaktadır. Son on yılda sadece üç antelmantik bileşik (siklik oktadepsipeptid, aminoasetonitril ve spiroindol) pazara sürülmüş ve bu antelmantiklerin bazılarının şimdiden GIN'da hızlı direnç gelişimine neden olduğu gösterilmiştir. Antelmantiklerin bol ve yoğun kullanımı, dirençli nematod suşlarının gelişmesine neden olmuş ve bazı suşlarda bu direncin çoklu ilaçlara karşı da şekillendiği gösterilmiştir. İlaç direncinin yaygın bir küresel sorun haline geldiğini ve bu direnç gelişimiyle mücadele etmenin zorunluluk haline geldiğini bildiren raporların sayısı ise günden güne artmaktadır. Antelmantik direnç sorunuyla mücadele etmek için öncelikli olarak direnç gelişiminin düzenli takibinin yapılması, stratejik ve taktik antelmantik kullanımı, alternatif yönetim stratejileri ve nematod kontrol programlarının geliştirilmesi gibi sıkı önlemlere ihtiyaç bulunmaktadır. Antelmantik direnç tespiti in vivo ve in vitro tekniklere dayanmaktadır. İn vivo teknikler dışkıda yumurta sayısı azaltma testini (FECRT) ve kontrollü testi içerir. İn vitro tekniklerin başlıcaları arasında yumurtadan çıkma testi (EHA), larva ve yetişkin gelişim testleri, biyokimyasal ve moleküler teknikler sayılabilir. Antelmantik direncinin gelişimi uygulanan tedavinin doz, sıklık ve süresiyle doğrudan bağlantılı olduğundan; ilaçların dönüşümlü ve kombine kullanımını da içerebilen stratejik ve taktik bir antelmantik tedavi protokolü uygulamak çok önemlidir. Nematod kontrol stratejileri selektif yetiştirme, mera yönetimi, beslenme yönetimi ve biyolojik kontrol gibi konulara odaklanır. Alternatif tedavi seçeneklerinden bazıları fitoterapi, homeopati, bakır oksit teller ve mantarlar olarak sıralanabilir. Değişen bir Dünya'da gün gelip de direnç gelişimine bağlı olarak elimizde kullanabileceğimiz bir antelmantik kalmayabileceği gözönüne alınırsa; olası tüm yönetim ve kontrol stratejilerinin ve yanısıra umut vaad eden holistik yaklaşımların da entegre edildiği uygulamaların önemi ve aciliyeti ortaya çıkmaktadır.

Anahtar Kelimeler: Gastrointestinal parazitler, direnç, antelmantikler, kontrol stratejileri, alternatif tedaviler



RESISTANCE TO ANTHELMINTICS USED IN THE TREATMENT OF SHEEP GASTROINTESTINAL NEMATODES AND ALTERNATIVE TREATMENTS

ABSTRACT

Gastrointestinal nematodes (GINs) are the most prevalent and serious parasites in small ruminants and has always been a major source of concern as they can cause significant economic losses. Main control strategy for the control of GIN infections has been the use of anthelmintic drugs most of which are among the major classes of benzimidazoles, imidazothiazoles and macrocyclic lactones. Anthelmintic options are scarce and limited number of new discoveries are slow and not very promising. Only three anthelmintic ingredients were marketed in the past ten years (cyclic octadepsipeptide, aminoacetonitrile and spiroindole) and some of these anthelmintics have already shown to induce quick development of resistance in GINs. Abundant and intensive use of anthelmintics has led to resistant nematode strains some of which are reportedly multi-drug resistant. Repeating reports show that drug resistance has become a wide-spread global problem and there lies a challenge to control resistance. To combat the anthelmintic resistance problem stringent measures are needed for resistance monitoring, strategical and tactical anthelmintic use, alternative management strategies and nematode control programmes. Anthelmintic resistance detection is based on in vivo and in vitro techniques. In vivo techniques involve faecal egg count reduction test (FECRT) and the controlled test and in vitro tests include tests such as Egg hatch assays (EHAs), larval and adult development tests, biochemical and molecular techniques. Since anthelmintic resistance is very much correlated to dose, frequency and duration of treatment; it is critical to implement a strategical and tactical anthelmintic program which may include rotation and combination of drugs. Nematode control strategies focus on topics such as selective breeding, pasture management, nutrition management, and biological control. Some of the alternative treatment options may be listed as phytotherapy, homeopathy, copper-oxide wires and fungi. As we're about to face a changing world where we can be left without any anthelmintics available to overcome resistance, there's an emergence of integrating all possible means of management and control strategies as well as promising holistic approaches.

Keywords: Gastrointestinal parasites, resistance, anthelmintics, control strategies, alternative treatments.



NIGHTMARE OF LOCUST ATTACK IN INDIA

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ABSTRACT

There's strength in numbers, goes the adage. The locust infestation became a severe threat to food security. The swarm enrooted in India through Iran and Pakistan. It devastated Rajasthan and Gujarat's border states and the interiors of Maharashtra, Uttar Pradesh, and Madhya Pradesh. The favourable climatic conditions make them breed and multiply. People have a different chance of fighting locusts now than their ancestors — more profound knowledge and technology. But to maintain the ecological balance, grasshoppers and locusts are very important, particularly in the grassland ecosystem. It plays a significant role in the food chain that is nutrient cycling and energy transfer from one tropical level to another. As a swarm, when it started devouring the crops, hence only with modern technology that the situation was controlled with the help of pesticides and specialist equipment. In the future, controlling locusts can be done with the help of drugs that target serotonin's pathway instead of using pesticides and insecticides. Because the usage of these chemicals on the land affects soil fertility as well as induces water pollution. This will preserve our mother earth from degradation. Hence this study insist that, proper remedial measure has to be taken at the earliest because already many episodes of locust attack had taken place in the history.

Keywords: Locust, life cycle, history, adverse effects, Innovative control methods



**SIMULATION LONGEST THE LENGTH OF DRY SPELLS WITH APPROACH OF
CLIMATE CHANGE IN IRAN**

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ABSTRACT

In this study, investigated long dry Spells under different precipitation thresholds (.1, 5 and 10 mm), and well-optimistic scenario (B1), for the middle climate (decades 2050) and under Hadcm3 model's results were in the area of Iran. Modeling dry spells indicated, based on (B1 scenario) in decate 2050 and the Southern East and Central area have longest dry spells. So that in the most optimistic case (scenario B1) dry spells, last an average of 3 days longer than they are similar in last time. However, dry spells predicted, in north and the coast of the Caspian Sea has not Considerable changed compared to the observed dry spells (only increased an average of 2 days). In the North of the West area, length of dry spells, longer than 5 days compare with past time. It will show increase trend of dryness in this area. Notable that, although the longest dry spells matches the arid and semi-arid area of countries, but the heightened area length of dry spells is impressive in wet areas like the northwest of the country. Other words, based of forecast model, dry spells without rain have trend northern. This means that border dry areas shifting to the northern. In decade of 2050, according to the results of scenarios can be said that more than 85% of Iran, experiment dry spells with more than 8 months in a year.

Keywords: Dry spells, simulation, climate scenarios, climate change, Iran



DONDURMA ANALİZLERİNDE KULLANILAN GÜNCEL FİZİKOKİMYASAL ANALİZ YÖNTEMLER

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ÖZET

Dondurma, tek tek bileşenlerin farklı fazlarda dağılmasından kaynaklanan çok fazlı bir fizikokimyasal sistemdir. Ayrıca dondurma; donmamış serum fazı, buz kristalleri, yağ kürecikleri ve hava kabarcıklarından oluşan karmaşık bir gıda koloididir. Dondurmanın yapısı, havanın yaklaşık üçte ikisini sudan oluşan donmuş sıvıda dağılmasıyla oluşur. Bu nedenle dondurma, bir sıvı (dispersiyon) fazının havada (dispersiyon fazı) dağıldığı bir sistem olan bir köpükten meydana gelmektedir. Dondurmanın ana bileşenleri yağ, katı süt, şeker, stabilizatör ve emülgatördür. Hava kabarcıkları kısmen yağ globülleri ile kaplanır ve yağ globülleri ise bir protein / emülgatör tabakasını oluşturur. Serum fazı, dondurularak konsantre bir çözelti içinde sakkaroz, laktoz, glikoz, yüksek moleküler ağırlıklı polisakkaritler vb. bileşenlerden oluşur. Karışım emülsiyonunu oluşturmak için yağın homojenleştirilmesi sırasında proteinler ve emülgatörler ara yüzey boşluklarına yerleşir. Yağın kristallenmesi ve homojenleştirilmesinin ardından, yağ globülü membranının en düşük serbest dinamizm durumuna yeniden düzenlenmesi gerçekleşir. Elde edilen emülsiyon daha sonra dinamik dondurma işlemi sırasında çırpma ve buz kristali oluşumuna maruz kalır ve bu da donmuş ürünün dört ana yapısal bileşeninin geliştirilmesine katkıda bulunur: donmamış matris (farklı mono- ve polisakkaritlerden oluşan bir çözelti), hava kabarcıkları (20 – 150 µm), buz kristalleri (10 - 75 µm) ve yağ kürecikleridir (0,4 - 4 µm). Karıştırma, pastörizasyon, homojenizasyon, olgunlaştırma, dondurma ve sertleştirme dahil olmak üzere üretim sürecindeki çeşitli adımlar, dondurma yapısının gelişmesine katkıda bulunurlar. Genel olarak, analitik yöntemler üç gruba ayrılabilir: kimyasal (uçucu ve uçucu olmayan bileşikler), fiziksel (reolojik ve renk analizi) ve yapısal analizdir. Bu çalışma kapsamında, dondurma ürünlerinin fiziksel, kimyasal ve yapısal içeriklerinin belirlenmesinde kullanılan en güncel teknolojilere ilişkin temel bir bilgilendirme yapılmış ve bu teknolojik uygulamalar yardımıyla gerçekleştirilen bazı akademik araştırmalara yer verilmiştir. Ayrıca, dondurma analizinde kullanılan yeni yöntemler gözden geçirilmiştir.

Anahtar Kelimeler: Dondurma, fiziksel, kimyasal ve yapısal analizler, güncel teknolojik uygulamalar



CURRENT PHYSICCHEMICAL ANALYSIS METHODS USED IN ICE CREAM ANALYSIS

ABSTRACT

Ice cream is a multiphase physicochemical system resulting from the dispersion of individual ingredients in different phases. Also ice cream; The unfrozen serum phase is a complex food colloid consisting of ice crystals, fat globules and air bubbles. The structure of ice cream is formed by the dispersion of air in the frozen liquid, which consists of approximately two-thirds of water. Therefore, ice cream consists of a foam, a system in which a liquid (dispersion) phase is dispersed in the air (dispersion phase). The main components of ice cream are fat, solid milk, sucrose, stabilizer and emulsifier. The air bubbles are partially covered by the fat globules and the fat globules form a protein / emulsifier layer. The serum phase is composed of sucrose, lactose, glucose, high molecular weight polysaccharides etc. in a freeze-concentrated solution. It consists of components. During the homogenization of the oil, proteins and emulsifiers settle in the interfacial spaces to form the mixing emulsion. Following crystallization and homogenization of the oil, the reorganization of the fat globule membrane to the lowest free dynamism state occurs. The resulting emulsion then undergoes whipping and ice crystal formation during the dynamic freezing process, which contributes to the improvement of the four main structural components of the frozen product: unfrozen matrix (a solution of different mono- and polysaccharides), air bubbles (20 – 150 μm) are ice crystals (10 - 75 μm) and fat globules (0.4 - 4 μm). Various steps in the production process, including mixing, pasteurization, homogenization, maturation, freezing and curing, contribute to the development of the ice cream structure. Generally, analytical methods can be divided into three groups: chemical (volatile and non-volatile compounds), physical (rheological and color analysis), and structural analysis. Within the scope of this study, a basic information was given on the most up-to-date technologies used in determining the physical, chemical and structural contents of ice cream products and some academic researches carried out with the help of these technological applications were included. In addition, new methods used in ice cream analysis were reviewed.

Keywords: Ice cream, physical, chemical and structural analysis, current technological applications



ANTIOXIDANT AND HYPOGLYCEMIC ACTIVITIES OF *CRYPTOTAENIA JAPONICA* HASSK. AFTER *IN VITRO* SIMULATED DIGESTION

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ABSTRACT

The *Cryptotaenia japonica* Hassk. is a perennial herb belongs to the genus Parsley in Umbelliferous family, and are consumed as Chinese herbal medicine and vegetable with abundant nutritional value. In this research, the antioxidant and hypoglycemic activities of *Cryptotaenia japonica* Hassk. *in vitro* simulated digestion were studied. The results shown that the *Cryptotaenia japonica* Hassk. had different degree release of active ingredients and biological activity in different simulated digestion stages *in vitro*. Amongst of the three stage, the simulated oral digestion and simulated intestinal digestion were more conducive to the preservation of active ingredients and their biological activities. In contrast, these active ingredients and their related activities were significantly reduced in the stage of simulated gastric digestion. The most amount of polyphenols released was out of the intestinal digestion dialysis bag, and the most amount of flavonoids released was in the stage of oral digestion. The best 1,1-diphenyl-2-trinitrophenylhydrazine (1, 1-diphenyl-2-picrylhydrazyl, DPPH) free radical scavenging ability was found in the stage of oral digestion with $13.87 \pm 0.85 \mu\text{mol Trolox/ g dry weight(DW)}$, and the highest 2'-hydrazine-bis-3-ethylbenzothiazoline-6-sulfonic acid (2, 2'-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS) free radical scavenging ability and ferric ion reducing antioxidant power (FRAP) were all found in the intestinal digestion dialysis bag (IN) with $6.72 \pm 0.05 \mu\text{mol Trolox/ g DW}$ and $33.41 \pm 0.32 \mu\text{mol Trolox/ g DW}$, respectively. Moreover, the *Cryptotaenia japonica* Hassk. also exhibited excellent hypoglycemic activity after simulated oral digestion, under the experimental concentration (50 mg/mL) of crude drug, the inhibitory rate for α -glucosidase and α -amylase were reach to 84.17% 85.67%, respectively. Our results indicate that the medicine-food plant *Cryptotaenia japonica* Hassk. possess good antioxidant and hypoglycemic activities through human digestion, it can be used to make functional foods, natural medicines, etc. with broad research prospects. This study provides experimental basis for further development and utilization of *Cryptotaenia japonica* Hassk.

Keywords: *Cryptotaenia japonica* Hassk.; polyphenol; flavonoid; *in vitro* simulated digestion; antioxidant activity; hypoglycemic activity



ULTRAFİLTASYON TEKNİĞİNİN SÜT VE SÜT ÜRÜNLERİNDE KULLANIMI

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ÖZET

Ultrafiltrasyon, normal bir filtrelemenin dışında süzme işlemi yapan, filtredeki gözeneklerinin boyutu 0,5-35 nm arasında değişen, molekül boyutuna göre bir sıvıyı basınç altında filtre eden membran filtreleme sistemi olarak tanımlanmaktadır. Süt bileşenlerinden olan süt yağı ve proteinler molekül büyüklüğünden dolayı membranın gözeneklerinden geçemeyerek membranın üst kısmında (retentat) olarak toplanırken, su, tuzlar, vitaminler ve düşük molekül ağırlıklı bileşenler permeat kısmına geçmektedir. Süt endüstrisinde ultrafiltrasyon tekniğinin kullanımı bazı teknolojik avantajlardan dolayı son yıllarda oldukça önem kazanmıştır. Bunlardan ilki peynir üretiminde sütü konsantre ederek peynirin protein oranını artırmak ve peyniraltı suyundan bileşenleri ayırmaktır. Peynir teknolojisinde bu tekniğin kullanımıyla ultrafiltre edilmiş sütlerden peynir üretiminde rennetle koagülasyon süresi kısalmaktadır. Çünkü bu sütlerdeki protein oranının yüksek olmasından dolayı kazein misellerinin birbirine olan yakınlığı artmakta ve bu da rennet enziminin substratı hidrolize etme süresini kısalmaktadır. UF tekniğinin peynir üretimindeki diğer bazı avantajları serum proteinlerinin pıhtıda kalmasıyla randımanı artırması, daha az enzim ve starter kültür kullanımı, maliyeti düşürmesi ve insan gücüne ihtiyaç olmadığından oluşabilecek kontaminasyonların engellenmesidir. Ultrafiltrasyon tekniğinin bir diğer önemi yoğurt üretiminde görülmektedir. Yoğurt teknolojisinde en önemli kusurlardan biri de sineresiz olayının gerçekleşmesidir. Sineresiz ise yoğurttaki protein oranının artmasıyla azalmaktadır. Ultrafiltre edilmiş sütlerde protein oranı fazla olduğundan bu şekilde üretilen yoğurtların protein oranı daha fazla olmaktadır. Proteinlerin su tutma kapasiteleri artacağından yoğurttaki sineresiz oluşumu engellenmektedir. Ultrafiltrasyon tekniğinin kullanımının dezavantajları da bulunmaktadır ki bunlardan en önemlisi membranlarda tıkanmanın meydana gelmesidir. Kullanılan membranların gözeneklerindeki tıkanmaya daha çok yağlar ve proteinler neden olmaktadır. Bu da membran yapısının daha sık değişmesine neden olmakta ve maliyeti artırmaktadır aynı zamanda membranda permeat akış hızını da düşürmektedir. Bu nedenle membran temizliği genelde fiziksel ve kimyasal olarak uygulanmaktadır. Fiziksel temizlemede hidrolik, elektriksel ve mekaniksel olarak temizlemek mümkünken kimyasal temizlemede çeşitli asitler, alkaliler, yüzey aktif maddeler kullanılmaktadır. Ultrafiltrasyon tekniğinde kullanılan membranların yapısı ısıya ve kimyasallara dirençli olmalı, mekanik olarak dayanıklı olmalıdır. Kullanılan membranlar başlıca selüloz asetat (CA), poliakronitril (PAN), polisülfan (PS), polietersülfon (PES), polivinilidinden florür (PVDF) membranlardır.

Anahtar Kelimeler: Membran teknoloji, filtrasyon teknikleri, ultrafiltrasyon, protein seperasyonu, membran temizleme



USE OF ULTRAFILTRATION TECHNIQUE IN MILK AND MILK PRODUCTS

ABSTRACT

Ultrafiltration is a membrane filtration system that filters a liquid under pressure on a molecular size basis, ranging from 0.5-35 nm in size of the pores in the filter, which performs filtering outside of a normal filtration. Milk fat and proteins, which are milk components, cannot pass through the pores of the membrane due to the size of the molecule and are collected in the upper part of the membrane (retentat), while water, salts, vitamins and low molecular weight components pass into the permeate part. The use of ultrafiltration technique in the dairy industry has gained a lot of importance in recent years due to some technological advantages. The first is to increase the protein content of cheese by concentrating milk in cheese production and to separate components from whey. With the use of this technique in cheese technology, the rennetle coagulation time is shortened in the production of cheese from ultrafiltered milks. Because of the high protein content in these milks, the proximity of the casein mycene to each other increases, which shortens the time it takes for the rennet enzyme to hydrolyze the substrate. Some other advantages of the UF technique in cheese production are increasing yield by keeping serum proteins in the clot, using fewer enzymes and starter cultures, reducing costs and preventing contamination that may occur because manpower is not needed. Another importance of ultrafiltration technique is seen in yogurt production. One of the most important defects in yogurt technology is the realization of the sinesis event. Sinesis decreases with the increase in protein content in yogurt. Since ultrafiltered milks have a high protein content, yogurts produced in this way have a higher protein content. The formation of synergism in yogurt is prevented as proteins will increase their water retention capacity. There are also disadvantages to the use of ultrafiltration technique, the most important of which is the occurrence of blockage in the membranes. The blockage in the pores of the membranes used is mostly caused by fats and proteins. This causes the membrane structure to change more frequently and increases the cost, while also reducing the permeate flow rate in the membrane. Therefore, membrane cleaning is usually applied physically and chemically. While it is possible to clean hydraulically, electrically and mechanically in physical cleaning, various acids, alkalines, surfactants are used in chemical cleaning. The structure of the membranes used in the ultrafiltration technique should be resistant to heat and chemicals and mechanically resistant. The membranes used are mainly cellulose acetate (CA), polyacronitril (PAN), polysulfane (PS), polyetersulfon (PES), polyvinilidene fluoride (PVDF) membranes.

Keywords: Membrane technology, filtration techniques, ultrafiltration, protein separation, membrane cleaning



**TRANSGLYCOSYLATION POTENTIAL OF α -GALACTOSIDASE FROM
STREPTOMYCES GRISEOLOALBUS FOR PROBIOTIC APPLICATIONS**

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ABSTRACT

α -Galactosidase (α -D-galactoside galactohydrolase, EC 3.2.1.22) is an exoglycosidase that cleaves the terminal non-reducing α -1 \rightarrow 6-linked galactose residues from galactose oligosaccharides and polysaccharides. α -Galactosidases have been generally known to catalyze hydrolytic reactions, however some of the α -galactosidases are also found to have galactosyl transfer activity especially when incubated at very high substrate concentration. The galactooligosaccharides produced by the transglycosylation reaction of α -galactosidases can be used as a probiotic in functional food. The present study was focused on the potential application of *Streptomyces griseoloalbus* α -galactosidases in the transglycosylation synthesis of galactooligosaccharides. Transglycosylation reaction was carried out using three purified α -galactosidases – α -Gal I, α -Gal II and α -Gal III – from *S. griseoloalbus* in a reaction mixture containing suitably diluted enzyme, galactosyl donor, acceptor sugar and McIlvaine buffer (pH 5.0). Reactions were carried out separately for 2 h at the temperature optimum for each α -galactosidase. Aliquots were removed at suitable time intervals and heated in a boiling water bath for 5 min to terminate the reaction. Transfer products were detected by thin layer chromatography. Among the three α -galactosidases, only α -Gal II possessed transglycosylation property. Incubation of stachyose and galactose with α -Gal II resulted in a new transfer product which was not similar to the chromatographic mobility of any of the standard sugars tested. When stachyose and glucose were incubated with α -Gal II two transfer products were obtained, one of which showed similarity to melibiose in chromatographic mobility and the other product was a new product observed as in the case of incubation with galactose. The new product obtained in the present investigation by incubation with stachyose and galactose/glucose was tentatively identified as verbascose. The transglycosylation potential of α -Gal II can be made use exploited for the synthesis of novel α -galacto-oligosaccharides which are having excellent probiotic applications.

Keywords: α -galactosidase; transglycosylation; galacto-oligosaccharides; probiotic



DOĞAL RENK MADDELERİNİN YUMURTA SARI RENGİ ÜZERİNE ETKİLERİ

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ÖZET

Günümüzde hayvansal kaynaklı gıdaların tüketimi ülkeler için bir gelişmişlik göstergesi sayılmaktadır. Yeterli ve dengeli bir beslenme için günlük protein ihtiyacının 1/3'ü hayvansal kaynaklı gıdalardan sağlanmalıdır. Hayvansal kaynaklı proteinler insanların günlük esansiyel aminoasit ihtiyaçlarını yeterli ve dengeli olarak içermelerinin yanı sıra bitkisel proteinlerden daha yüksek biyolojik yararlanıma sahiptir. Yumurta, süt, et vb. hayvansal kaynaklı proteinler %98 düzeyinde sindirilebilirken kuru baklagiller %78 düzeyinde sindirilmektedir. Hayvansal kaynaklı gıdalardan yumurta gerek içerdiği besin maddeleri gerekse maliyeti bakımından öne çıkmaktadır. Son yıllarda hem ülkemizde hem de Dünya'da yumurta tavukçuluğu sektörüne yapılan yatırımlar ve desteklemeler dikkat çekmektedir. Sofralık yumurta üretim miktarında bazen azalmalar görülsede üretim miktarları yukarı yönlü olmaktadır. Buna mukabil tüketicilerin yumurta alımını etkileyen en önemli faktör yumurta sarı rengidir. Yumurta sarı renginin belirlenmesinde 15 tondan oluşan Roche renk kartelaları kullanılmakta ve insanların yumurt sarı rengi tercihi farklı bölgelerde, kültürlerde ve geleneklerde değişiklik gösterebilmektedir. Bazı tüketiciler açık sarı renkli yumurtaları tercih ederken bazıları ise turuncuya yakın rengi tercih edebilmektedirler. Tüketicilerin tercih ettiği yumurta sarı rengi için yumurta tavuğu rasyonlarına sentetik yem katkı maddesi kullanılmaktadır. Sentetik maddelerin kullanıldığı ürünlerin alımına yönelik tüketicilerin tutumlarının değişmesi yumurta tavukçuluğu sektöründe sentetik maddelerin yerine kullanılacak alternatif üretim arayışları başlamıştır. Kırmızıbiber ekstratı, kadife çiçeği, yonca unu, zencefil tozu, ısırgan otu bu ürünler arasında öne çıkmaktadır. Hayvan ve insan sağlığı üzerine olumsuz etki yapmamaları, kalıntı bırakmamaları ve yumurta tavuklarında performans üzerine olumlu etkileri sebebiyle sektörde kullanımları yaygınlaşmaktadır. Bu derlemenin amacı; yumurta tavuklarında yem katkı maddesi olarak kullanılan doğal renk pigmentlerine yönelik güncel besleme çalışmalarını ele alınarak, bundan sonra yapılacak olan çalışmalara katkı sağlamaktır.

Anahtar Kelimeler: Yumurta tavukları, yumurta sarı rengi, doğal renk maddeleri, tüketici tercihleri



EFFECTS OF NATURAL COLOR SUBSTANCES ON EGG YOLK COLOR

ABSTRACT

Consumption of animal-based foods is considered a development indicator for countries in nowadays. For an adequate and balanced diet, 1/3 of the daily protein need should be provided from the foods of animal origin. In addition to the fact that the proteins of animal origin contain the essential amino acids that people need on a daily basis in a sufficient and balanced manner, they have a higher biological utilization value than vegetable proteins. Proteins of animal origin such as egg, milk, meat etc. can be digested at the level of 98 %, legumes can be digested at the level of 78 %. Among the foods of animal origin, eggs stand out in terms of both the nutrients it contains and its cost. In recent years, investments and subsidies made in the egg poultry sector both in our country and in the world have attracted attention. Although there has sometimes been a decrease in the amount of table egg production, the production amounts are upward. On the other hand, the most important factor affecting the egg purchased of the consumers is the egg yolk color. Roche color charts consisting of 15 shades are used to determine the color of egg yolk, and people's preference for egg yolk color may vary in different regions, cultures and traditions. Some consumers prefer light yellow eggs, while others prefer a color close to orange. Synthetic feed additives are used in laying hen diet for the egg yolk color preferred by consumers. The change in the attitudes of consumers towards the purchase of products using synthetic substances has started to search for alternative production that can be used instead of synthetic substances in the egg poultry sector. Red pepper extract, marigold, alfalfa meal, ginger powder, nettle come to the forefront among these substances. Their use in the sector is widespread due to they don't have negative impact on animal and human health, they don't leave residue, and their positive effects on performance in laying hens. The aim of this review is; Current feeding studies for natural color pigments used as feed additives in laying hens are discussed and to contribute to future studies.

Keywords: Laying hens, egg yolk color, natural color substances, consumer preferences



KÜÇÜKBAŞ RUMİNANLARDA MASTİTİSE GENEL BİR BAKIŞ

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ÖZET

Sağlıklı hayvanlardan yüksek kaliteli süt üretiminin sağlanması, süt hayvanı yetiştiricilerinin birincil hedefidir. Bununla birlikte, onlarca yıldır kontrol programları uygulanmasına rağmen, mastitis halâ süt hayvanlarının en sık görülen ve ekonomik açıdan en zor hastalığı olmaya devam etmektedir. Türkiye’de koyun ve keçilerde genellikle sağımın elle yapılıyor olması memede yaralanma ve çevresel patojenlere maruz kalma riskini artırarak meme sağlığını olumsuz etkilemektedir. "Meme sağlığı" terimi, memeyi yüksek kaliteli süt üretebilmesi için sağlıklı tutan önlemleri ifade eder. Bu nedenle meme sağlığı yönetimi, kaliteli süt üretiminin ayrılmaz bir bileşenidir ve insan tüketimine yönelik kaliteli süt üretiminin her aşamasını kapsamaktadır. Mastitis, meme bezinin iltihaplanması ve memenin anatomisi ve/veya fizyolojisinde değişiklik anlamına gelmektedir. Mastitis, süt kalitesinde ve miktarında azalma ile birlikte antibiyotik kullanımına ve veteriner hekim hizmetlerine bağlı olarak artan maliyetler nedeniyle küçükbaş hayvan yetiştiriciliğinde önemli ekonomik kayıplara sebep olmaktadır. Bununla birlikte mastitis olgularının sık görüldüğü küçükbaş sürülerinde anaların yeterince kolostrum sağlayamaması sonucunda kuzu ve oğlaklarda düşük canlı ağırlık gözlenmekte ve neonatal enfeksiyonların görülme oranı da artmaktadır. Mastitislerin tanısında kullanılan teşhis yöntemleri hastalığın seyrine göre değişmektedir. Bu hastalığa çeşitli bakteriyel etkenler neden oluyorsa da hastalığın oluşumunda hazırlayıcı faktörlerin rolleri büyüktür. Bu faktörler; düzenli ve iyi bir sağımın yapılamaması, hijyenik olmayan çevre, kirli barınaklar, memelerin sarkık ve gevşek olması, meme başlarının çok iri olması, meme kanallarının dar veya uçlarının kör olmasıdır. Ayrıca koyun ve keçilerin meralarda yetiştirilmesiyle ilgili olarak memelerin daha sık ve kolay yaralanması da küçükbaş mastitislerinin oluşumunda etkilidir. Mastitisin tedavisi patojene göre değiştiğinden, başarılı klinik mastitis tedavisi, ilgili patojenin doğru tanımlanması da dahil olmak üzere erken teşhise ve uygun tanıya dayanır. Klinik mastitislerde memelerin ve sütün klinik, fiziksel ve bakteriyolojik muayenesi yapılırken özellikle subklinik mastitislerin teşhisinde somatik hücre sayımı, sütün elektriksel iletkenliğinin ölçülmesi, sütteki enzimlerin ve minerallerin ölçülmesi esasına dayalı olan biyokimyasal yöntemler kullanılmaktadır. Bu yazıda koyun ve keçilerde mastitisin etiyolojisi, epidemiyolojisi, risk faktörleri, tanı yöntemleri, tedavisi, kontrol ve korunma stratejileri derlenmiştir.

Anahtar Kelimeler: Dişi koyun, dişi keçi, meme sağlığı, somatik hücre sayısı



A GENERAL OVERVIEW ON MASTITIS IN SMALL RUMINANTS

ABSTRACT

Getting high quality milk from healthy animals is the primary aim of dairy animal breeders. However, although various control programs have been applied for decades, mastitis still continues to be the most frequently-observed and economically the most difficult illness of dairy animals. In Turkey, since milking is generally done manually in ewes and does, it affects udder health negatively by increasing the risk of injury in the udder and exposure to environmental pathogens. The term "udder health" refers to the precautions keeping the udder healthy so that it can produce high quality milk. For this reason, the udder health management is an integral part of quality milk production and covers all the stages of quality milk production for human consumption. Mastitis is the inflammation of the udder gland and the change in the anatomy and/or physiology of the udder. Together with the decrease in the quality and the amount of milk, due to the costs increasing dependently on the use of antibiotics and veterinary physician services. Mastitis leads to important economic losses in small ruminants breeding. However, as a result of mothers' being unable to provide sufficient amount of colostrum, low live weight is observed in lambs and yeanelings and also the rate of incidence of neonatal infections increases in small ruminant herds where mastitis phenomena are observed frequently. The methods used in the diagnosis of mastitis change according to the course of disease. Although various bacterial agents cause this disease, preparatory factors have a great role of in the breaking-out of the disease. These factors are irregular and improper milking, non-hygienic environment, dirty shelters, deep and hung udders, unfavourable position of teats, narrow ducts with blind ends. Moreover, that udders get hurt more frequently and more easily because ewes and does graze in rangelands has also effect on the formation of mastitis in small ruminants. Since the treatment of mastitis changes according to the type of pathogen, a successful clinical mastitis treatment is based on early diagnosis including the correct identification of the related pathogen as well and proper diagnosis. While udders and milk are examined clinically, physically and bacteriologically in clinical mastitis, biochemical methods based on the counting of somatic cells, the measurement of the electrical conductivity of milk, the measurement of the enzymes and the minerals in milk are used especially in the diagnosis of subclinical mastitis. In this paper, the etiology, epidemiology, risk factors, diagnostic methods, treatment, control and prevention strategies of mastitis in in small ruminants were compiled.

Keywords: Ewe, doe, udder health, somatic cell count



**RATLARDA YÜKSEK YAĞLI DİYET İLE İNDÜKLENEN OBEZİTE OLUŞUMU
ÜZERİNE NİGELLA SATİVA'NIN ENGELLEYİCİ ETKİSİNİN HİSTOPATOLOJİK
VE BİYOKİMYASAL OLARAK ARAŞTIRILMASI**

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ÖZET

Bu çalışmada, yüksek yağlı diyetle beslenerek kilo artışı sağlanan ratlarda, Nigella Sativa'nın obezite oluşumu üzerine etkisi histopatolojik ve biyokimyasal olarak araştırıldı. Bu amaçla 32 rat, her bir grupta sekiz rat olacak şekilde; Kontrol (n:8), Obezite (n:8), Obezite+Nigella Sativa (n:8) ve Nigella Sativa (n:8) olmak üzere rastgele 4 gruba ayrıldı. Kontrol grubu, standart rat pelet yemiyle beslendi. Obezite grubu, enerji değeri yüksek diyetli pelet yem ile beslendi. Obezite+Nigella Sativa grubu, enerji değeri yüksek diyetli pelet yem ile beslenmeye ilaveten günlük 3mg/kg/rat dozda Nigella Sativa ekstratı orogastrik gavaj ile verildi. Nigella Sativa gurubu ise; standart pelet yem ile beslenmeye ilaveten günlük 3mg/kg/rat dozda Nigella Sativa ekstratı orogastrik gavaj ile verildi. Çalışma boyunca ratların kilo alımı takip edildi. Deneme sonucunda nekropsi yapılan ratlardan biyokimyasal ve histopatolojik incelemeler için kan ve doku örnekleri alındı. Kan serum örneklerinde; alanin transaminaz (ALT), aspartik transaminaz (AST), alkalen fosfataz (ALP), laktat dehidrogenaz (LDH), gama glutamil transferaz (GGT), kolesterol, trigliserit, HDL kolesterol, LDL kolesterol ve açlık kan şekeri (AKŞ) aktiviteleri belirlendi. Histopatolojik olarak Obezite grubunda karaciğerde sentrilobuler hepatositlerde farklı büyüklüklerde keskin sınırlı yağ vakuelleri ve hepatositlerin bazısında koagülasyon nekrozu gözlenirken, Obezite+Nigella Sativa grubu ile Nigella Sativa grubunda karaciğerin normal histolojik görünümü gözlemlendi. Biyokimyasal olarak Obezite grubunda trigliserid düzeyi; kontrol, Obezite+ Nigella Sativa ve Nigella Sativa grubuna göre anlamlı olarak yüksek çıktığı gözlemlendi. Obezite+ Nigella Sativa grubunda serum ALT düzeyi; kontrol ve obezite grubundan anlamlı olarak daha yüksek iken, ALP, HDL, trigliserit ve AKŞ aktiviteleri kontrol grubuna göre önemli ölçüde arttığı gözlemlendi. Nigella Sativa ekstratı grubu ise kontrol grubuna oldukça yakın olduğu tespit edildi. Sonuç olarak, enerji değeri yüksek diyetli pelet yem ile beslenmeye ilaveten Nigella Sativa ekstratı verilen ratlarda karaciğerde yağ dejenerasyonunun büyük oranda önlenildiği belirlendi. Bu araştırma Van Yüzüncü Yıl Üniversitesi Bilimsel Araştırma Projeleri Başkanlığı tarafından TYL-2019-8290 (ID: 8290) nolu proje olarak desteklenmiştir.

Anahtar Kelimeler: Biyokimya, histopatoloji, nigella sativa, obezite, rat



HISTOPATHOLOGICAL AND BIOCHEMICAL INVESTIGATION OF THE PREVENTIVE EFFECT OF NIGELLA SATIVA ON THE FORMATION OF OBESITY INDUCED BY HIGH-FAT DIET IN RATS

ABSTRACT

In this study, the effect of *Nigella Sativa* on the formation of obesity was investigated histopathologically and biochemically in rats fed with high fat diet and gained weight gain. For this aim, thirty-two (32) rats were randomly separated in four groups, to be eighth (8) rats in each group, control (n=8), obesity (n=8), Obesity +*Nigella sativa* (n=8) and *Nigella sativa* (n=8). The Control group was fed with standard rat pellet feed. The Obesity Group was fed pellet feed with a high energy value diet. The Obesity+*Nigella sativa* extract group was fed with high energy value diet pellet feed, additionally, *Nigella sativa* extract was daily given the dose of 3mg/kg/rat with an orogastric gavage. The *Nigella sativa* extract group was fed with standard pellet feed, additionally, *Nigella sativa* extract was daily given the dose of 3 mg/kg/rat with an orogastric gavage. During the experiment, the weight gaining of rats was tracked. At the end of the experiment, blood and tissue samples were taken from the necropsied rats for biochemical and histopathological examinations. In blood serum samples; Alanine transaminase (ALT), aspartic transaminase (AST), alkaline phosphatase (ALP), lactate dehydrogenase (LDH), gamma glutamyl transferase (GGT), cholesterol, triglyceride, HDL cholesterol, LDL cholesterol and fasting blood glucose (FBG) activities were determined. Histopathologically, in the Obesity group, sharply circumscribed fat vacuoles of different sizes in centrilobular hepatocytes in the liver and coagulation necrosis in some of the hepatocytes were observed, while in the Obesity + *Nigella Sativa* group and *Nigella Sativa* group the liver was observed normal histological appearance like in the control group. Biochemically, triglyceride level in obesity group; It was observed that it was significantly higher than the control, Obesity + *Nigella Sativa* and *Nigella Sativa* groups. In the Obesity + *Nigella Sativa* group; Serum ALT level was significantly higher than the control and obesity groups, while ALP, HDL, triglyceride and FPG activities increased significantly compared to the control group. The *Nigella sativa* extract group was quite similar to that of the control group. As a result, In addition to high fat diet, *Nigella Sativa* extract greatly prevented fatty liver changes in rats. This research was supported by the Scientific Research Projects Directorate of Van Yüzüncü Yıl University as a project numbered TYL-2019-8290 (ID: 8290).

Keywords: Biochemistry, histopathology, *nigella sativa*, obesity, rat



**FORECASTING THE WORLD BROILER MEAT DEMAND AND PRODUCTION
TO MEET UN 2030 AGENDA**

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ABSTRACT

Several forces drive consumer demand for broiler products, including the absence of religious limitations and low product prices. Broiler meat is one of the fastest growth rate products worldwide, and the requirement for production is relatively low compared to other meat products. Broiler meat is also considered the most sustainable compared to other meat production. On the other hand, food insecurity yet is extensive throughout the world, and hunger and malnutrition are expected to remain severe humanitarian and political concerns, both in the short term and for the foreseeable future, particularly in low-income developing countries. In some countries, domestic broiler production is expected to be especially vulnerable to the impacts of climate change over the next 30 years. The present study aimed to forecast the broiler meat production in the next ten years based on historical data, including the booming Asian producing countries facing the increasing population. We analyzed quantitative variables referring to production and meat consumption in the continents from 2015 to 2020, including the emerging markets, to estimate the following ten-year scenario. Results lead us to foresee a trend in increasing broiler meat availability worldwide; however, there is still a gap in meeting the UN 2030 established agenda goals.

Keywords: Broiler meat production, broiler meat international market sustainable broiler farming



**BURSA/TÜRKİYE'DEKİ SÜPERMARKETLERDE SATILAN PROBİYOTİK SÜT
ÜRÜNLERİNDEKİ *BIFIDOBACTERIUM* spp. ve *LACTOBACILLUS* spp.
TÜRLERİNİN SAYIMI ve İDENTİFİKASYONU**

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ÖZET

Probiyotik gıdalar, Dünya Sağlık Örgütü (DSÖ)'ne göre 'yeterli miktarlarda vücuda alındığında konakçıya yarar sağlayan canlı mikroorganizmalar' olarak tanımlanan probiyotik türlerin ve starter kültürlerin eklenmesiyle üretilen gıdalardır. *Bifidobacterium* ve *Lactobacillus* türleri, probiyotik süt ürünlerinde yaygın olarak kullanılmaktadır. Yararlı etkilerini göstermeleri için canlı probiyotik mikroorganizmaların sayısı, ürünün raf ömrü boyunca en az 6 log kob/ml veya g olmalıdır. Bu çalışmada probiyotik yoğurt (n:11) ve probiyotik içecek (n:9) olmak üzere toplam 20 adet probiyotik süt ürünü örneğinden *Lactobacillus* spp., *Lactobacillus acidophilus* ve *Bifidobacterium* spp. izolasyonu, sayımı ve suş düzeyinde identifikasyonu yapılmıştır. *Lactobacillus* spp., *Lactobacillus acidophilus* ve *Bifidobacterium* spp. izolasyonu ve sayımı için sırasıyla MRS agar, klindamisin / siprofloksasin ile takviye edilmiş MRS selektif agar ve lityum mupirosin çözeltisi (MUP) eklenmiş *Bifidobacterium* selektif agar kullanılmıştır. Analizler, +4 °C sıcaklıkta muhafaza edilen probiyotik ürünlerin raf ömürlerinin 0., 7., 14., 21. ve 28. günlerinde yapılmıştır. Sayılan izolatların biyokimyasal testleri ve morfolojik identifikasyonlarından sonra izolatlar alt pasajlama yapılarak saflaştırılmıştır. İleri tanımlama için -20 °C'de %20 gliserol içinde saklandılar. Örneklerde canlı probiyotik bakteri sayısının pH değeri ve meyve içeriği arasındaki ilişkisi incelenmiştir. Daha sonra bu izolatlar tür / alttür düzeyinde MALDI-TOF MS ile tanımlanmıştır. Elde edilen sonuçlara göre ortalama bakteri sayısının 28 günde 7 log kob/ml veya g seviyesinden 6 log kob/ml veya g seviyesine düştüğü ve azalmanın istatistiksel olarak anlamlı olduğu görüldü ($p<0,001$). Bakteri sayısı ile meyve içeriği arasında istatistiksel olarak anlamlı bir ilişki vardı ($p<0,05$). *Bifidobacterium* olarak sadece *B. animalis* ssp. *lactis* izole edildi. Ek olarak, yoğurtların içeceklere göre daha fazla *L. acidophilus* ve *Bifidobacterium* spp. içerdiği görüldü ve bu farkın istatistiksel olarak anlamlı olduğu tespit edildi ($p<0,05$). Sonuç olarak, probiyotik süt ürünlerinin erken raf ömrü süresi içinde tüketilmesi, ürünlerin arzu edilen sağlıklı etkilerini sağlaması konusunda önem arz etmektedir.

Anahtar Kelimeler: Probiyotik süt ürünleri, *Lactobacillus*, *L. acidophilus*, *Bifidobacterium*, raf ömrü



**ENUMERATION and IDENTIFICATION of *BIFIDOBACTERIUM* spp. and
LACTOBACILLUS spp. in PROBIOTIC DAIRY PRODUCTS SOLD in
SUPERMARKETS in BURSA PROVINCE, TURKEY**

ABSTRACT

Probiotic foods are produced by adding starter cultures and probiotic strains which are ‘live microorganisms when administered in adequate amounts confer health benefits on the host’ according to World Health Organization (WHO). *Bifidobacterium* and *Lactobacillus* species are commonly using in probiotic dairy products. To show beneficial effects, the level of viable probiotic microorganisms should be at least 6 log cfu/ml or g of viable cells throughout the product shelf-life. In this study, isolation, enumeration and identification of *Lactobacillus* spp., *Lactobacillus acidophilus* and *Bifidobacterium* spp. from 20 probiotic dairy products including yogurts (n:11) and drinks (n:9), were performed. *Bifidobacterium* and *Lactobacillus* species in probiotic dairy samples are identified at the species/subspecies level. In order to isolation and enumeration of *Lactobacillus* spp., *Lactobacillus acidophilus* and *Bifidobacterium* spp., MRS, MRS selective agar base supplemented with clindamycin/ciprofloxacin and *Bifidobacterium* selective count agar supplemented with lithium mupirocin solution (MUP) were used, respectively. Analyses were made at 0., 7., 14., 21. and, 28. of storage days at 4°C. After the enumeration, biochemical tests and morphological identification of the isolates were carried out and then they were purified by sub-passaging. They were stored at -20°C in 20% glycerol for further identification. Also, it is studied that the relation of the number of live probiotic bacteria between pH value and fruit content of dairy products. Then, these isolates were identified at the species/subspecies level via MALDI-TOF MS. According to the results, it was observed that the average amount of bacteria decrease from 7 to 6 log cfu/ml or g in 28 days and the decrease was significant statistically ($p<0,001$). There was a statistically significant relationship ($p<0,05$) of the bacteria count between pH value and fruit content. Among *Bifidobacterium* spp., only *B. animalis* ssp. *lactis* were isolated in probiotic dairy products. In addition, yogurt samples contained more *L. acidophilus* and *Bifidobacterium* spp. than drinks and it was determined that statistically significant difference between these products ($p<0,05$). In conclusion, the probiotic bacteria count declined during the storage period, so consuming the probiotic dairy products in the early shelf-life period is important to provide their desired health effects.

Keywords: Probiotic dairy products, *Lactobacillus*, *L. acidophilus*, *Bifidobacterium*, shelf life



**ACTIVITIES OF ANTIOXIDANT ENZYMES IN COMPATIBLE AND
INCOMPATIBLE INTERACTIONS IN *Zymoseptoria tritici*-WHEAT PATHOSYSTEM**

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ABSTRACT

Z. tritici, previously known as *Mycosphaerella graminicola*, is the causal agent of septoria tritici blotch (STB), one of the most economically important diseases of bread wheat (*Triticum aestivum*) threatening global food security. One of the earliest wheat defense responses towards infection by *Z. tritici* is an oxidative burst event, a sudden accumulation of reactive oxygen species in the attacked cells. Antioxidant enzymes are a key player in maintaining the ROS level in the infected cells in such a way as to provide an acceptable level of ROS and resistance reactions. This study aimed to investigate the activity of antioxidant enzymes of cv. Shafir harboring the *Stb6* resistance gene upon inoculation by the *Z. tritici* IPO323 carrying the AvrStb6 effector and the strain deleted for AvrStb6 (IPO323 Δ AvrStb6 # 33.). To this aim, wheat seedlings were infected by the tested isolates, and the inoculated leaves were harvested at 2, 4, 8, 12, 16, and 20 days post-inoculation (dpi). Subsequently, the samples were immediately transferred to a -80 freezer, and finally, the harvested samples were crushed and grinded with the liquid nitrogen. The activity of antioxidant enzymes including catalase, guaiacol peroxidase, ascorbate peroxidase, superoxide dismutase, and glutathione reductase were assessed in the compatible and incompatible interactions. Finally, our analysis demonstrated that activities of antioxidant enzymes, were significantly different between both interactions at $P < 0.001$. We observed an increase in the activities of antioxidant enzymes in the incompatible interaction where cv. Shafir was inoculated by *Z. tritici* IPO323 compared to that of the compatible context where cv. Shafir was infected by IPO323 Δ AvrStb6 # 33.

Keywords: Septoria tritici blotch, wheat, antioxidant enzymes, Stb6, AvrStb6



GIDA AMBALAJLARINDAN GELEN SESSİZ TEHLİKE ‘ MİGRASYON’

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ÖZET

Ambalaj, içerisinde bulunan ürünü şekline ve yapısına göre dış etkenlerden koruyan, ürünün taşınmasını, depolanmasını kolaylaştıran ve ürünün tanıtımını yapan paketleme sistemidir. Amacı tamamen gıda maddelerini korumak olan ambalajlar bazen sağlık için çok tehlikeli olabilir. Bu tehlike ambalaj malzemesi yapımında kullanılan bazı kimyasalların gıda ile etkileşim halinde olabilmesinden kaynaklanmaktadır. Başta plastik olmak üzere metal ve kağıt ambalajlardan da farklı kontaminantlar gıdalara nüfuz edebilir. ‘Migrasyon’ olarak tanımlanan bu olay ambalaj malzemesi ile gıda bileşenleri arasındaki etkileşim sonucu bazı maddelerin ambalajdan gıdaya nüfuz olmasıyla gerçekleşir. Ambalaj materyalinden gıdaya geçen maddeler ise migrant olarak adlandırılmaktadır. Gıda ile temas eden ambalaj materyali ile gıda arasındaki migrasyonun hızını ve oranını birçok faktör belirleyebilmektedir. Bunlar gıda ile temas eden malzemenin özelliği, migrantın kimyasal özelliği, temas yüzeyinin alanı, etki süresi, sıcaklık ve depolama koşulları, migrantın konsantrasyonu, gıda maddesinin özelliği gibi faktörlerdir. Gıda ambalajlamada kullanılan materyallerden gıdalara insan sağlığına zararlı hiçbir maddenin geçmemesi gerektiği yasal düzenlemelerde bildirilmiştir. Ambalaj malzemesi üretiminde kullanılan binlerce monomer ve katkı maddesi Avrupa Komisyonu tarafından potansiyel kontaminant olarak listelenmiştir. Migrant maddeler etkileşimde oldukları gıdaların organoleptik özelliklerini etkileyebilmelerinin yanı sıra belirlenen yasal ve toksikolojik limit değerlerini aşmaları durumunda başta endokrin sistem bozuklukları olmak üzere, beyin ve sinir sistemi bozuklukları, üreme sistemi bozuklukları gibi sağlık üzerinde olumsuz etkiler oluşturabilirler. Ambalaj materyallerinden gıdalara geçen migrantlar yüksek basınçlı sıvı kromatografisi (HPLC), gaz kromatografisi (GC), gaz kromatografi-kütle spektrometresi (GC-MS) gibi kromatografik metotlarla tesbit edilebilirken, çok düşük konsantrasyonların ve kompleks gıdaların analizleri daha pahalı ve zaman alıcı teknikler gerektirebilir. Bu derleme ile gıda endüstrisinde önemli bir yeri olan ambalaj materyallerinin olası migrasyon tehlikesi irdelenmiştir.

Anahtar Kelimeler: Migrasyon, migrant, kontaminant, kimyasal bulaşma



SILENT HAZARD ARISING FROM FOOD PACKAGING "MIGRATION"

ABSTRACT

Packaging is a packaging system that protects the product from external factors according to its shape and structure, facilitates the transportation and storage of the product and promotes the product. Packages that are purely intended to protect foodstuffs can sometimes be very dangerous to health. This danger arises from the interaction of some chemicals used in the production of packaging material with food. Different contaminants from plastic, metal and paper packaging can also penetrate into foods. This event, defined as "migration", occurs when some substances penetrate from the packaging to the food as a result of the interaction between the packaging material and the food components. Substances that pass from the packaging material to food are called migrants. Many factors can determine the speed and rate of migration between food contact packaging material and food. These are factors such as the property of the material in contact with the food, the chemical property of the migrant, the area of the contact surface, the duration of action, the temperature and storage conditions, the concentration of the migrant, the property of the foodstuff. It is stated in the legal regulations that no substance harmful to human health should pass from the materials used in food packaging to foods. Thousands of monomers and additives used in the production of packaging material have been listed as potential contaminants by the European Commission. Migrant substances can affect the organoleptic properties of the foods they interact with, as well as if they exceed the legal and toxicological limit values, they can have negative effects on health such as brain and nervous system disorders, reproductive system disorders, especially endocrine system disorders. While migrants migrating from packaging materials to food can be detected by chromatographic methods such as high pressure liquid chromatography (HPLC), gas chromatography (GC), gas chromatography-mass spectrometry (GC-MS), analysis of very low concentrations and complex foods may require more expensive and time-consuming techniques. With this review, the potential risk of migration of packaging materials, which have an important place in the food industry, has been examined.

Keywords: Migration, migrant, contaminant, chemical contamination



FREE RADICAL SCAVENGING PROPERTIES OF SELECTIVE POLYPHENOLIC EXTRACTS OBTAINED FROM *Salvia officinalis* L.

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ABSTRACT

Natural antioxidants can be a viable alternative to replacing synthetic additives to provide protection against oxidative degradation of food. In this sense, *Salvia officinalis* L. (sage) is a species used since ancient times as a spice to improve flavours but also for its important role in the preservation process. The aim of the paper is to evaluate the free radical scavenging properties and the phenolics compounds content of natural antioxidants obtained from *Salvia officinalis* L. Natural antioxidants from *Salvia officinalis* L., were obtained from selective polyphenolic extracts achieved by applying the Soxhlet method extraction. By UV-VIS (Jasco, Japan, V-570 spectrophotometer) spectrometric method were determined total phenolic contents (TPC) expressed as gallic acid equivalent/g (mg/GAE g^{-1}) using the Folin-Ciocalteu reagent, total flavonoid contents (TFC) expressed as rutin equivalent/g (mg/RE g^{-1}), by aluminum chloride colorimetric assay and the caffeic acid derivatives content (CAD_c) expressed as mg caffeic acid equivalent/g dry extract (mg/CAG^{-1}) by using Arnows' reagent. Antioxidant properties was studied using the chemiluminescence technique, DPPH(2,2-diphenyl-1-picrylhydrazyl) free radical scavenging assay and ABTS (2,2'azinobis-(3-ethylbenzthiazoline-6- sulfonic acid) methods. The results obtained indicated a significant free radical scavenging capacity of selective polyphenolic extracts obtained from *Salvia officinalis* L. for all the three methods applied: chemiluminescence(CL), DPPH and ABTS. The present study highlighted a good correlation between the total phenolic contents, total flavonoid contents and the caffeic acid derivatives content, with antioxidant activity, fact which confers the natural antioxidants obtained from *Salvia officinalis* L., but also for the plant as such, a set of properties as additive natural, conservant or stabilizers and the possibility use in the food industry but also the cooking process.

Keywords: Phenolic acids; flavonoids; caffeic acid derivatives, antioxidant, *Salvia officinalis* L.



LOGISTICS OF AGRICULTURAL FREIGHT IN A PERI-URBAN AREA OF IBADAN, NIGERIA

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ABSTRACT

Efficient distribution of agricultural freight has always been a major issue in rural, peri-urban and urban areas of developing economies including Nigeria. Agricultural freight particularly in rural and peri-urban areas is characterized with various challenges that do not only hinders the performance of agricultural practices but also affects the socio-economic development of the locality. It is based on this backdrop that this study examined the logistics of agricultural freight in Akufo area in Ibadan, Nigeria. A cross-sectional research design was adopted for this study and simple random sampling was used to administer 400 copies of questionnaires on the farmers within the area. Findings revealed that the majority of the respondents were male (60%), aged between 40-60 years (58%) and earn an average of #100,000 and above per annum (70%). Findings on the nature and the characteristics of agricultural produce revealed that food crops, vegetables and poultry products are the most ranked and persistent freight in the study area. Market information, route optimization, fleet maintenance cost, turnaround time, freight volume, condition of vehicles used, method of freight collection and method of distribution of freight were most rated logistics factors that affect the performance of agricultural practices in Akufo area. While, deplorable road condition, systematic withdrawal of government in logistics infrastructural provision, lack of freight policy, weak maintenance culture are major challenges affecting logistics practices in the study area. This study recommends best possible mechanism for improving the logistics practices of agricultural freight in the study area and areas with similar issues.

Keywords: Agricultural freight, akufo area, food, logistics and Nigeria



FARKLI ORİJİNLERE AİT KANOLA (*Brassica napus*) GENOTİPLERİNİN AKDENİZ İKLİM KOŞULLARINDAKİ ADAPTASON YETENEKLERİNİN ÖN DEĞERLENDİRMESİ

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ÖZET

Bu araştırma, Bornova-İzmir koşullarında 2019-2020 sezonunda Ege Üniversitesi Ziraat Fakültesi Tarla Bitkileri bölümü uygulama alanlarında kışlık olarak yürütülmüştür. Araştırmada 17 kışlık kanola genotipi kullanılmıştır. Araştırmada tane verimi, bin tane ağırlığı çiçeklenme ve fizyolojik olum olum gün sayıları, bitki boyu, yan dal sayısı, harnup sayısı, harnupta tane sayısı incelenmiştir. Genotiplere ait karakteristik özellikler, ortalama, minimum ve maksimum değişim aralıkları, standart sapma ve CV değerleri belirlenmiştir. Bu çalışmanın amacı orijini birbirinden farklı olan 17 kolza genotiplerinin kışlık ekim dönemindeki performanslarını belirleyerek bir veri tabanı oluşturmak ve ıslahçılar için yeni kaynak oluşturmaktır.

Anahtar Kelimeler: Kanola, brassica, adaptasyon



**PRELIMINARY EVALUATION OF THE ADAPTATION ABILITY OF CANOLA
(*Brassica napus*) GENOTYPES OF DIFFERENT ORIGINS UNDER
MEDITERRANEAN CLIMATE CONDITIONS**

ABSTRACT

This research was conducted to determine of winter potentials of rapeseed cultivars and types for Bornova, İzmir conditions in 2019/2020 growing season on experiment field of Ege University Faculty of Agriculture. As materials were used that 17 winter rapeseed genotypes. The examine specification were seed yield, 1000 seed weight, flowering and physiological mature date, plant height, branch number, capsule number per plant, seed number per capsule. Characteristics of genotypes, average, minimum and maximum change intervals, standard deviation and CV values were determined. The aim of this study is to determine the performance of 17 rapeseed genotypes, which are different in origin, in winter planting period, to create a database and to create a new source for breeders.

Keywords: Kanola, brassica, adaptation



TRAINING NEEDS OF CASSAVA PROCESSORS IN IWO LOCAL GOVERNMENT AREA OF OSUN STATE NIGERIA

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ABSTRACT

Cassava is mostly cultivated in the southwest, Nigeria as an important food and economic crop. The rural women used traditional methods to process cassava tubers into garri, lafun and tapioca for human consumption. However, these traditional techniques call for review and trainings to enable cassava processors adjust to the modern methods of cassava processing. Therefore, this study examined the training needs of cassava processors in Iwo Local Government Area (LGA) of Osun State, Nigeria. A simple random sampling technique was used to select two hundred and forty (240) respondents from the selected LGA. Structured interview guide was the main tool used for data collection and the data were analyzed with SPSS 17. Data were also subjected to the descriptive statistics and correlation analysis. The result shows that 48.9% of the respondents were within the age of 31 – 50 years, 82.9% were females, and 65.2% were married. Findings showed that 84% of the respondents need training for operating milling machine, 76% need training for hydraulic pressing, 51% need training for the packaging and 81% need training marketing strategies. Almost all (99.4%) needs training for the working place hygiene. There is a positive and strong correlation between the cassava processing techniques and the training needs. Additionally, socio-economic characteristics of the respondents have positive correlation with the training needs in the study area. The study concluded that cassava processors need training to bridge the gap between the traditional methods and innovative ways of processing cassava. Therefore the study recommends that extension workers should come up with innovative trainings to improve the skills and capacity of the cassava processors in the study area.

Keywords: Cassava, garri, training, processing, innovation, osun, Nigeria, processors



Nax1 ve Nax2 GENLERİNİ İÇEREN GERİ MELEZ 4 HATLARININ YÜKSEK DOZDA TUZ UYGULAMASI ALTINDA VERMİŞ OLDUKLARI TEPKİLERİN BELİRLENMESİ

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ÖZET

Abiyotik stres kaynaklarından biri olan toprak tuzluluğu, çoğunlukla kurak ve yarı kurak bölgelerde ortaya çıkmaktadır. Dünyada bu stres faktörü, giderek geniş alanları etkisi altına almaktadır. Artan tuzluluk stresine bağlı olarak, günümüzde bitkilerde verim ve kalite açısından oldukça önemli kayıplar meydana gelmektedir. Bilinçsiz ve aşırı sulamayla beraber toprakların yıkanarak yeraltı suyuna karışmasıyla da tuzluluk problemi yaygınlaşmaktadır. Yer altı suyuna karışan bu çözünebilir tuzlar kapilarite yolu ile toprak yüzeyine çıkmaktadır ve su buharlaşarak topraktan yitmektedir. Bu yitme sonucunda toprak yüzeyinde ve yüzeye yakın kısımlarında tuzun birikmesiyle tuzluluk problemi oluşmaktadır. Tuzlu alanların yaygınlaşması sonucu ürün kayıplarının önemli boyutlara ulaşması sebebiyle; uluslararası kuruluşlar ve hükümetler bu problemi azaltmaya yönelik çözüm yolları geliştirmeye başlamışlardır. Çözüm yollarından bazıları toprak ıslahı, tuzsuz sulama suyunun kullanımı ve bilinçli toprak işlemesi gibi çalışmalardır. Bu yöntemler maliyetli ve uzun vadeli olduğu için sürdürülebilirlik açısından kalıcı çözümler üretilebilir. Bitki ıslahı bu yönde kullanılabilecek avantajlı bir yöntem olarak kabul görmektedir. Buğday gerek insan gerek hayvan beslenmesinde önemli bir besin kaynağıdır.



3rd INTERNATIONAL CONFERENCE
on FOOD, AGRICULTURE and VETERINARY
19-20 June, Izmir-TURKEY



Tarımsal, ekolojik ve sosyo-ekonomik yönden de stratejik bir ürün olma özelliği açısından gıda sektörünün vazgeçilmez ana ürünlerinden birisidir. Ülkemiz coğrafyası da, buğdayın gen merkezi olması nedeniyle yabancı buğday türlerini, yerel buğday çeşitlerini ve modern buğday ıslah çeşitlerini birlikte barındırmaktadır. Bundan dolayı buğday yönünden son derece geniş bir çeşitliliğe ve zenginliğe sahiptir. Bu çalışmada Türkiye topraklarındaki yaygın sorunlardan biri olan tuzluluk problemi ele alınmış ve tuzluluğa toleranslılık genlerini ihtiva eden ekmeklik buğday hatları ile çalışılmıştır. Moleküler destekli ıslah programı ile tuzluluğa toleranslılık sağlayan Nax1 ve Nax2 genlerini içeren Avustralya kökenli genotipler ve EBH1 buğday hattı 4 (GM4) defa art arda geri melezlenmiştir. Bu çalışma kapsamında GM4 popülasyonunda bulunan ilgili genlerin NaCl uygulaması altında beklenen fonksiyonları gösterdiği belirlenmiş ve bu süreçte bitkilerin gösterdiği fizyolojik tepkiler detaylı olarak araştırılmıştır. Çalışma sonucunda bitki büyüme parametreleri, bitki EC içeriği ve bitki besin element içeriklerinden Na ve Cl içeriklerine bakılmıştır.

Anahtar Kelimeler: Abiyotik stres, ekmeklik buğday, geri melez, moleküler ıslah, toleranslılık, tuzluluk



DETERMINATION OF RESPONSES OF BACK HYBRID 4 LINES CONTAINING Nax1 AND Nax2 GENES UNDER HIGH DOSE SALT ADMINISTRATION

ABSTRACT

Soil salinity, one of the sources of abiotic stress, mostly occurs in arid and semi-arid regions. In the world, this stress factor is increasingly affecting large areas. Due to the increasing salinity stress, significant losses occur in plants in terms of yield and quality. Along with unconscious and excessive irrigation, the problem of salinity becomes widespread as the soils are washed and mixed with the groundwater. These soluble salts mixed with the groundwater rise to the soil surface via capillarity and the water evaporates and is lost from the soil. As a result of this loss, salinity problem occurs with the accumulation of salt on the soil surface and near the surface. due to the widespread use of salty areas, product losses reached significant levels; international organizations and have started to develop solutions to reduce this problem. Some of the solutions are works such as soil improvement, the use of salt-free irrigation water and conscious soil cultivation. Since these methods are costly and long-term, permanent solutions should be produced in terms of sustainability. Plant breeding is accepted as an advantageous method that can be used in this direction. Wheat is an important food source in both human and animal nutrition. It is one of the indispensable main products of the food industry in terms of being a strategic product in terms of agricultural, ecological and socio-economic aspects. The geography of our country also hosts wild wheat species, local wheat varieties and modern wheat breeding varieties together, as it is the gene center of wheat. Therefore, it has an extremely wide variety and richness in terms of wheat. In this study, salinity problem, which is one of the common problems in Turkish soils, was handled and bread wheat lines containing salinity tolerance genes were studied. With the molecular assisted breeding program, Australian genotypes containing the Nax1 and Nax2 genes conferring salinity tolerance and the EBH1 wheat were backcrossed 4 (BC4) times in succession. Within the scope of this study, it was determined that the relevant genes in the GM4 population showed the expected functions under NaCl application, and the physiological responses of the plants in this process were investigated in detail. As a result of the study, plant growth parameters, plant EC content and Na and Cl contents of plant nutrients were examined.

Keywords: Abiotic stres, bread wheat, back cross, molecular breeding, tolerance, salinity



PROGRESS TOWARDS DEVELOPMENT OF NON-RECOMBINANT GAMETES IN POTATO USING RNAI TECHNOLOGY

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ABSTRACT

Potato (*Solanum tuberosum* L.) is the most vital non-grain food crop of the world, grown all across the global and rank 3rd in terms of human consumption after rice and wheat. Potato is multiplied through tubers and is highly heterozygous, thus cannot remain true to type if multiplied sexually. Fixing the genomic composition and yet multiplication through TPS (True potato seed) is an important challenge in potato. The theory of meiosis, during Meiosis Prophase I, the key process include DNA double strand break (DSB) and subsequent homologous recombination, which are essential for chromosome segregation and in case of tetraploid potato, which leads to highly heterozygous and formation of uneven parental type of TPS. The concept of deficient mutants in meiotic recombination process, arrest the meiotic recombination, crossing over and pairing of chromosomes. Therefore, targeted the creation of *DMC1* mutants in potato to avoid the cross over, recombination and to understand the functionality and role of heterozygosis in potato. *In silico* analysis and molecular characterization of *DMC1* gene showed the sequence homology with the reference genome double monoploid *Solanum tuberosum* followed by *Solanum pennellii* and *Solanum lycopersicum* indicating conserved nature of the *DMC1* gene in Solanaceae family. The *DMC1* RNAi lines have been developed in popular tetraploid potato cultivars, and generated >200 putative transformants using *Agrobacterium* mediated genetic transformation using internodal stem cuttings as explants. The micro-plants were further screened using nptII PCR and found 90 lines were positive. The positive lines are under flowering study to evaluate for meiotic study. The suppression of recombination and identification of asynaptic mutant lines could possibly recreate the parental type gametes and true to type botanical seed similar in genetic constitution to starting clone. This study would help in understanding the functionality of *DMC1* in meiotic recombination, DSB break, cross-over role in chromosome segregation and would help in developing the maintaining genetic purity of the potato cultivars.

Keyword's: DSB (Double Strand Break), *DMC1* (Disrupted Meiotic cDNA 1), TPS (True Potato Seed)



ZEYTİN DAL KANSERİ ETMENİ *Pseudomonas savastanoi* pv. *savastanoi*'nin EPİFİT ve ENDOFİT BAKTERİLER İLE BİYOLOJİK MÜCADELESİ

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ÖZET

Bu çalışmanın amacı, *Pseudomonas savastanoi* pv. *savastanoi* (*Psav*)'nin biyolojik mücadelesinde sağlıklı zeytin ağaçlarının kök ve sürgünlerinden izole edilen epifit ve endofit bakterilerin kullanım olanaklarının belirlenmesidir. Çalışma kapsamında toplam 336 (196 epifit ve 140 endofit) bakteri izole edilmiş ve MALDITOF-MS ile tanıları yapılmıştır. Antagonistik etkinin (A-indeks) belirlendiği ikili kültür denemelerinde 81 bakteri izolatu patojen gelişimini farklı oranlarda engellemiştir. En yüksek engelleme oranı 5.24 A-indeks değeri ile *Bacillus megaterium* HZEP7 izolatında belirlenirken bunu sırası ile *Bacillus subtilis* HZEN1 (4.85) ve *Pseudomonas koreensis* HZEN27 (4.83) izolatları izlemiştir. Ayrıca *in vitro* etki mekanizmalarının belirlenmesi çalışmalarında epifit ve endofit bakterilerin siderofor ve proteaz üretimi gibi mekanizmaları incelenmiştir. *In vivo* testlerde kullanılacak izolatlar yüksek antagonistik etkiye göre belirlenmiş olup, *Bacillus subtilis* HZEN1, *Bacillus megaterium* HZEP7, *Pseudomonas koreensis* HZEN27 ve *Bacillus pumilus* HZEP29 izolatları havuç dilimleri ve fidan inokulasyonu ile biyokontrol etkinin belirlenmesi çalışmalarına seçilmiştir. Havuç dilimleri inokulasyonu ile biyokontrol etkinin belirlenmesi testlerinde, en yüksek engelleme % 98,78 ile *Bacillus subtilis* HZEN1 izolatında belirlenirken bunu sırası ile *Bacillus megaterium* HZEP7 (%94.49), *Pseudomonas koreensis* HZEN27 (%92.09) ve *Bacillus pumilus* HZEP29 (%90.26) izolatları izlemiştir. Fidan inokulasyonu testlerinde havuç dilimlerine benzer şekilde tüm bakteri izolatları ur oluşumunu engellemiş olup en yüksek engelleme %78.72 ile *Bacillus subtilis* HZEN1 izolatında belirlenirken bunu sırası ile *Bacillus megaterium* HZEP7 (60.87), *Pseudomonas koreensis* HZEN27 (46.09) ve *Bacillus pumilus* HZEP29 (44.87) izolatları izlemiştir. Elde edilen sonuçlar *Bacillus subtilis* HZEN1, *Bacillus megaterium* HZEP7, *Pseudomonas koreensis* HZEN27 ve *Bacillus pumilus* HZEP29 izolatlarının zeytin dal kanseri hastalığı ile mücadelede biyokontrol etmeni olarak kullanılabileceğini göstermiştir.

Anahtar Kelimeler: Zeytin dal kanseri, *Pseudomonas savastanoi* pv. *savastanoi*, biyolojik mücadele, antagonizm



BIOLOGICAL CONTROL of *Pseudomonas savastanoi* pv. *savastanoi* CAUSING THE OLIVE KNOT DISEASE WITH EPIPHYTIC and ENDOPHYTIC BACTERIA

ABSTRACT

The aim of this study was to determine the biological control possibilities of *Pseudomonas savastanoi* pv. *savastanoi* (*Psv*) by using epiphytic and endophytic bacteria isolated from the roots and shoots of healthy olive trees. A total of 336 bacterial isolates (196 epiphytes and 140 endophytes) were recovered and diagnosed by using Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometry (MALDI-TOF-MS). In dual culture tests, 81 bacterial strains inhibited pathogen development at different degrees. The highest inhibition value (A-index) was determined in *Bacillus megaterium* HZEP7 with a 5.24 A-index value, followed by *B. subtilis* HZEN1 (4.85) and *Pseudomonas koreensis* HZEN27 (4.83), respectively. Mechanisms of antagonist bacterial strains for siderophore and protease production were also investigated by *in vitro* tests. The strains to be used in *in vivo* tests were determined according to high antagonistic effects, and *B. subtilis* HZEN1, *B. megaterium* HZEP7, *P. koreensis* HZEN27, and *B. pumilus* HZEP29 strains were selected for *in vivo* tests. In the carrot slices inoculation, the highest inhibition value was detected in *B. subtilis* HZEN1 with 98.78%, followed by *B. megaterium* HZEP7 (94.49%), *P. koreensis* HZEN27 (92.09%), and *B. pumilus* HZEP29 (90.26%) isolates, respectively. Similar to carrot slices in seedling inoculation tests, all bacterial isolates inhibited gall formation. The highest inhibition value was determined in the *B. subtilis* HZEN1 isolate with 78.72%, followed by *B. megaterium* HZEP7 (60.87%), *P. koreensis* HZEN27 (46.09%), and *B. pumilus* HZEP29 (44.87%) isolates, respectively. The obtained results showed that *B. subtilis* HZEN1, *B. megaterium* HZEP7, *P. koreensis* HZEN27, and *B. pumilus* HZEP29 isolates could be used against *Psv*, the causal agent of the olive knot disease, as a biocontrol agent.

Keywords: Olive knot, *Pseudomonas savastanoi* pv. *savastanoi*, biocontrol, antagonism



GREEN SYNTHESIS OF REDUCED GRAPHENE OXIDE UNDER MUFFLE ATMOSPHERE FROM AN AGRO WASTE FOR WASTEWATER MANAGEMENT

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ABSTRACT

In recent trends reduced Graphene oxide (rGO) gain more attention in various fields from environmental to biomedical practices. Although, it is preferable to develop eco-friendly methods to synthesize rGO the availability of carbon-rich sources plays a vital role in fixing the cost of commercial production. Therefore the direct muffle-based synthesis of high-quality, cost-effective rGO was supported by using an agricultural waste, Pearl Millet (*Pennisetum glaucum* – panicle portion). Since India is the largest producer of Pearl Millet the annual estimated production yields huge tonnes of waste material. Such post-harvest agricultural waste serves as a rich carbon source for rGO synthesis. In this work, we exposed the one-step conversion of raw material into reduced graphene oxide by using a potential oxidizing catalyst. The synthesized material was characterized by UV Visible Spec, XRD, FTIR, and Raman Spectra analysis to confirm the production of high-quality reduced graphene oxide. Additionally, rGO obtained has immense potential for degradation of various water pollutions, especially against organic dye degradation. Hence, the rGO developed by this facile, eco-friendly process from agricultural waste could be a good candidate for wastewater management.

Keywords: Reduced Graphene oxide, agricultural waste, Pearl Millet, organic dye, Muffle, Eco friendly



A FINANCIAL VIABILITY APPROACH OF MACAÚBA PALM (*A. aculeata*) TO BRAZILIAN SAVANNA

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ABSTRACT

The Macaúba Palm (*A. aculeata*) has a production around 114 kg/plant/year and design an interesting option to be used for vegetal recomposition of Brazilian savanna areas. Macaúba Palm is a native specie that occurs naturally at and its suitable for poor soils and climate with limited rainfall. The objective of this study is verify the technical viability around the productive chain of this palm focusing on small rural properties. The technical coefficients used come from experimental plantations and the productivity indicators based on plants which are native, totally adapted and without domestication. The analysis were built by the project's cash flow and verifying indicators such as: net present value (NPV), internal rate of return (IRR), discounted pay-back, as well as sensitivity and risk analysis. To contextualize and simulate the impact of the project, the Jequitinhonha Valley region in Minas Gerais state, whose brazilian savanna are verified as a predominant biome. That region has 550,000 ha available for implementation of agroforestry systems. Converting this area into intercropping of native forest with *A. aculeata* is possible an annually production about 13 million tons of coconut after six years. The NPV presents positive results in interest rates that range from 2.43% p.a. to 4.91% p.a.. In this case the project is considered unfeasible exclusively for financial proposes. When the reference interest rates at any level reaches above the 4.96% p.a. range the project may be considered viable, bringing positive returns in fifteen years considering the direct sale of the Macaúba coconut without beneficiation that is sold for around US\$ 77.5/kg. The *A. aculeata* presents itself as an option for its remarkable oil productivity available for degraded or preserved landscapes in Brazil. This work presents an attractive financial scenarium to sustainable economy able to support environmental and social demands.

Keywords: biofuels. biodiesel. oil palm. sustainability. sustainable economy.



GREEN SYNTHESIS AND CHARACTERIZATION OF IRON NANOPARTICLES FROM COMBINED HERBAL EXTRACTS FOR BIOMEDICAL APPLICATIONS

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ABSTRACT

The growing and expected concern for environmental sustainability calls for the adoption of 'Greener' techniques. The application of green synthesized iron nanoparticles (Fe-NPs) provides a promising route in this context. We, for the first time has reported a facile room-temperature assisted synthesis of iron nanoparticles utilizing aqueous extract of *Azadirachta indica* (neem), *Piper betel* (betel leaves) with a combination of Ayurvedic herbs such as *Asparagus racemosus* (Shatavari), *Symplocos* (Lodhra). The extracts served as both reductants and capping agents owing to the myriad of polyphenolic compounds present. Thus synthesized nanoparticles were confirmed through visual observation of colour changes and by UV-VIS spectroscopic technique. Based on UV-Vis data, prepared iron nanomaterials showed a maximum plasmon resonance absorbance at 325 nm. FT-IR analysis indicated the presence of functional groups such as Olefinic (alkene), Thiols (S-H stretch), Acetylenic (alkyne), Aromatic cyanide, which may be responsible for capping of nanoparticles. Fe SEM-EDX was performed to find the size of the synthesized nanoparticle and the size was found to be in the range of 83 to 352nm and the presence of iron was confirmed by elemental analysis. VSM analysis was performed and the nanoparticles were found to be super paramagnetic through S – shaped curve observed in the results. Based on these results it was concluded that the synthesised nanoparticles have a potential use in Biomedical application as a contrast agent in imaging.

Keywords: Magnetic nanofluids, green synthesis, superparamagnetism, bioimaging, medicinal plants



**KEFİR ÜRETİMİNDE PEYNİRALTI SUYU PROTEİN KONSANTRESİ ve
Bifidobacterium lactis KULLANIMININ ÜRÜNÜN MİKROBİYOLOJİK ve DUYUSAL
ÖZELLİKLERİNE ETKİSİ**

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ÖZET

Kefir Kafkasya orjinli fermente bir süt ürünüdür. Geleneksel kefir üretiminde süt kefir daneleriyle inoküle edilmektedir. Kefirin kendine özgü bir mikroflorası vardır. Danelerde bulunan çok sayıda mikroorganizmanın simbiyotik faaliyeti kefirin eşsiz özelliklerini oluşturmaktadır. Son yıllarda kefirin kalite özelliklerini geliştirmek amacıyla çeşitli uygulamalar yapılmaktadır. Çalışmamızda, geleneksel kefir üretiminde kefire işlenecek sütün peyniraltı suyu protein konsantresi (WPC) ve *Bifidobacterium lactis* ilavesiyle zenginleştirilmesi ve elde edilecek ürünün kalite özelliklerinin incelenmesi amaçlanmıştır. Kefir üretiminde kullanılan çiğ süt Ege Üniversitesi Menemen Uygulama ve Araştırma Çiftliği'nden, kefir daneleri ise Süt Teknolojisi Bölümü'nden temin edilmiştir. Kontrol grubu (K), probiyotik ilaveli kefir (B), WPC ilaveli kefir (W), probiyotik ve WPC ilaveli kefir (WB) olmak üzere dört farklı geleneksel kefir üretimi yapılmıştır. Kefir örneklerinde genel bileşimi belirlemek amacıyla pH, asitlik, yağ, protein, kurumadde analizleri yapılmıştır. Örneklerin *Lactococcus spp.* sayısı M17 Agar, *Lactobacillus spp.* sayısı MRS Agar, maya sayısı YGC Agar, *B. lactis* sayısı TOS-Muporicin Agar kullanılarak yapılmıştır. Duyusal özellikler görünüş, yapı ve kıvam, tat, koku ve genel kabul edilebilirlik açısından değerlendirilmiştir. Kefir örneklerinde kurumadde oranı WPC ilaveli örneklerde yüksek bulunmuştur. Örneklerin protein değerleri % 3,13-3,97 arasında değişmiş, WPC ilavesinin protein oranını önemli derecede artırdığı belirlenmiştir. Örneklerde yağ oranı bakımından istatistiksel bir fark belirlenmemiştir. Asitlik değerleri WPC ilaveli örneklerde daha yüksek bulunmuştur. Kefir örneklerinde laktokok sayıları 7.56-8.73 log kob/ml arasında değişmiştir. Depolama süresi boyunca en yüksek laktokok sayısı K örneğinde tespit edilirken, bunu B örneği takip etmiştir. Çalışmamızda örneklerin laktobasil sayıları 7.35-8.76 log kob/ml arasında, maya sayıları 4.87-5.94 log kob/ml arasında değişmiştir. Literatüre göre iyi kalitede üretilmiş kefirde olması gereken laktobasil, laktokok ve maya sayıları örneklerimizde tespit edilmiştir. Kefir örneklerimizin *B. lactis* sayıları da 8.26-8.96 log kob/ml arasında değişmektedir. Sayılar



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probiyotik ilaveli fermente st rnlerinin yararlı etki gsterebilmesi iin minimum 10^6 kob/ml konsantrasyonda olması gerekliliđini sađlamaktadır. Maya ve *B. lactis* sayıları sırasıyla B ve WB rneklerinde yksek bulunmuştur. Duyusal zelliklere WPC ve *B. lactis* ilavesinin nemli bir etkisinin olmadığı grlmştr. alıřmamızda geleneksel yntemle retilen kefirlerin gerekli kalite zelliklerini asitlik deđerleri, mikrobiyolojik ve duyusal zellikler bakımından karřıladıđı dřnlmektedir. Asitlik deđerleri en yksek WPC ilaveli rneklerde belirlenmiřtir. Bu veriler ıřıđında, *B. lactis*'in dane ile retilen kefirlerde kullanılabilir bir probiyotik bakteri olduđu sylenebilir. WPC ise kefirin kalite zellikleri desteklemek ve *B. lactis*'in canlılıđını desteklemek iin uygun bir prebiyotik olarak nerilebilir.

Anahtar Kelimeler: Kefir, Peyniraltı Suyu Protein Konsantresi, Probiyotik İlavesi



INFLUENCE of WHEY PROTEIN CONCENTRATE and *Bifidobacterium lactis* ADDITION ON MICROBIOLOGICAL and SENSORY PROPERTIES of KEFİR

ABSTRACT

Kefir is a fermented dairy product originated from Caucasus. In traditional kefir production, milk is inoculated by kefir grains. Kefir has a specific microflora. The symbiotic activity of many microorganisms found in grains creates the unique properties of kefir. In recent years, various applications have been made to improve the quality characteristics of kefir. In our study, whey protein concentrate (WPC) and *Bifidobacterium lactis* were added to kefir milk for the purpose of enrichment and improving the quality characteristics of kefir. The raw milk used in the kefir production was obtained from Ege University Menemen Application and Research Farm whereas kefir grains were obtained from Dairy Technology Department. Four different traditional kefir samples were produced including control group (K), kefir with probiotic (B), kefir with WPC (W), kefir with probiotic and WPC (WB). Kefir samples were analyzed in terms of pH, acidity, dry matter and fat content in order to determine general composition. In samples, *Lactococcus spp.* enumeration was made on M17 Agar, *Lactobacillus spp.* on MRS Agar, yeasts on YGC Agar and *B. lactis* on TOS-Muporicin Agar. Sensory properties were evaluated in terms of appearance, structure and consistency, taste, odor and general acceptability. In kefir samples, dry matter content was higher in samples with WPC. The protein values of the samples were ranged between % 3.13-3.97 and the enrichment with WPC significantly improved the protein content of the samples. There were no statistical differences between the samples in terms of fat content. The acidity values were also higher in the samples with WPC. In kefir samples the counts of *Lactococcus spp.* ranged between 7.56-8.73 log kob/ml. The highest lactococci counts were enumerated in sample K and this was followed by sample B. In our study, the counts of *Lactobacillus spp.* ranged between 7.35-8.76 log kob/ml, the yeast counts ranged between 4.87-5.94 log kob/ml in the samples. According to the literature, lactobacilli, lactococci and yeast numbers that should be in kefir produced in good quality were detected in our samples. The counts of *B. lactis* ranged between 8.26-8.96 log kob/ml in our kefir samples. The numbers ensure that the fermented products enriched with probiotic bacteria must have a minimum concentration of 10^6 cfu/ml in order to have a beneficial effect. Yeast and *B. lactis* counts were higher in samples B and WB, respectively. Enrichment with WPC and *B. lactis* had no significant effect on sensory properties. In our study, it is thought that kefir samples produced by the traditional method meet the required quality characteristics in terms of acidity values, microbiological and sensory properties. The highest acidity values were determined in the samples added with WPC. According to these data, it can be said that *B. lactis* is a probiotic microorganism that can be used in kefir produced with grain. WPC can be recommended as a suitable prebiotic to support the quality characteristics of kefir and support the viability of *B. lactis*.

Keywords: Kefir, whey protein concentrate, probiotic addition



GENDER EQUALITY: AGAINST THE CONTRADICTIONS OF INEQUALITY IN INDIA

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ABSTRACT

Women are relatively marginalized even though they make up approximately half the human population. It's quite unclear whether total equality will ever be achieved as women have a history of being discriminated against and struggle. 'GENDER' refers to the characteristics which are socially constructed as men and women, roles, norms etc.,. Gender equality means that both men and women share equal opportunities, rights and access to resources. Women on the most part have unequal access to health services, education facilities also they face discrimination at workplace. Despite the evidence of women's importance in the development process and the fact that they are most likely the key to effective resolution to some of the biggest challenges around the globe, gender equality remains a myth.

The present study is significant towards understanding the idea of gender equality in the following ways

1. Insight into the progress towards gender equality and its stand in the contemporary world
2. Understanding gender inequality against women's diverse contributions towards society
3. Does 'gender' create inequality?
4. Why is it important to take into account the gender concerns in development process.
5. Does government and legal instruments impact gender and equality construction ?.

Keywords: Gender, inequality



ARONYA MEYVESİNİN (*Aronia melanocarpa*) BİYOAKTİF BİLEŞİKLERİNİN ULTRASES DESTEKLİ EKSTRAKSİYON KOŞULLARININ OPTİMİZASYONU

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ÖZET

Bu çalışma, aronya (*Aronia melanocarpa*) meyvesinden fenolik bileşiklerin ekstraksiyon verimi üzerine ultrason destekli ekstraksiyon parametrelerinin (sıcaklık, süre ve ultrason gücü) etkisini araştırmayı ve optimum ekstraksiyon koşullarını belirlemeyi amaçlamıştır. Ekstraksiyon sıcaklığı, ultrases gücü ve ekstraksiyon süresinin fenolik bileşen verimi üzerine etkisi kuadratik model ile modellenmiştir. R^2 , düzeltilmiş R^2 ve tahmin edilen R^2 değerleri sırasıyla 0.9918, 0.9770 ve 0.8741 olarak bulunmuştur, bu da ikinci dereceden modelin fenolik bileşiklerin ekstraksiyon verimine proses koşullarının etkisini belirlemek için başarıyla kullanılabileceğini göstermektedir. Tüm parametrelerin lineer etkisi önemli bulunmuştur. Ultrases gücü ve ekstraksiyon süresinin fenolik bileşen verimi üzerine kuadratik etkisi de önemli bulunmuştur. Toplam fenolik bileşiklerin (TPC) analizi, Folin-Ciocalteu yöntemi kullanılarak yürütülmüştür. TPC değeri 4,32 ile 11,85 mg/g arasında değişmekte olup, artan sıcaklık, güç ve süre ile artmıştır. 54.33°C, 542.22 W ve 2.89 dakika optimal ekstraksiyon koşulları olarak bulunmuştur. Optimum ekstraksiyon şartlarına göre elde edilen ekstrakta antioksidan kapasitesi, toplam antosiyanin değeri ve fenolik profil analizi yapılmıştır ve optimum noktadan elde edilen değerler geleneksel ekstraksiyon yöntemleri ile karşılaştırılmıştır. Ultrases destekli ekstraksiyondan elde edilen toplam fenolik, toplam antosiyanin ve antioksidan kapasite değerleri geleneksel ekstraksiyon yöntemiyle elde edilen metottan daha yüksek bulunmuştur. Ayrıca fenolik bileşen dağılımlarında da iki metotta farklılık gözlenmiştir. Bu çalışmanın sonuçları, ultrases destekli ekstraksiyonun Aronya (*Aronia melanocarpa*) meyvesinden fenolik bileşik verimini artırabileceği ve biyoaktif özelliklerini iyileştirebileceğine işaret etmiştir.

Anahtar Kelimeler: Aronya (*Aronia melanocarpa*), ultrases destekli ekstraksiyon, fenolik bileşen profili, antioksidan kapasite



THE PROCESS OPTIMIZATION OF ULTRASOUND ASSISTED EXTRACTION OF BIOACTIVE COMPOUNDS FROM CHOKEBERRIES (*Aronia melanocarpa*)

ABSTRACT

This study aimed to investigate effect of the ultrasound assisted extraction parameters (temperature, time and ultrasound power) on extraction yield of phenolic compounds from Chokeberries (*Aronia melanocarpa*) fruit and to determine optimum extraction conditions. The effect of extraction temperature, ultrasound power and extraction time was modeled by quadratic model. The value of the R^2 , adjusted R^2 and predicted R^2 were found as 0.9918, 0.9770 and 0.8741 respectively, indicating that quadratic model could be successfully used to determine the effect of process conditions on phenolic compounds extraction yield. The linear effect of all parameters was found as significant and quadratic effect of ultrasound power and extraction time was also found to be significant. The analysis of total phenolic compounds (TPC) was performed by using Folin–Ciocalteu methods. TPC value and was ranged between 4.32 and 11.85 mg/g and increased with increasing temperature, power and time. 54.33°C, 542.22 W ve 2.89 were found to be optimum extraction conditions. Antioxidant capacity, total anthocyanin value and phenolic profile analysis were performed for the extract obtained based on optimum extraction conditions. The values obtained from the optimum point were compared with conventional extraction methods. Total phenolic, total anthocyanin and antioxidant capacity values obtained from ultrasound assisted extraction were found to be higher than the method obtained by traditional extraction method. In addition, differences were observed in the phenolic component distributions in the two methods. The results of this study showed that ultrasound assisted extraction could improve phenolic compound yield and bioactive properties from Chokeberries (*Aronia melanocarpa*) fruit.

Keywords: Chokeberries (*Aronia melanocarpa*), ultrasound assisted extraction, phenolic profile, antioxidant



DENİZ ALASINDA (*Oncorhynchus mykiss*, Walbaum 1792) PORTAKAL VE LİMON SUYU MUAMELESİNİN MİKROBİYAL KALİTE ÜZERİNE ETKİSİ

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ÖZET

Günümüzde balık, ahtapot ve karides gibi çeşitli su ürünlerinin herhangi bir şekilde ısıtılma işlemine tabi tutulmadan asidik özelliğe sahip, limon ve portakal gibi narenciye sularıyla marine edilerek soğuk olarak tüketime sunulması oldukça popüler hale gelmiştir. Bu şekilde hazırlanan yiyecekler aynı zamanda çeşitli baharat, meyve ve sebzelerle de (karabiber, tuz, sarımsak, kişniş, soğan, avakado, mango vb.) tatlandırılmaktadır. Bu tip kombine uygulamalar ile çiğ su ürünü hem lezzetlendirilmiş olmakta hem de yenilebilir hale gelmektedir. Genellikle bu tip yemeklerde asidik özelliğe sahip narenciye suları, sirke veya soslar antimikrobiyal koruyucu olarak kullanılmaktadır. Bu sayede uygulandıkları su ürününün de pH 'nı düşürerek mikroorganizma gelişimi için uygun olmayan ortamlar oluşturulur. Bu tip ürünlerde mikrobiyal riski kontrol etmenin bir yolu asit içerikli narenciye sularının kullanımı olmasına rağmen bu durum gıda güvenliğini garanti etmez. Su ürünleri pek çok bakteri grubuna ev sahipliği yapabilmektedir. Dolayısıyla herhangi bir şekilde ısıtılma işlemine tabi tutulmadan hazırlanan bu tip yemeklerde mikrobiyal kalitenin değerlendirilmesi önemlidir. Bu çalışmada limon ve portakal suyu ile muamele edilmiş alabalıkların mikrobiyolojik kalitesinin belirlenmesi amaçlanmıştır. Çalışmada limon ve portakal suyu ile 2 saat muamele edilen alabalıklarda pH ölçümü, mikrobiyolojik ve duyu analizleri yapılmıştır. Muameleli ve muamelesiz alabalıklarda toplam mezofilik aerobik bakteri, toplam psikrofilik bakteri, toplam maya-küf, *Staphylococcus* spp., toplam Enterobacteriaceae, toplam koliform, *Escherichia coli*, *Salmonella* spp., *Vibrio* spp. ve *Listeria monocytogenes* analizleri yapılmıştır. Elde ettiğimiz sonuçlara göre her iki narenciye suyu da mikrobiyal yükü düşürmüştür. Toplam mezofilik aerobik bakteri, toplam enterobacteriaceae, toplam koliform, ve *Staphylococcus* spp. sayısını düşürmede en etkili ($p<0.05$) uygulama limon suyu olmuştur. Çalışmada alabalık örneklerinde *Salmonella* spp., *Vibrio* spp. ve *L. monocytogenes* tespit edilmemiştir.

Anahtar Kelimeler: Portakal suyu, limon suyu, alabalık, mikrobiyolojik kalite



**EFFECT OF TREATMENT WITH ORANGE AND LEMON JUICE ON THE
MICROBIAL QUALITY OF MARINE TROUT (*Oncorhynchus mykiss*, Walbaum
1792)**

ABSTRACT

Presently, it has become very popular to serve various seafood, such as fish, octopus and shrimp without any heat treatment, they are served cold, marinated with acidic citrus juices such as lemon and orange. Foods prepared in this manner can also be flavored with various spices, fruits and vegetables (black pepper, salt, garlic, coriander, onion, avocado, mango etc.). With such combined treatments, the raw seafood becomes both flavored and palatable. Generally, acidic citrus juices, vinegar or sauces are used as antimicrobial preservatives in such dishes. This way, unsuitable environments for microorganism growth are created by lowering the pH of the seafood they are applied to. Although use of acidic citrus juices is a way to control microbial risk, it is not definitive for food safety. Fish can host many bacterial groups. Therefore, it is important to evaluate the microbial quality in this type of food prepared without any heat treatment. In this study, it was aimed to determine the microbiological quality of trout treated with orange and lemon juices. In the study, pH measurement, microbiological and sensory analyzes were performed on trout treated with lemon and orange juices for 2 hours. Total mesophilic aerobic bacteria, total psychrophilic bacteria, total yeast and mold, *Staphylococcus spp.*, total Enterobacteriaceae, total coliform, *Escherichia coli*, *Salmonella spp.*, *Vibrio spp.* and *Listeria monocytogenes* analyzes were performed in treated and untreated trout. According to our results, both citrus juices reduced the microbial load. The most effective ($p < 0.05$) application in reducing the number of total mesophilic aerobic bacteria, total Enterobacteriaceae, total coliform and *Staphylococcus spp.* was lemon juice. In the study, *Salmonella spp.*, *Vibrio spp.* and *L. monocytogenes* were not detected.

Keywords: Orange juice, lemon juice, trout, microbiological quality



**BIOREMEDIATION OF SALINIZED SOILS OF DESERTIFICATION AREA IN
THE BRAZILIAN NORTHEAST USING *Cladonia substellata* (lichen) AND THEIR
COMPOUNDS: A COMPILATION OF RESULTS**

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ABSTRACT

In the Brazilian Northeast, the semi-arid climate originated Desertification Cores in Caatinga Domain, region with high endemism, and impacted by human action. In desertification areas, the soil is degraded by salinization where the agricultural activity is developed, mainly on those ones whose land owners are little farmers. Investigations have been developed for minimizing the salinization, and recovering soil fertility, where bioremediation using the lichens is one of the options. In this study the ability of *Cladonia substellata* was evaluated for diminishing the salt content, and chemically transform Fluvisols in the Assunção island, whose inhabitants are indigenous people from Truká tribe. Experiments were carried out in domes with degraded soil covered by lichen thalli, or added of ether extract, or in combination with organic fertilizer and its byproduct, produced in laboratory, or by submitting to gamma radiation. Columns with the same treatments were tested, simulating a soil profile. Pre-and post-moistened soil and/or thalli were also used as parameter of simulating dry and rainy seasons. Chemical and physical essays were conducted to soil and lichens before, during and after the experiments for testifying lichen action. Statistical analyses were carried out using multivariate analysis (Sisva 5.6, Tukey test, GraphPad.Prism 5, PCA by R-studio). *C. substellata* was able of remediating the Fluvisols, through chelation of salts, being Ca^{2+} and Mg^{2+} the elements of greatest susceptibility. The applied radiation to soil, thallus or both was not viable for diminishing sodium content, but organic matter and ether extract enhanced physico-chemical properties. The soil column could reduce Na^+ content, making it slightly sodic. *C. substellata* showed remarkable chelating ability, with emphasis to its extract, including in association to organic matter. The species was able of minimizing the salinization or restore the fertility, demonstrating also to be a promising technique.

Keywords: Degraded soils, desertification, Caatinga, usnic acid



SMART IRRIGATION SYSTEM USING SOIL MOISTURE SENSOR

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ABSTRACT

In this paper, an automation of farm irrigation and soil moisture control by Arduino using soil moisture sensor. This automatic irrigation system senses the moisture content of the soil and automatically switches the pump when the power is on. A proper usage of irrigation system is very necessary because the main reason is the shortage of land reserved water due to lack of rain, spontaneous use of water as a result large amounts of water goes waste. For this reason, we use this automatic plant watering and soil moisture monitoring system and this system is very useful in all climatic conditions. India is the agriculture-based country. Our most of peoples are completely depended on the agricultural harvesting. Agriculture is a source of employment of majority Indians and has great impact on the economy of the country. In dry areas or in case of lacking rainfall, irrigation becomes difficult. So, it needs to be automated for proper watering a plant and handled remotely by farmer. When soil goes dry pump will start watering. The aim of the implementation is to reduce water use and automatic irrigation can be used for save time and low power monitor device. The aim of the implementation this project was to demonstrate that the automatic plant irrigation can be used to reduce water use, and save your time.

Keywords: Arduino, soil moisture, automatic irrigation system, smart agriculture



BROİLER'LERDE (*Gallus gallus domesticus*) SCHİRMER TEST I, GÖZ İÇİ BASINCI VE MERKEZİ KORNEAL KALINLIĞI ÖLÇÜMLERİNİN BELİRLENMESİ

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ÖZET

Kümes hayvanı üretiminde koruyucu hekimlik uygulamaları, bir salgın meydana gelmeden önce hastalıkların erken teşhisini amaçlar. Bu amaç doğrultusunda sağlıklı kümes hayvanlarının göz muayenesi için referans değerlerinin bilinmesi, hastalıkların erken tanısı için önem arz etmektedir. Sunulan çalışmada Avrupa Birliği standartlarına uygun koşullar altında (20 lux ışık şiddeti ve %80'i aydınlatılmış kapalı alan) yetiştirilen sağlıklı Broiler'lerde Schirmer gözyaşı testi I (STT I), göz içi basıncı (GİB) ve merkezi kornea (MKK) kalınlığının değerlerini belirlemek amaçlanmıştır. Çalışmada erkek, sağlıklı, toplam 24 Broiler'lerde sağ (n=24) ve sol (n=24) gözleri değerlendirildi. Tüm hayvanların fiziksel ve klinik muayenelerini takiben göz kapakları, konjunktiva, kornea, iris, lens ve fundus için refleks muayeneleri (pupiller, palpebral, tehdit, ışık) ve direkt oftalmoskopi dâhil olmak üzere rutin oftalmolojik muayeneler yapıldı. STT I testi için standart Schirmer test kâğıdı ile gerçekleştirildi. GİB değeri ise rebound tonometre ile ölçüldü. MKK ölçümleri pakimetre cihazı ile yapıldı. Her bir ölçüm sağ ve sol göz için ayrı ayrı yapıldı. Sağ (n=24), sol (n=24) ve sağ+sol (n=48) gözlerin STT I değerleri ortalama±standart hata olarak sırasıyla 9,75±0,79 mm/dk; 6,67±0,20 mm/dk ve 8,21±0,46 mm/dk olarak belirlendi. Sağ (n=24), sol (n=24) ve sağ+sol (n=48) gözlerin GİB ölçüm sonuçları ortalama±standart hata olarak sırasıyla 12,21±0,50 mmHg; 11,67±0,50 mmHg; 11,94±0,36 mmHg olarak bulundu. Sağ (n=24), sol (n=24) ve sağ+sol (n=48) gözlerin MKK değerleri ortalama±standart hata olarak sırasıyla 265,46±7,42 µm; 285,92±10,46 µm; 275,69±5,17 µm olarak ölçüldü. Çalışmada yer alan sağ (9,75±0,79) ve sol (6,67±0,20) gözlerin STT I değerleri arasındaki istatistiksel olarak anlamlı bir farklılık saptandı (p<0,05). Sağ ve sol göz GİB değerleri arasında istatistiksel olarak anlamlı, pozitif bir korelasyon tespit edildi (r=0,525; p<0,005). Sunulan sonuçların Broiler yetiştiriciliğinde sağlıklı göz referans değerlerinin saptanması, hastalıkların erken teşhisi ve hayvan yetiştiriciliğinin sürdürülebilirliği bakımından konu ile ilgili paydaşlar için faydalı olabileceği düşünülmektedir.

Anahtar Kelimeler: Broiler, göz, schirmer gözyaşı testi, rebound tonometri, göz içi basıncı, merkezi kornea kalınlığı



DETERMINATION OF SCHIRMER TEST I, INTRAOCULAR PRESSURE, AND CENTRAL CORNEAL THICKNESS MEASUREMENTS IN BROILER'S (*Gallus domesticus*)

ABSTRACT

In the poultry industry, preventive approaches demand early disease detection before an outbreak occurs. As a result, healthy poultry eye examination reference values are crucial for early disease diagnosis. Schirmer tear test I (STT I), intraocular pressure (IOP), and central corneal thickness (CCT) of 48 eyes (24 right and 24 left eyes) of 24 healthy male Broiler's were measured under European Union standards (20 lux light intensity and 80% of the used area is illuminated indoor). Routine ophthalmological examinations, including reflex tests (pupillary, palpebral, threat, light) and direct ophthalmoscopy for the eyelids, conjunctiva, cornea, iris, lens, and fundus, were performed following physical and clinical evaluations of all animals. Standard Schirmer test paper was used for the STT I test. Rebound tonometry was used to determine the IOP value. A pachymeter has been used to obtain CCT measurements. The measurements for the right and left eyes were performed separately. STT I values of the right (n=24), left (n=24), and right+left (n=48) eyes as mean±standard error were 9.75±0.79 mm/min, 6.67±0.20 mm/min and 8.21±0.46 mm/min, respectively. As a mean standard error, the IOP measurements of the right (n=24), left (n=24), and right+left (n=48) eyes were 12.21±0.50 mmHg, 11.67±0.50 mmHg, and 11.94±0.36 mmHg, respectively. The CCT values (mean±standard error) of the right (n=24), left (n=24), and right+left (n=48) eyes were 265.46±7.42 µm, 285.92±10.46 µm, 275.69±5.17 µm, respectively. A statistically significant difference was observed between the STT I values of the right (9.75±0.79) and left (6.67±0.20) eyes (p<0.05). A statistically significant positive correlation was found between right and left eye IOP measurements (r= 0.525, p<0.005). According to the results, identifying the healthy eye reference values of Broiler poultry breeding may be helpful for early disease detection and the sustainability of poultry production.

Keywords: Broiler, eye, schirmer tear test, rebound tonometry, intraocular pressure, central corneal thickness



EFFECT OF EXOGENOUS NIACIN ON GROWTH AND PHYSIOCHEMICAL ATTRIBUTES OF SPINACH UNDER CADMIUM STRESS

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ABSTRACT

Heavy metals have become significant threat for plant growth and development. The present research was appraised to evaluate the efficacy of exogenous niacin in circumventing cadmium (Cd) effects on spinach. For this purpose, a number of growth, physiological and biochemical parameters were undertaken. Cd toxicity caused a significant decline in different growth characteristics and chlorophyll contents. Further, significant perturbations were observed in anthocyanins, lipid peroxidation measured as malondialdehyde (MDA), H_2O_2 , flavonoids, and phenolics in spinach plants under Cd toxicity. Activities of antioxidant enzymes SOD, POD, CAT and APX were significantly upregulated in plants treated with exogenous niacin. Besides, plants treated with niacin manifested minimal oxidative damage reflected as limited H_2O_2 and MDA accumulation. Antioxidant enzyme activities were greatly strengthened by exogenous niacin. The results clearly indicated the significant role of exogenous niacin in decreasing Cd phytotoxic effects on spinach by regulating growth and secondary metabolism.

Keywords: Attributes, Physiochemical



RASFF VERİTABANI ANALİZİ İLE ARI ÜRÜNLERİNDE ORTAYA ÇIKAN GIDA GÜVENLİĞİ SORUNLARININ BELİRLENMESİ

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ÖZET

Gıda ve Yemde Hızlı Alarm Sistemi(RASFF; The Rapid Alert System for Food and Feed) Avrupa Birliği (AB) tarafından oluşturulan, kritik yasal düzenleyici araçlardan birisi olup, AB'ne üye ülkeler tarafından ithal edilen ürünlerin güvenli olup olmadıklarının tespiti ve sonrasında gerekli önlemlerin alınmasını sağlayan bir sistemdir. Bu çalışmada, 1999-2020 yılları arasında RASFF sistemine arı ürünleri ile ilgili yapılan bildirimler incelenmiş ve elde edilen bu verilerin gıda güvenliği ve halk sağlığı açısından değerlendirilmesi amaçlanmıştır. RASFF online arama sayfası üzerinden belirtilen tarih aralığında, bal ve arı sütü olarak yapılan arama sonuçlarına göre elde edilen veriler, sistemde kayıtlı bildirimlerin yıl, tehlike kategorisi, risk tanımlaması ve ihracatçı ülkeye göre dağılım analizleri yapılmıştır. 1999 ve 2020 yılları arasında bal ve arı sütü ile ilgili toplam 381 adet bildirim sisteme kayıt edilmiştir. Bildirimlerin büyük çoğunluğunu alarm ve bilgilendirme uyarıları oluşturmuştur. Ballara ilişkin en yaygın bildirim, tehlike kategorilerine göre sınıflandırıldığında 319 (% 83,73) bildirim ile veteriner ilaç kalıntılarıdır. Türkiye'den ithal edilen ballara ait 22 adet bildirim yapıldığı, bu bildirimlerin 18'inin (%81) veteriner ilaç kalıntısı kaynaklı olduğu görülmüştür. Antibiyotikler ile pestisitlerin yaygın ve kontrolsüz bir şekilde kullanılması, arı ürünlerinde kimyasal kontaminasyonlara neden olmaktadır. Mevcut çalışmadan elde edilen sonuçlar, ülkemizin bal üretimi ve ihracatındaki temel sorunların belirlenmesi ve uluslararası gıda güvenliği standartlarına uygun olarak üretim yapılabilmesi açısından kritik önem taşımaktadır.

Anahtar Kelimeler: Arı ürünleri, avrupa birliği, bal, gıda güvenliği, RASFF



IDENTIFYING FOOD SAFETY PROBLEMS IN BEE PRODUCTS WITH THE RASFF DATABASE

ABSTRACT

The Rapid Alert System for Food and Feed (RASFF) is a critical legal regulatory tool in order to ensure a high level of food safety of the imported products for EU member states. In this study, the data of alert and information notifications about bee products between 1999-2020 have been extracted from the RASFF database from entry logs made, and the results were evaluated in terms of food safety and public health. Distribution analyzes of the notifications were made according to the year, hazard category, risk definition and exporting country. A total of 381 notifications on bee products were registered in the system between the dates specified. Most of the notifications consisted of alarm and information alerts. The most common notification was veterinary drug residues with 319 notifications (83.73%) when classified according to hazard categories. It has been observed that 22 notifications were made on honey imported from Turkey and 18 (81.00%) of these notifications originate from veterinary drug residues. The widespread and uncontrolled use of antibiotic and pesticides cause high chemical contamination in honey and other bee products. The results obtained from the current study are critically important for determining of the main problems in honey production and exports of our country, and making food production in accordance with international food safety standards.

Keywords: Bee products, european union, food safety, honey, RASFF



PHYTOREMEDIATION: A GREEN APPROACH TO CLEAN UP METAL CONTAMINATED SOILS

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ABSTRACT

Heavy metal contamination is becoming a rising problem across the world. Heavy metals are mostly deposited in soil as a result of human activities such as toxic solid waste disposal, smelting, and industrial discharge, etc. Heavy metals have been released into the environment as a result of mobilization of these elements through ore extraction and processing for various uses. Because heavy metals are non-biodegradable, they can survive in the environment and contaminate the food chain, thereby accumulating in human body via biomagnification. Heavy metal pollution has presented a severe threat to human health and environment due to its poisonous nature. As a result, soil pollution must be remediated as soon as possible. Heavy metals that remain in the soil can be taken up by plant tissues, invade the biosphere, and accumulate in the food web's trophic levels. For the cleaning of heavy metal polluted soil, a variety of biological, chemical and physical biological remediation approaches are available. Phytoremediation is most feasible, environmentally beneficial and cost effective of these techniques. A deeper knowledge of the processes behind heavy metal tolerance and accumulation in plants is required to increase phytoremediation effectiveness. Phytodegradation, phytoextraction, phytovolatilization, and phytoaccumulation are some of the processes used in phytoremediation.

Keywords: Soil, metal



RATLARDA ETANOL İLE OLUŞTURULMUŞ KARACİĞER FİBROZİSİNDE ISIRGAN OTU TOHUMUNUN (*Urtica dioica* SEED) TEDAVİ EDİCİ ETKİSİNİN HİSTOPATOLOJİK VE İMMUNOHİSTOKİMYASAL OLARAK ARAŞTIRILMASI

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ÖZET

Bu çalışmada, etil alkol ile deneysel olarak 8 haftalık süre içinde karaciğerde fibrozis oluşturulduktan sonraki 2 aylık tedavi sürecinde, ısırgan otu tohumu ekstrakt'ı kullanılarak fibrozisin geri dönüşümünün mümkün olup olmadığı biyokimyasal, histopatolojik ve immünohistokimyasal olarak araştırıldı. Çalışmada toplam 24 adet rat kullanıldı ve ratlar her grupta 8'er adet olmak üzere üç gruba ayrıldı. Deneme süresi toplam 4 ay olarak belirlendi. Kontrol grup; standart rat pelet yemiyle beslendi. Alkol grubu ve alkol+ısırgan tohumu ekstrakt'ı grubunda ise denemenin ilk 2 ayında günde bir defa orogastrik gavajla 4 mL/kg %30'luk etil alkol verilerek hepatik fibrozis oluşturuldu. Daha sonraki 3. ve 4. aylarda alkol grubuna sadece alkol verilirken, alkol+ısırgan tohumu ekstrakt grubundaki ratlara ise alkol ile birlikte ısırgan otu tohumu ekstrakt'ı (30 mg/kg)'da verilerek fibrozisin geri dönüşümü uygulama sonunda izlendi. Deneme sonunda nekropsi yapılan ratlardan alınan kan ve karaciğer doku örnekleri biyokimyasal, histopatolojik ve immünohistokimyasal olarak incelendi. Histopatolojik ve immünohistokimyasal bulgulara göre; ısırgan otu tohumu ekstrakt'ının önceki çalışmalarda kaydedilmiş birçok biyoaktif bileşenleri ve terapötik özellikleri sayesinde karaciğerdeki dejeneratif-nekrotik değişiklikler ve fibrozisi önemli düzeylerde geri dönüştürdüğü gözlemlendi. Biyokimyasal analizlerde; alkol grubunda ALT, AST, LDH ve HDL düzeyleri kontrol grubuna göre azalmıştı ($p<0.05$). Ancak, alkol grubunda glukoz, LDL ve trigliserid seviyeleri ise kontrol grubuna göre artmıştı ($p<0.05$). Alkol+ısırgan grubunda alkol grubuna göre; ALT, LDH, LDL, glukoz ve trigliserid düzeyleri azalmış iken, alkalen fosfataz ve HDL seviyeleri ise alkol grubuna göre artmıştı ($p<0.05$). Çalışmanın sonuçları, alkolik hepatik fibrozisli olgularda ısırgan otu tohumu ekstrakt'ının antifibrotik etkiye sahip olduğunu, lipid profili ve karaciğer fonksiyon testlerini önemli ölçüde restore ettiğini gösterdi. Bu araştırma Van Yüzüncü Yıl Üniversitesi Bilimsel Araştırma Projeleri Başkanlığı tarafından TYL-2018-7586 numaralı proje olarak desteklenmiştir.

Anahtar Kelimeler: Fibrozis, histopatoloji, ısırgan otu tohumu, lipidprofili, rat



HISTOPATHOLOGIC AND IMMUNOHISTOCHEMICAL INVESTIGATION OF THE THERAPEUTIC EFFECT OF STINGING NETTLE SEED (*Urtica dioica* SEED) IN ETHANOL-INDUCED LIVER FIBROSIS IN RATS

ABSTRACT

In this study, it was investigated biochemically, histopathologically and immunohistochemically whether it is possible to recycle the fibrosis by using nettle seed extract during the 2-month treatment process after the fibrosis was formed in the liver within an experimental period of 8 weeks with ethyl alcohol. A total of 24 rats were used in the study and the rats were divided into three groups, 8 in each group. The trial period was determined as 4 months in total. Control group; standard rat was fed with pellet feed. In the alcohol group and alcohol + nettle seed extract group, hepatic fibrosis was induced by giving 4 mL / kg 30% ethyl alcohol by orogastric gavage once a day in the first 2 months of the trial. In the next third and fourth months, only alcohol was given to the alcohol group, while the rats in the alcohol + nettle seed extract group were given nettle seed extract (30 mg / kg) together with alcohol and the recovery of fibrosis was observed at the end of the application. At the end of the experiment, blood and liver tissue samples taken from necropsied rats were examined biochemically, histopathologically and immunohistochemically. According to histopathological and immunohistochemical findings; It was observed that nettle seed extract recycled degenerative-necrotic changes and fibrosis in liver significantly thanks to its many bioactive components and therapeutic properties recorded in previous studies. In biochemical analysis; ALT, AST, LDH and HDL levels were decreased in the alcohol group compared to the control group ($p < 0.05$). However, glucose, LDL and triglyceride levels were increased in the alcohol group compared to the control group ($p < 0.05$). According to the alcohol group in the alcohol + nettle group; While ALT, LDH, LDL, glucose and triglyceride levels were decreased, alkaline phosphatase and HDL levels were increased compared to the alcohol group ($p < 0.05$). The results of the study showed that nettle seed extract had antifibrotic effect in alcoholic hepatic fibrosis patients and significantly restored lipid profile and liver function tests. This research was supported by the Scientific Research Projects Directorate of Van Yüzüncü Yıl University as a projectnumbered TYL-2018-7586.

Keywords: fibrosis, histopathology, nettle seed, lipid profile, rat



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ÖZET

Süt ürünleri tüketiminin 2050 yılına kadar kişi başına % 19 oranında artacağı tahmin edilmektedir. Bununla birlikte, süt üretimi yoğun enerji tüketen bir süreçtir. Tarımsal üretimden kaynaklanan küresel sera gazı emisyonları ile ilgili kaygılarla birlikte, süt üretiminin artırılmasında; enerji kaynaklarının sürdürülebilir kullanımı, süt işleme endüstrisinin ekonomik ve çevresel sürdürülebilirliği dikkate alınmalıdır. Bu çalışmada, süt üretiminde enerji kullanımı konusunda yapılmış olan araştırmalar incelenmiştir. Toplam birincil enerji tüketim değerleri, organik süt üretimi yapan hayvancılık işletmelerinde 2,7 MJ/kg ile süt üretilen geleneksel hayvancılık işletmelerinde 4,2 MJ/kg düzeyindedir. Toplam birincil enerji gereksinimleri, barınak veya mera sistemlerin kullanılıp kullanılmadığına bağlı olarak değişir. Genel olarak, mera temelli bir süt üretim sistemi kullanılması durumunda, enerji tüketimi % 35 oranında azalır. Standart regresyon yöntemleriyle karşılaştırıldığında, çeşitli makine öğrenme algoritmalarının kullanılarak, enerji tüketimi değerleri daha doğru olarak tahmin edilebilir. Süt üretiminde enerji tahmin modelleri, üretim sistemi altyapısı ve yönetim uygulamalarındaki değişikliklerin etkisini belirlemek için yaygın olarak kullanılmaktadır.

Anahtar Kelimeler: Süt sığırcılığı, enerji tüketimi, enerji verimliliği



ENERGY USE FOR COW MILK PRODUCTION

ABSTRACT

It is estimated that consumption of dairy products will increase by 19% per capita until 2050. However, milk production is an energy-intensive process. Along with the concerns about global greenhouse gas emissions arising from agricultural production, in increasing milk production; Sustainable use of energy resources, economic and environmental sustainability of the dairy processing industry should be taken into account. In this study, researches on the use of energy in milk production have been examined. Total primary energy consumption values are 2.7 MJ / kg in livestock farms producing organic milk and 4.2 MJ / kg in traditional livestock farms producing milk. Total primary energy requirements vary depending on whether shelter or pasture systems are used. In general, energy consumption is reduced by 35% if a pasture-based milk production system is used. Energy consumption values can be estimated more accurately using various machine learning algorithms compared to standard regression methods. Energy prediction models in milk production are widely used to determine the impact of changes in production system infrastructure and management practices..

Keywords: Dairy cattle, energy consumption, energy efficiency



GIDA ENDÜSTRİSİNDE YENİ TRENDLER VE RİSKLER

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ÖZET

Bir yandan gıda sektörü ve gastronomi alanındaki gelişmeler, bir yandan da tüketici beklenti ve isteklerinde meydana gelen değişiklikler yeni trendlerin oluşmasına neden olmaktadır. Günümüzde bu beklenti ve istekleri önden anlayan hatta bunlara yöne veren şirketler bir adım daha öne çıkmaktadır. Bu beklenti ve istekler paralelinde Ar-Ge çalışmalarını yapıp ürünlerini piyasaya sunanlar rekabet açısından büyük avantajlar elde etmektedir. Gıda endüstrisindeki bu yeni trendler arasında sağlıklı ve iyi beslenme, premium ve artisanal ürünlere yönelim, hazırlaması pratik ve kolay olan dondurulmuş ve hazır yiyeceklere olan yönelim, etik kaynak kullanımı, sürdürülebilirlik ve İyi tarım uygulamaları ve yoğun lezzetli inovatif ürünlere yönelim ön plana çıkmaktadır. Bu trendler arasında özellikle covid salgını döneminde sağlıklı ve iyi beslenme trendi daha da ön plana çıkmıştır. İyi hal ve sağlığı geliştirici, hastalıkların riskini azaltıcı fonksiyonel ürünlere ve organik ürünlere olan yönelim artmıştır. Aynı şekilde diyetik beslenme de önem kazanmıştır. Clean Label (Temiz Etiket) trendi, Slow food hareketi, yenilebilir böcekler ve hüresel tarım uygulamaları, nörogastronomi ve moleküler mutfak gibi trendler gelişmeye devam edecektir. COVID-19, özellikle perakende, hizmet sektörü, turizm gibi bir çok sektörleri olumsuz etkilerken, online alışverişte ise önemli bir artışa sebep olmuştur. 25 trilyon dolarlık dünya ticaretinde online alışveriş satışları 3.5 trilyon dolara ulaşmıştır. Gıda sektöründeki en büyük risk artan dünya nüfusunun sağlıklı ve güvenli beslememesini sağlayacak kaynakların kıtlığıdır. Küresel Ayak İzi Ağı ve Dünya Doğayı Koruma Vakfı'nın Avrupa Birliğinde doğal kaynak tüketim hızının temel alındığı rapora göre, dünyamızın doğal kaynakları 10 Mayıs'ta bitmiş bulunmaktadır. Hızla artan dünya nüfusuyla birlikte açlık çeken insanların sayısı da hızla artmaktadır. Buna pandemi döneminin etkileri de eklendiğinde günümüzde nerdeyse 1.2 milyar insan açlık çekmektedir. Halen güvenilirliği tartışılıyor olsa da gıda endüstrisinde açlığa çare için en önemli çözüm genetiği değiştirilmiş ürünlerde görülmektedir. Bu derleme çalışmasında halen içinde bulunduğumuz pandemi süreci ve sonrasında gıda endüstrisinde oluşacak yeni trendler ve bunlara bağlı olarak ortaya çıkabilecek riskler ele alınmıştır.

Anahtar Kelimeler: Gıda endüstrisinde yeni trendler, sağlıklı ve iyi beslenme



NEW TRENDS AND RISKS IN THE FOOD INDUSTRY

ABSTRACT

On the one hand, developments in the food sector and gastronomy and, on the other hand, changes in consumer expectations and wishes lead to the formation of new trends. Nowadays, companies that are aware of these expectations and wishes and that achieve even managing these expectations and requirements are a step ahead of the other companies. The companies that conduct R&D studies by considering consumer expectations and offer their products to the market get great competitive advantages. Among these new trends in the food industry, healthy and good nutrition, the tendency to premium and artisanal products, the trend towards frozen and ready-made foods that are practical and easy to prepare, the use of ethical resources, sustainability and good agricultural practices and the orientation to intense delicious innovative products stand out. Among these trends, the trend of healthy and good nutrition has come to the fore especially during the covid epidemic period. The tendency towards functional products and organic products that improve well-being and health and reduce the risk of diseases has increased. Likewise, dietetic nutrition has gained importance. Trends such as the Clean Label trend, the Slow food movement, edible insects and cellular farming practices, neurogastronomy and molecular cuisine will continue to evolve and to be improved. While COVID-19 negatively affected many sectors such as retail, service sector and tourism, it caused a significant increase in online shopping. In the world trade of 25 trillion dollars, online shopping sales reached 3.5 trillion dollars. The greatest risk in the food sector is the scarcity of foods that can feed the growing world population. According to the report of the Global Footprint Network and the World Foundation for the Conservation of Nature, which is based on the rate of natural resource consumption in the European Union, the natural resources of our world have been exhausted on May 10. With the rapidly increasing world population, the number of people suffering from hunger is rapidly increasing. When the effects of the pandemic period are added to this, almost 1.2 billion people are starving today. Although its reliability is still under debate, the most important solution to hunger in the food industry is seen in genetically modified products. In the following compilation possible risks and new food trends that may occur during and after the pandemic are handled.

Keywords: New trends in food industry, healthy and good nutrition



**FOOD SECURITY AND AGRICULTURAL PRODUCE TRANSPORTATION IN
SAKI REGION OF OYO STATE, NIGERIA**

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ABSTRACT

Agricultural practices have been the mainstay of many developing economies in the global South over the years in which climatic conditions are optimally utilised. The consistent maintaining of food supplying chain and improvement of the socio-economic attributes of farming population in the agricultural practising zones require suitable and efficient transportation system. With this, the ease and extent of transporting agricultural produce from production points which are farms into points of consumption domicile outside the farms becomes seamless in order to optimise the production activities and as such, enhance food security for urban population. In this regard, this study examines 'Food security and agricultural produce transportation in Saki region of Oyo state', Nigeria with a view to enhancing food security in the state and Nigeria at large. With the use of multistage sampling, data was obtained from 225 farmers and the results of the data analysis showed that food crops, vegetables, fruits



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and poultry products are not only in persistent motion, but remained major backbone for food security quest of the country. Also, the persistent neglect of agricultural produce is identified among the factors causing poor access to affordable food supplies and erosion of purchasing power of farmers as high transportation cost of farm products and other cross cutting issues is adversely impacting farming productivity. Results of Regression analysis reveals the existence of significant relationship between attributes of agricultural produce/freight and transport cost ($F_{205}^{19} 11.916 = P < 0.05$). The study therefore, recommends extensive rehabilitation of farm roads, provision of storage facilities; improved extension services, establishment of rural freight transport service and the use of spoke and hub concept in agricultural produce transportation as veritable mechanism to ensure food security in the country.

Keywords: Agricultural produce, farmers, food security, transport, and Nigeria



DIVERSITY OF PRACTICES IN MAKING BREAD WITH TRADITIONAL SOURDOUGH IN MOROCCAN BERBER AREA "Figuig"

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ABSTRACT

Our study target Figuig, the far eastern region of Morocco, as a Berber tribes region kneading bread "aghroum or matlouae" with a different traditional sourdough named in Tamazight language "tamtount", which refers to their own traditional customs which mark a specific identity of each *ksar* in this region. The investigation is realising in Figuig area with 100 peasant women, in two periods (autumn and spring). The information's obtained from the survey, reveals 17 traditional sourdough recipes based on usage principally of two cereals wheat (82%) or barley(18%). The results shown a highest percentage of three recipes most using, whole wheat/ lukewarm water (31%), followed by recipes incorporating a special ingredient such as fermented milk "*leben*"(12%), barley (12%) or fresh dates (9%). When the mixture of sourdough is realised, it's directly transferred in to different shapes and sizes of utensil jars mostly made of glass (61%), or of clay (17%), or introduced into flour (13%), then the spontaneous fermentation taking place after incubation at room temperature (74%), or exposing it to the sun (26%), for a variable period which ranges between 24h (51%) to a week (42%), or it can be exceeded in 2 weeks in some bakers (14%), depending on the nature of sourdough "



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stiff, liquid, or dried". In order to develop and produce the distinctive aromas and acidity typical of sourdough, the microorganisms " yeast and lactobacillus bacteria" must feed on the nutrients present in the deferent mixture added; the basic mixture the most used is lukewarm water and flour (42%), approximately at equal weight in depending on the quantity taken to make the future bread. Although there are someone who boost their own one with a piece of bread dough (20%), or a mixture of wheat, date and lukewarm water (16%), or barley and lukewarm water (6%) , or fermented milk "*leben*" and wheat (6%) , which gives a sprout to a slightly drowsy sourdough. After a few days, during the growth period which special ingredients have been added regularly according to the "refresher" principle, the sourdough (chief) is doubles in volume, and the first signs of fermentation appear, namely the visible formation of little bubbles on the surface and a noticeable (31%), slightly sour (39%) and acidic smell (30%). The storage process is the last and the important phase on long-term sourdough conservation, that depending on the frequency of usage, if it daily than it must keeping at room temperature (31%), and it need to be feed it every day. But if it isn't intend to be used every day, it is preferable to store it in the fridge in cold at 4 C° (61%), and it will only require feeding once a week to maintain it in live. Our study area" Figuig" hosts a variety of sourdough recipe based on the uses of a multitude of ingredients according to their ancestral knowledge specific to each family, that must be preserved to avoid their disappearance.

Keywords: Bread, sourdough, survey, Morocco



**EFFECT OF THE FLAVOR OF SWEET RICE WINE FERMENTED BY
Saccharomyces fibuligera AND *rhizopus***

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ABSTRACT

Sweet rice wine is a type of alcoholic beverage and β -phenylethanol is the main aroma of sweet wine. To improve the fragrance of Sweet rice wine, this study selected non-*Saccharomyces* (*Saccharomyces fibuligera*) and *Rhizopus* from traditional Chinese starter and used them for Sweet rice wine fermentation. Compared with sweet rice wine fermented by single strain *Rhizopus*, which fermented by *Saccharomyces fibuligera* and *Rhizopus* increased the content of β -phenylethanol by 3.68 times, and have better flavor. Then the activities of enzymes related to β -phenylethanol metabolism were studied, by the end of the fermentation process, the activity of aromatic amino acid transaminase, pyruvate decarboxylase, ethanol dehydrogenase glucose-6-phosphate dehydrogenase, isocitrate dehydrogenase, malate dehydrogenase had also increased by 0.21, 0.35, 3.07, 6.59, 1.05, 12.49 times, respectively. Finally, the protein metabolism was studied, the activities of acidic protease had increased by 26%, the amino acids content had also increased by 25%. Sweet rice wine fermented by *Saccharomyces fibuligera* and *Rhizopus* generated more pleasant flavor than single strain. These results lay the foundation to improve the flavor of Sweet rice wine.

Keywords: *Saccharomyces fibuligera*, *rhizopus*, Sweet rice wine, flavor



CRITERIA OF BIOLOGICAL SAFETY IN THE FORMATION OF A STRATEGY FOR COMBATING INTRA-FARM INFECTIONS OF CATTLE

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ABSTRACT

In any farm, at the level of the animal population, a parasitic system is formed, which can include a different number of representatives of different taxonomic affiliation, including viruses, bacteria, fungi, protozoa, and zooparasites. This parasitic system has self-regulation of its quantitative and qualitative properties. In the process of evolution, as well as as a result of the interaction of microbiocenoses with the macroorganism, the system of its protection against infections was improved. However, in other microbial agents, properties that provide the possibility of vital activity and parasitism in the host body, that is, pathogenicity factors, arose and were fixed by selection. The results of the studies already conducted indicate that the associations of intra-farm microbiota that circulate among the cattle of farms are parasitocenoses that are independently regulated and evolve under the constant influence of macroorganism and environmental factors. This is a complex, multicomponent, strictly balanced ecosystem, each of the joints of which can be a trigger in the etiology of the development of intra-farm infections in cattle. Therefore, the study of the spread of intra-farm infections in farms, the development and implementation of scientifically based methods of control over them in order to increase the colonization resistance of the animal body, is relevant.

Keywords: Cows, factor infections, biotope, parasitocenosis



ANALYSIS OF BIOCHEMICAL AND IMMUNOLOGICAL PARAMETERS OF BLOOD DURING PROBIOTIC THERAPY OF PURULENT WOUNDS IN CATS

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ABSTRACT

Throughout the history of medicine, surgical infection has been a major obstacle to the development and expansion of the range of surgical interventions. Despite significant progress in the fight against purulent-inflammatory processes, infection in veterinary surgery remains a complex and urgent problem. Microbial contamination in inflammatory processes is caused by the spread of surgical infection, the appearance of new antibiotic-resistant strains of microorganisms, changes in their biological properties, complications of wounds, as well as a high level of immunosuppression caused by various factors. In recent years, probiotics – bacterial preparations from live microbial cultures-have been widely used for the prevention and treatment of infectious diseases, correction of intestinal dysbiosis. Their use causes an increase in the body's resistance, favorable metabolic changes, as well as an antagonistic effect on the microflora harmful to the animal. Probiotics do not cause adverse reactions, have no contraindications to use, and have a positive effect on the microbiocenosis of the macroorganism. We concluded that the use of probiotic drugs in the complex treatment of purulent-inflammatory processes of soft tissues is an evolutionarily justified approach and requires further study in order to determine the indications for widespread use in surgical practice. The article presents an analysis of morpho-biochemical and immunological parameters of the blood of cats in the control of the effectiveness of therapy for accidental purulent wounds. It is shown that the proposed probiotic-sorption drugs "Dilaxil" and "Sorbelact" in the complex therapy of cats with purulent wounds have shown their effectiveness. Thus, their use in a complex of therapeutic measures has a positive effect on hematological parameters, cleaning of the wound surface from purulent exudate, reduces the time of the beginning of epithelization of wounds and their complete healing.

Keywords: Cats, surgical infection, probiotics, immunity



EFFECT OF DIFFERENT LEVELS OF MINERAL AND VITAMIN SUPPLEMENTS ON BROILERS PERFORMANCE

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ABSTRACT

Today, the poultry industry is expanding and developing. Much of the cost in this industry, is the cost of feed. One of the most expensive components of the diet are mineral and vitamin supplements that are added to birds' diets to provide minerals such as zinc, copper, iron, etc., and vitamins such as vitamins A, K, C, E, D and B group. One of the solutions that can be used to reduce costs is to reduce the percentage of adding these supplements to the diet until the bird's performance is not reduced. To find the right level of supplement in the diet, we designed an experiment based on a completely randomized design. For this experiment, we used 416 10-day-old broilers (Cobb 500) in 4 treatments, 4 replication, and 26 birds per replication. Dietary treatments were: 1. control (basic diet with standard levels of mineral and vitamin supplement based on Cobb 500 strain catalog); 2. 75%Min&Vit (basic diet with 75% of the standard requirement of vitamin and mineral supplements); 3. 50%Min&Vit (basic diet with 50% of the standard requirement of vitamin and mineral supplements); 4. 50%Min (basic diet with 50% of the standard requirement of mineral supplement). Chickens were fed ad libitum with the dietary treatment during the grower (10-20 d), finisher 1 (21-30 d) and finisher 2 phases (31-40 d). Body weight of each bird was recorded individually on 20, and 40 d of age. Also, feed intake of the broiler chickens was recorded at 20 and 40 d of age; and the average daily weight gain (ADG), average daily feed intake (ADFI), feed conversion ratio (FCR) and European efficiency factor (EEF) were calculated accordingly. Data were analyzed using the GLM procedures of SAS 9.4 statistical software (SAS Institute, 2009), as a completely randomized design. Tukey's tests were used to determine the difference between treatments. According to the results of this experiment, the lowest ADG and the highest FCR in the grower period (10-20 d) was related to the 50%Min&Vit and 50%Min treatments ($P>0.05$). In the finisher period (21-40 d), the lowest ADG was related to chickens in groups of 50%Min&Vit and 50%Min; but this difference was not statistically significant with the control treatment ($P>0.05$). However, the FCR in the 50%Min treatment was significantly higher than the control treatment ($P<0.05$). Also, in the



whole experimental period (10-40 d), the lowest ADG was observed in 50%Min treatment ($P>0.05$); and the FCR in this treatment was significantly higher than the control group ($P<0.05$); but there was no significant difference between other treatments. At the end of the experiment, it was found that the highest EEF was related to the control treatment, but no statistically significant difference was observed between the treatments ($P>0.05$). Based on the findings of our study, reducing the percentage of mineral and vitamin supplements to the level of 75% of the standard requirement does not reduce bird performance because no significant difference was observed between control and 75%Min&Vit treatments. For this reason, we recommend that feed costs can be reduced by reducing the level of mineral and vitamin supplements after the starter phase in the Cobb Broilers diets.

Keywords: Broiler chicken, Cobb 500, mineral supplement, vitamin supplement



ENVIRONMENTAL PROTECTION: CSR INITIATIVES OF MEDIA ORGANISATIONS IN KERALA

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ABSTRACT

The time has come for us to develop a sense of urgent need to protect our environment as well as a sense of hope for its future. Plenty of damage has been done to the earth, the more is inflicted every day. India is the first country in the world to make corporate social responsibility (CSR) mandatory, following an amendment to the Companies Act, 2013 in April 2014. : As per Section 135 of the Act and rules issued thereunder, CSR norms are applicable on companies which has (a) net worth of Rs 500 Crore or more; (b) turnover of Rs 1000 Crore or more; or (c) net profit of Rs 5 Crore or more. Businesses can invest their profits in areas such as education, poverty, gender equality, environment protection and hunger as part of any CSR compliance. Kerala is the southernmost state of India. Two leading media organisations – Malayala Manorama and Mathrubhumi have been engaging in CSR for the past ten years in Kerala. Media provides environmental awareness and participation by making information widely available through creating people's awareness about environmental protection and conservation of natural resources. The public also get to know ways to prevent environmental pollution, and learn how to curb environmental degradation. In this study researcher tries to analyse the CSR initiatives - SEED (Student Empowerment for Environmental Development- Mathrubhumi) and Palathulli (Many a drop- Malayala Manorama) and their roles, importance and benefits in environmental protection. Also assess the advantages of involvement of media organisations in environmental protection activities.

Keywords: CSR, environmental protection, natural resources, environmental degradation



**EVALUATION OF VIRULENCE AND THE OXALIC ACID PRODUCTION ON
Cryphonectria parasitica VIRULENT AND CONVERTED STRAINS BY CHV1
HYPOVIRUS**

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ABSTRACT

Chestnut Blight, caused by *Cryphonectria parasitica* (Murrill) Bar, is a major disease in *Castanea sativa* Mill. on the European continent. Biological control by hypovirulence is a sustainable and efficient method to control the disease. The presence of *Cryphonectria hypovirus* 1 (CHV1) in *C. parasitica* reduces the fungus virulence that promote canker healing and tree recovery. Hypovirus infection results in phenotypic and metabolic changes, including the reduction of ligninolytic enzymes activity, and decreased oxalic acid production. The aim of this work was to evaluate the oxalic acid production in both virulent and converted strains on PDB (Potato Dextrose Broth, 24g/L) and to access the virulence of these strains on chestnut stems. Six isolates were converted with two characterized hypovirulent *C. parasitica* isolates (RBB111, SR44.2) and the presence of CHV1 was detected by molecular methods. Oxalic acid production was evaluated by spectrophotometry after the growth of the strains on 100 ml of PDB supplemented with 2mM MnSO₄ in an orbital incubator during five days. To evaluate the virulence of the isolates, chestnut stems were inoculated with the virulent isolates, their converted ones and the hypovirulent isolates. The characterized hypovirulent isolates used in this work has complete ability to convert virulent isolates with effective hypovirus transmission and PCR detection of CHV1 was obtained in all *C. parasitica* converted strains. The obtained results by spectrophotometric analysis have revealed that virulent strains always produced more oxalic acid than converted strains. The infection area on chestnut stems caused by virulent



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19-20 June, Izmir-TURKEY**



strains was significantly higher ($P < 0.05$) than the infection area caused by converted strains. The converted strains Cast26/RBB111 and Cast26/SR44.2 showed 50% and 88.6% reduction in the content of oxalic acid present in supernatant, respectively. This suggests that the reduction in enzymatic activities caused by hypovirulent strains is variable with the hypovirulent donor used in conversion.

Keywords: European chestnut, pathogenesis, oxalate



LIVING MULCH PERFORMANCE IN BLACK CARAWAY (*Nigella sativa* L.) FIELD IMPACT ON YIELD AND WEED CONTROL AND

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ABSTRACT

To evaluate the effect of living mulches on weed control and yield of black caraway (*Nigella sativa* L.) weeds by living mulch, two split factorial experiments were conducted in the form of a randomized complete block design with four replications in the research field of Aburaihan Campus, the University of Tehran in 2018 and 2019. The factors included; 1. seedbed planting type (stale seedbed and common seedbed); 2. living mulch species (berseem clover (*Trifolium alexandrinum* L.), fenugreek (*Trigonella foenum-graecum* L.) and alfalfa (*Medicago sativa* L.), and 3. planting time of living mulch (two weeks before and at the same time of black seed cultivation). The first factor was in the main plots and the combination of the second and third factors was in the subplots. The results showed that fenugreek and alfalfa were more successful in terms of weed control than clover with a 40% reduction in weed density and biomass compared to the control without living mulch and without weeding. In general, this study showed that two weeks earlier sowing of living mulch than sowing time of black caraway significantly reduces the competitive power (density, fresh weight and dry weight) of all weeds, which is due to the canopy effect of living mulch on the quality of light received by Seeds and germination are weeds. The predominant weed density of canopy was reduced by up to 80% with earlier cultivation of living mulch compared to uncontrolled control. Also, in order to achieve the highest percentage of black caraway yield traits (83.02, 93.44 and 50.50), the number of capsules per plant, number of seeds per capsule and 1000-seed weight (g), respectively, it is recommended to cultivate fenugreek at the same time as black caraway. In the case of alfalfa, pre-sowing is also recommended. Stale seedbed planting system did not play a positive and significant role in weed control and increase in black seed yield traits.

Keywords: Performance, black



**USE OF THE VEGETABLE WASTES AS AN ALTERNATIVE NUTRITIONAL
SOURCE FOR THE GROWTH AND SURVIVAL OF INDIAN MAJOR CARPS (Catla
catla, Labeo rohita and Cirrhinus mrigala)**

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ABSTRACT

The present study has been conducted to observe the growth performance (with reference to length) of fingerlings of catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) fed on pellets prepared from the combination of different vegetable wastes for a period of 24 days. Different vegetable wastes were taken in equal ratio and were used to prepare the pellets. And the pelleted feed was given to the fingerlings of Indian Major Carps as a replacement of costly feed ingredients like commercially available fish meals. It was observed that the survival rate of fishes was 100% during the experiment. The growth rate of fingerlings fed by the experimental feed was observed as the SGR (Specific Growth Rate) for length, with compare to fingerlings which fed by the controlled feed; the SGR was 1% and 0.8 % respectively. This result displays the good effect of vegetable waste feed on the growth of fingerlings.

Keywords: Vegetable, wasres



WATER QUALITY ASSESSMENT OF EFFLUENT-DOMINATED CREEKS OF SURAT CITY, GUJARAT

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ABSTRACT

In Surat city of Gujarat flows of creeks are now perennially dominated by municipal sewage and industrial effluent discharges, particularly in urbanised area. As these waste water dominated water bodies have not been studied previously, we select current topics associated with water quality of creeks receiving effluent flows from industries as well as storm drainage and STP. Water samples were collected monthly from three sampling sites from Oct-2013 to March-2014 following standard method of APHA to assess water quality. pH, Temperature, Silicate, Phosphate, Nitrate and Nitrite were selected for the study. The results on physico-chemical parameters of water clearly point out the influence of industrial effluent and sewage discharge. The contaminants which are found may pose a high risk to the water body on a large scale and hence needed to be monitored at regular intervals. So, it is suggested that there is a need of regular monitoring of water resources and further improvements in the industrial waste water treatment methods.

Keywords: Effluent, sewage, creeks, Industrial, Surat



TRANS FATTY ACIDS, BIOLOGICAL ACTIVE SUBSTANCES AND ASSESSMENT OF FATTY ACID COMPOSITION IN SHEEP MILK FROM TWO BREEDS

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ABSTRACT

This study aims to determine the content of natural trans fatty acids (TFA), biological active and anticancer components in sheep milk from two breeds- Synthetic Population Bulgarian Dairy (SPBD) breed and her crosses with Lacon during the lactation and to evaluate the fatty acid composition of fat as a healthy source in human nutrition. Individual milk samples were investigated from April to July period (4x8 pieces) of SPBD sheep and the cross between SPBM and Lacon rearing at the IAS- Kostinbrod base. Extraction of total lipids was carried out by the Roese-Gottlieb method, fatty acid methyl esters were analysed by Shimadzu-2010 gas chromatograph (Kioto, Japan). The qualitative assessment of the fat fraction includes the following: lipid preventive score, atherogenic and thrombogenic index, ratio between hyper- and hypocholesterolemic, trans and the amount of saturated fatty acids. The trans fatty acids in the analysed SPBD milk decrease from 5.07 to 3.14 g/100g fat during the lactation, and at the cross breed milk have a lower content than the SPBD breed and decrease from 3.71 to 3.00 g/100g fat. The total amount of CLA was highest on May- 1.21 g/100g fat and had a relatively constant concentration during the lactation period and decreased slightly from 1.05 to 0.98 g/100g fat in milk from SPBD. The lipid preventive score is the lowest in the milk from SPBD – 14.24 to 17.25 g/100 ml milk. The milk obtained from SPBD has a lowest atherogenic and thrombogenic index, respectively 1.95 to 2.67 and from 2.17 to 2.76 and a ratio of hyper- and hypocholesterolemic fatty acids were similar in both breeds from 0.53 to 0.65. The analysed milk from different ewe's breed was characterized as foodstuffs with a low content of TFA (from 0.23 to 0.27g/100g milk) and a high content of SFA (from 5.05 to 6.50 g/100g milk).

Keywords: Ewe's milk, CLA, indices



CAUSES AND WELL-BEING OF WOMEN IN-MIGRANTS OF GAJAPATI DISTRICT OF ODISHA

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ABSTRACT

People migrate from one place to another with a basic purpose of improving their livelihood. As people migrate from their native place to a migrated place, they are called as in-migrants at migrated place and out-migrants at native place. Migration changes the social, economical and cultural activity of the people. People are migrating from local area to an unknown place to achieve several objectives like education of the children, to mitigate the medical expenditure, marriage of the sister, to repay the old loans, etc. Although the migrants have good reasons to migrate, they come across several difficulties like living in an unhygienic environment, getting treated as outsider, staying away from home, etc. Ordinarily, men prefer to migrate. However, considering the economic condition of the households, women are also migrating. As such, migrant people encounters tough time at migrated places and if the migrants are women, the toughness of the situation gets escalated. In fact, the women migrants are highly prone to risk at migrated places. Thus, their journey as a migrant is not at all smooth. In spite of high level of inconveniences and risks, owing to compulsion, there are a good number of women in-migrants in Odisha, particularly in Gajapati District of Odisha. Gajapati district is one of the backward districts of Odisha, where about 55% people are tribal. Despite such backwardness, as per Census 2011, 40% of the total population are in-migrants. Out of total in-migrant population of 213758 in the district, 139100 are women. Thus, two genuine queries crop up in any intellectual's mind are; 1) Why such a big number of women are migrating to a backward district of Odisha? And 2) Are the women in-migrants in the District getting the things that they genuinely deserve?. On the basis of these two queries, the paper tries to determine the causes of women in-migrants to the Gajapati district of Odisha and explore the working status of the female in-migrants in the Gajapati district of Odisha. Besides, the paper enumerates the problems that the women in-migrants are facing in the Gajapati district and suggests the policy measures for improving the well-being of the female in-migrants in the district.

Keywords: Migration, in-migrants, women, well-being, odisha



İTALYAN ÇİMİ'NİN (*Lolium italicum*) FARKLI BAKLAGİLLER VE KARIŞIM ORANLARINDA BAZI SİLAJ ÖZELLİKLERİNİN BELİRLENMESİ ÜZERİNE BİR ARAŞTIRMA

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ÖZET

İtalyan çimi yeşil ot, kuru ot ve silaj olarak değerlendirmek amacıyla yetiştirilmektedir. Otlatmaya pek uygun değildir. Ancak, gerek fazla miktarda yeşil aksam oluşturması, gerekse bol yapraklı oluşu nedeniyle, tarla koşullarında yetiştirmeye uyum sağlamakta bundan dolayı bölgemizde ve benzer iklime sahip bölgelerde kışlık ara ürün olarak yetiştirilebilmektedir. İtalyan çimi tek yıllık, bazen iki yıllık bir bitkidir. Bol miktarda yumak oluşturmaktadır. Gövde dik olarak gelişmekte 80-150 cm boylanmaktadır. Gövdenin fazla boylanması, ot üretimine elverişliliğini artırmaktadır. Proteince zengin bir yapı gösteren baklagil yem bitkilerinin teksel silajlarının gösterdiği sıkıntılar nedeniyle (yüksek tamponlanma kapasitesi, düşük mayalanma kalitesi, vb.), karbonhidratça zengin bir içeriğe sahip bazı çayır otları ve buğdaygiller ile karışım olarak yetiştirilebilmektedir. Böylece enerji, ham protein ve mineral maddelerce zengin bir silo yemi elde edilebilmektedir. Bu çalışma, 2015-2016 yılı kış vejetasyon döneminde, Ege Üniversitesi Ödemiş Meslek Yüksekokulu deneme tarlalarında ve Ege Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü Silaj Kalite Analiz Laboratuvarı'nda; İtalyan Çimi (*Lolium italicum L.*)'nin dört farklı baklagil yem bitkisi [Acem Üçgülü (*Trifolium resupinatum L.*), Adi Fiğ (*Vicia sativa L.*), Koca Fiğ (*Vicia narbonensis L.*) ve Tüylü Fiğ (*Vicia villosa Roth.*)] ile farklı oranlardaki (%100-0, %80-20, %60-40, %40-60, %20-80,% 0-100) karışımlarının bazı silaj kalite özelliklerinin belirlenmesi amacıyla yürütülmüştür. Silaj pH değeri, kuru madde oranı, Flieg değeri, DLG kalite puanı, ham kül oranı, ham protein oranı, ham selüloz oranı, NDF, ADF, ADL değeri özellikleri incelenmiştir. Elde edilen sonuçlara göre; silaj kalitesi açısından önemli farklılıkların olduğu belirlenmiştir. Karışımlar içerisindeki baklagil oranı arttıkça, ham protein oranı ve sindirilebilirlik değerleri artış göstermiştir. Karışım türleri içinde ise, İtalyan çiminin adi fiğ ile oluşturduğu karışımlar, Akdeniz iklim koşulları için en iyi silaj kalite özelliğini göstermişlerdir.

Anahtar Kelimeler: Silaj, kalite, İtalyan çimi, baklagiller, karışım



**EFFECTS OF MIXTURE RATES ON THE SOME SILAGE QUALITY
CHARACTERISTICS OF DIFFERENT LEGUME MIXTURES WITH ANNUAL
RYEGRASS (*Lolium italicum*)**

ABSTRACT

Italian grass is grown to be used as green grass, hay and silage. It is not very suitable for grazing. However, due to its large amount of green parts and its abundant leaves, it adapts to cultivation in field conditions. Therefore, it can be grown as a winter intermediate product in our region and regions with similar climates. Italian grass is an annual, sometimes biennial, herb. It forms a large amount of fluff. The trunk develops vertically and grows to 80-150 cm. Over-lengthening of the trunk increases its suitability for grass production. Due to the problems of single silage of leguminous forage crops with a protein-rich structure (high buffering capacity, low fermentation quality, etc.), it can be grown as a mixture with some meadow grasses and grasses that have a carbohydrate-rich content. Thus, a silo feed rich in energy, crude protein and mineral substances can be obtained. This study has been conducted to determine some silage quality characteristics of different mixtures (100-0%, 80-20%, 60-40%, 40-60%, 20-80%, 0-100%) of four different legumes forage crops [Persian clover (*Trifolium resupinatum* L.), common vetch (*Vicia sativa* L.), Narbon vetch (*Vicia narbonensis* L.), hairy vetch (*Vicia villosa* Roth.)] with annual ryegrass (*Lolium italicum*) in experimental fields of Odemis Vocational Training School and silage quality analysis laboratory of Department of Field Crops, Faculty of Agriculture, Ege University for 2015-2016 winter growing season. Silage pH, dry matter rate, Flieg score, DLG quality point, crude ash content, crude protein content, crude selulose content, NDF, ADF and ADL traits were tested. According to the results obtained; it was determined that significant differences occurred between in terms of the silage quality. Higher legume ratio in the mixture increased crude protein content and silage digestibility. Common vetch with annual ryegrass were the best alternatives with regard to silage quality characteristics in the region under Mediterranean climatic conditions.

Keywords: Silage, quality, annual ryegrass, legumes, mixture



**SYRINGIC ACID ALLEVIATES HYPERGLYCEMIA BY REGULATING KEY
ENZYMES OF CARBOHYDRATE METABOLISM IN STREPTOZOTOCIN
INDUCED DIABETIC RATS**

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ABSTRACT

Diabetes mellitus is a complex metabolic disorder in which the body's ability to produce or respond to insulin hormone is impaired. The consistent and chronic hyperglycemia associated with diabetes can lead to increased risk of developing serious health problems. The purpose of this study is to evaluate whether syringic acid (SA), a bioactive phenolic compound exerts any ameliorative effect on hyperglycemia in streptozotocin induced diabetic rats. 30 Male Sprague-Dawley rats used for the study were divided to five groups; Normal(N), Normal + syringic acid (N+SA), Diabetic control (DC), Diabetic + syringic acid (D+SA) and Diabetic+Glimepiride (D+GM). Diabetes was induced by a single intraperitoneal injection (40 mg/kg) of streptozotocin. Syringic acid (SA) was administered orally at a dose of 50 mg/Kg body weight daily once for 60 days. The levels of plasma insulin, glucose, glycated hemoglobin, hepatic toxicity markers, serum lipids and activities of carbohydrate metabolising enzymes were analysed. Results were compared with diabetic rats provided with the standard drug glimepiride (0.1 mg/kg). Administration of syringic acid to diabetic rats at a dose of 50 mg/Kg body weight, significantly ameliorated hyperglycemia, elevated insulin levels, decreased HbA1c and hepatic toxicity markers. Syringic acid could also effectively reduce hyperlipidemia. In addition, Syringic acid could restore the activities of glycolytic enzymes such as hexokinase and pyruvate kinase and could significantly reduce the activities of glucose-6 phosphatase and fructose1,6-bisphosphatase. These findings suggests that syringic acid potentially alleviates hyperglycemia through its modulatory effect on carbohydrate metabolism in streptozotocin induced diabetic rats.

Keywords: Syringic acid, glimepiride, hyperglycemia, carbohydrate metabolism



COMPARISON OF PHYSIOLOGICAL RESPONSES OF TWO HALOPHYTE SPECIES TO FINE DUST STRESS

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ABSTRACT

Deserts are the most significant sources of fine dust production. The emission of these suspended particles can noticeably affect the Earth's climate and become a global problem. The first effect of dust on agriculture is to reduce production, reduce diversity and reduce vegetation density because fine dust is a factor that has negative effects on plant physiology. Most plant species in arid and saline areas are halophyte species. Among these, two plant species of *Salsola* and *Salicornia* are widely grown in the desert pastures of Iran. The main purpose of this study is to investigate the tolerance indices of these two plant species for dust collection. This experiment was performed as a factorial split in a randomized complete block design with three replications in Pakdasht, Tehran, Iran in 2020. Factors were three planting dates (20 March, 3 April, 19 April) as the main plots, dust factor (control (no artificial dust), dust spread on the plant for 5 days and 10 days) in sub-plots and species factor (*Salicornia iranica*, *Salsola imbricata*). The results of analysis of variance showed that the effects of fine dust and planting date and their interaction were significant on the measured traits. The mean comparisons of data showed that the highest percentages of relative leaf moisture were observed in *Sa. iranica* the first planting date without application of fine dust (with an average of 81%) and the lowest relative leaf moisture was obtained in *S. imbricata* at the third planting date with ten days without application of fine dust (with an average of 55%). The highest amount of chlorophyll was related to the control treatment on the second planting date (with an average of 57 mg g⁻¹ fresh weight) in *Sa. iranica*. As the number of days of application of fine dust increased, the amount of chlorophyll in *Salicornia* also decreased. The third planting date, with 10 days dust stress, chlorophyll content (with an average of 47 mg g⁻¹ fresh weight) was reduced by about 17%. On the other hand, *S. imbricata* had the highest and lowest chlorophyll content on the first planting date in control treatment (without application of fine dust) with an average



of 44 mg g⁻¹ fresh weight and the third planting date in 10 days treatment with fine dust application with an average of 30 mg g⁻¹ fresh weight. According to the obtained results, it can be said that a longer period of dust stress increased the accumulation of fine dust on its leaf surface and lead to decrease chlorophyll content; the deposition of fine dust on the leaf surface reduces light thereby chlorophyll content reduced. Shading on the leaves will reduce leaf chlorophyll and eventually reduce photosynthesis. The highest and lowest cell membrane stability in *Sa. iranica* were obtained on the first planting date, in the control treatment (without application of fine dust) with an average of 78% and the third planting date in the 10-day treatment of fine dust application with an average of 59%. In, *S. imbricata*, the highest and lowest cell membrane stability were obtained in the first planting date, control treatment (without application of fine dust) with an average of 75% and the third planting date in 10 days treatment of fine dust application with an average of 63%. *S. imbricata* had higher cell membrane stability in the treatment of 10 days of fine dust application on the third implantation date than *Sa. iranica*. Dust stress, decreased the stability of the cell membrane. Dust stress had a significant effect on the Calvin cycle activity, especially RUBP regeneration. With the reduction of NADPH consumption, non-consumption of electrons from the ferredoxin distribution field, production of ROS and consequently damage to physiological membranes will increase.

Keywords: *Salicornia iranica*, *Salsola imbricate*, planting date



**OPTIMIZATION OF ORGANIC, REACTIVE AND TEXTILE EFFLUENT DYE
DEGRADATION BY PHOTO CATALYST FROM MICRO ALGAE – A COST
EFFECTIVE AND CHEMICAL FREE APPROACH**

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ABSTRACT

Degradation and Optimization of Reactive dyes and Organic dye by photocatalyst from microalgae. In conventional methods of dye degradation many heavy metal ions and harmful chemicals applicable methods are used for the preparation of photocatalyst. But here we have proposed a completely chemical free photocatalyst method of preparation for degradation of Organic, Reactive and Textile effluent. We have used microwave assisted technique in preparation of Carbon quantum dots (CQD) as photocatalyst from microalgae. The characterization studies which include morphological properties, absorbance and fluorescence emission and excitation spectra and photocatalytic activity of photocatalyst was performed in small- and large-scale preparation of photocatalyst. Optimization of process parameters which includes concentration, pH, Volume, and time for dyes degradation by Carbon Quantum Dots was also performed. The dye degradation process and their metabolites were analyzed by UV – visible spectrophotometer and Gas chromatography/Mass Spectrometry (GC-MS) respectively. Water quality analysis which includes physico – chemical parameters such as BOD, COD, TOC, and TIC were analyzed to check whether treated water was at permitted level. A wide range of different chemical structure-based dyes degraded water after complete water quality analysis; we planned to recycle for agricultural and Industrial reuse of the treated water.

Keywords; Quantum Dots, Photocatalytic activity, dye treatment, *Spirulina platensis*



PRELIMINARY STUDY OF LEISHMANIASIS IN IRAN AND NEIGHBORING COUNTRIES

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ABSTRACT

Leishmaniasis is a common parasitic disease between animals and humans and occurs in a variety of forms, including cutaneous (leishmaniasis), mucosal-dermal, diffuse, and visceral (kala-azar) skin. Two types of skin and visceral leishmaniasis have been registered in Iran. Skin leishmaniasis can be seen in both rural and urban forms. The disease is caused by different types of vectors that have three basic components called parasitic reservoir carriers. 90% of cases of leishmaniasis have been reported in the Middle East. In Iran, rural leishmaniasis accounts for 80% of cases of leishmaniasis in Iran and covers 17 regions of the country. Among the most important centers of this disease in the country, we can mention the two regions of Isfahan and Turkmen Sahara. In addition to Iran, Iran's neighboring countries also face this disease. These countries include Lebanon, Afghanistan, Pakistan, Azerbaijan, Turkmenistan, Uzbekistan and Yemen. In Iraq, the disease is found in many Iraqi provinces, including Baghdad, Basra, Wasit, Diyala, Salah al-Din, Najaf, Diwanayah and Ti Qar. In Pakistan, the city of Tehsil-e-Khal is also known as the main center of the disease. Seeker is native to tropical and subtropical regions. In Iran, one of the reasons for the spread of this disease is the promotion of desertification and desalination by planting saline and salt-loving plants that destroy and disrupt the natural nests of reservoir rodents, moving them around cities (which It may increase the prevalence of the disease in Yazd province, urban development, collection and establishment of Afghan refugee camps, construction of crossings and roads in northern Iran, the existence of a free trade zone in Bushehr province, and an increase in travel and people sensitive to the region. Mine development and the existence of imposed war in neighboring countries. Due to the prevalence of this disease in the country and the region and due to the lack of effective vaccines for this disease and migration and travel to hyperemic areas, long periods of ulcers in sick people and high costs and psychological effects are possible. Lack of accurate and efficient management can increase the prevalence of this disease. As the complexity of the disease increases in all respects, further epidemiological studies in native areas are needed to help prevent and treat programs. This is even more important in areas affected by natural disasters. As a result, both in Iran and in neighboring countries affected by this disease, it is necessary that all factors affecting the spread of this disease be identified and evaluated, and to minimize the destructive effects, effective and efficient management measures and set a coherent and codified plan. To be done by relevant organizations, including the Ministry of Health, and to raise awareness among the community.

Keywords: Iran, leshmaniasis, vector, reservoir, disease



EFFICACY OF *BELLIS PERENNIS* AS ANTIOXIDANT AND ANTIDIABETIC ACTIVITIES: A COMPARATIVE STUDY OF ITS DIFFERENT EXTRACTS

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ABSTRACT

Bellis perennis is a common European species of daisy, belongs to Asteraceae family. The present study was designed to evaluate the in vitro antioxidant and antidiabetic activity of this plant subsequent to the phytochemical analysis of its various extracts. For this purpose, ethanol, methanol and distilled water extracts were prepared from the whole dried plant powder. Phytochemical analysis of the extracts was conducted to determine the total phenolic content (TPC) and total flavonoid content (TFC) in the extracts. Antioxidant capacity of the extracts was evaluated by DPPH (Diphenyl-1-picrylhydrazyl) assay, FRAP (ferric reducing antioxidant potential) and ABTS (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid)) assays. Antidiabetic activity of the extracts was determined by α -amylase inhibitory and α -glucosidase inhibitory activities. The results showed that methanolic extract of the *Bellis perennis* has the maximum antioxidant capability since it showed the highest scavenging ability towards the DPPH (IC₅₀ value= 0.41±0.00 mg/ml), FRAP (291.69±14.41 μ MFe²⁺/g), and ABTS (297.47±20.44 μ MTEq/g) due to the presence of high TPC (14.51±0.92 mg GAEq/g) and TFC (9.06±2.65 mgQEg/g) values. Antidiabetic activity in terms of α -amylase inhibition and α -glucosidase inhibition activity was also observed maximum in methanolic extract (IC₅₀ value= 0.24±0.08 mg/ml and 0.96±0.05 mg/ml respectively) and minimum in the distilled water extract (IC₅₀ value= 1.55±0.09 mg/ml and 2.83±0.28 mg/ml respectively). The results of the study indicated that the various extracts of the *Bellis perennis* possess antioxidant and antidiabetic activities being maximum in its methanolic extract having positive correlation with the total phenolic and flavonoid contents of the plant extract.

Keywords: *Bellis perennis*, methanolic extract, antioxidant, antidiabetic



**EFFECT OF GRAIN MOISTURE CONTENTS(MC) AND CLEARANCES
BETWEEN CYLINDERS(CBC) ON RICE HUSKING**

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ABSTRACT

The effect of husking machine on rice, Amber (AM) cultivar was studied based on some technical indicators. one type of machine (Satake) were tested at two clearances of 0.5 and 0.7mm between cylinders and three ranges of grain moistures of 11%-13%, 13%-15% and 15%-17%. The experiments were carried out in a factorial experiment under complete randomized design with three replications. The results showed that the CBC of 0.7mm was significantly better than the CBC of 0.5 mm in all studied conditions. The results showed a broken rice of 6.369 and 7.336%, cracked grains of 5.059 and 6.194%, head rice of 67.372% and 64.769%, brown rice of 80.236% and 79.139%, bran ratio of 5.034% and 5.478% and total extraction ratio of 75.757% and 73.621% for respectively. The MC of 11-13% was significantly superior to the other two levels of 13-15% and 15-17% in all studied conditions.

Keywords: Rice, Amber cultivar, husking; MC, CBC



3rd INTERNATIONAL CONFERENCE
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19-20 June, Izmir-TURKEY



FULL TEXT



**ETLİK PİLİÇLERDE SIVI FORMDA SARIMSAK (*Allium sativum L.*)
EKSTRAKTININ İNCE BAĞIRSAK HİSTOMORFOLOJİSİ VE SEKAL
MİKROFLORA ÜZERİNE ETKİLERİ**

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ÖZET

Bu çalışmanın amacı etlik piliçlerde içme suyuna sıvı formda sarımsak (*Allium sativum L.*) ekstraktı ilavesinin ince bağırsak histomorfolojisi ve sekal mikroflora üzerine etkilerinin ortaya konmasıdır. Çalışmada, toplam 384 adet bir günlük yaşta Ross 308 genotipli etlik civciv rastgele olacak şekilde iki gruba ayrılmıştır. Deneme grupları kontrol ve sarımsak ekstraktı ilave edilen deneme grubu olmak üzere düzenlenmiştir. Yetiştirme döneminin 1 ile 14. günleri arasında, sarımsak ekstraktı (5 mg allisin/ml) civcivlerin içme suyuna 1ml/L düzeyinde günlük olarak katılmıştır. Her iki deneme grubunda bulunan etlik piliçler mısır-soya küspesi içeren etlik piliç başlangıç ve büyütme yemleri ile beslenmiştir (1-35. günler arasında). Denemenin 35. gününde her iki deneme grubundan rastgele 12 adet etlik piliç seçilmiş ve canlı ağırlığın belirlenmesi için tartım yapılmıştır. Histomorfolojik özelliklerden villüs gelişimi ve mikrobiyal popülasyonun belirlenebilmesi için jejunum ve sekum örnekleri alınmıştır. 35 günlük yaşta sarımsak ekstraktı ilave edilen gruptaki etlik piliçlerin canlı ağırlık değerinin kontrol grubundakilerden daha yüksek olduğu gözlenmiştir (sırasıyla 2285.1 g ve 2177.7 g, P<0.01). Villüs yüksekliği sarımsak ekstraktı ilave edilen deneme grubundaki etlik piliçlerde (875.5 µm) kontrol grubundaki piliçlere göre daha yüksek (662.8 µm) bulunmuştur (P<0.01). Villüs genişliği ve villüs yüzey alanının da sarımsak ekstraktı ilave edilen deneme grubundaki piliçlerde daha yüksek ortalama değere sahip olduğu gözlenmiştir. Sarımsak ekstraktı ilavesi sekumda *Staphylococcaceae*, *E. coli*, *Klebsilla-Enterobacteriaceae* popülasyonunu azaltıcı yönde etki ederken, *Lactobacillus* spp. popülasyonunu ise artırıcı yönde etki etmiştir (P<0.05). Bağırsak histomorfolojisi ve sekal mikroflorada gözlenen değişimler dikkate alındığında, içme suyuna sıvı formda sarımsak ekstraktının etlik piliçlerde bağırsak sağlığı, sindirilebilirlik ve patojen kontrolünde etkili bir stimülant katkı maddesi olduğu sonucuna varılabilir.

Anahtar Kelimeler: Etlik piliç, allisin, villüs, mikroflora, bağırsak



INTESTINAL HISTOMORPHOLOGY AND CECAL MICROFLORA OF BROILERS SUPPLEMENTED WITH LIQUID GARLIC (*Allium sativum L.*) EXTRACT

ABSTRACT

The aim of this study is to determine the effects of the garlic (*Allium sativum L.*) extract supplementation as liquid form into drinking water on intestinal histomorphological traits and cecal microflora in broilers. A total of 384 Ross 308 one day old broiler chicks were randomly classified into two groups. The experimental groups were planned as the control and garlic extract (GE) supplementation. Between 1-14 days, the supplementation of liquid garlic extract contained 5 mg allicin per ml, was daily applied as 1 ml/l drinking water. All broilers were fed with maize-soybean meal-based diets during growing period (between 1-35 days). At 35 days of age, randomly sampled 12 broilers from each group were weighed to determine the body weight. Then jejunum and cecum samples for histomorphological characters for villus growth, and microbial population were collected. At 35 days of age, broiler supplemented with GE had a heavier body weight than the control broilers (2285.1 g and 2177.7 g respectively, $P < 0.01$). Villus height was found to be higher in the GE supplementation group (875.5 μm) than the control (662.8 μm , $P < 0.01$). A higher mean value for villus width, villus apparent surface area was observed in the GE supplementation group. The garlic extract supplementation decreased the average count of *Staphylococcaceae*, *E. coli*, *Klebsilla-Enterobacteriaceae*, whereas it increased the population of *Lactobacillus* spp. in the cecum ($P < 0.05$). Regarding with the observe changes in the intestinal histomorphological traits and cecal microflora, the liquid garlic extract into drinking water could be recommended as a stimulant additive for intestinal health, digestibility process and pathogen control in broiler production.

Keywords: Broiler, allicin, villus, microflora, intestine



GİRİŞ

Dünya nüfusunun hızla artış göstermesiyle hayvansal kaynaklı besin maddeleri ve hayvansal protein kaynakları içerisinde piliç eti giderek önem kazanmıştır. Son yıllarda, hayvansal üretim faaliyetlerinde performansın artırılması, güvenilir gıda üretimi ve ürün kalitesinin geliştirilmesi gibi bazı konular gündeme gelmiş ve tüketiciler tarafından da önemsenmeye başlanmıştır. Özellikle performansın artırılması amacıyla uzun yıllar hayvan beslemede antibiyotikler büyümeyi uyarıcı faktör olarak kullanılmıştır. Ancak, gıdalarda kalıntı riski ve antibiyotiklere karşı direnç oluşturma şeklinde gözlenen olumsuz etkilerden dolayı, 2006 yılında antibiyotiklerin hayvan beslemede büyümeyi uyarıcı faktör olarak kullanımını yasaklanmıştır (Fonseca ve ark., 2010; Ganau ve ark., 2012). Bu nedenle, günümüzde entansif kanatlı yetiştiriciliğinde büyümeyi artırıcı özelliklere sahip ve hayvansal ürünlerde kalıntı bırakmayacak özellikte çeşitli alternatif bitkisel kaynaklar gündeme gelmiştir (Varmaghany ve ark., 2015).

Son yıllarda başta performansın artırılması, bağırsak sağlığının ve bağışıklık sisteminin geliştirilmesi amacıyla doğal kaynaklardan elde edilen ve antibiyotiklere alternatif olarak gündeme gelen bitkisel ekstraktlar önem kazanmıştır. Bu bitkisel kaynaklardan bir tanesi sarımsak (*Allium sativum* L.) olup, sarımsağın antibakteriyel, antifungal, antiviral, antiparaziter, antikolesteromik, antikanserojen ve antioksidan özelliklere sahip olduğu yapılan çalışmalar sonucunda ortaya konmuştur (Gardzielewska ve ark., 2003; Chang ve Cheong, 2008; Gbenga ve ark., 2009; Hanieh ve ark., 2010). Yapılan bilimsel araştırmalarda, sarımsaktan elde edilen ekstraktın rasyona toz formda ilave edilmesiyle kanatlı beslemede kullanımı bağışıklık ve sindirim sistemi üzerine olumlu etki göstermekle birlikte içme suyuna sıvı formda eklenmesi ile performans parametrelerinde artış gözlemlendiği ifade edilmiştir (Issa ve Omar, 2012; Khan ve ark., 2012; Elagib ve ark., 2013; Al-Shuwaili ve ark., 2015; Sözcü, 2019). Bu araştırmanın amacı etlik piliçlerde içme suyuna sıvı formda sarımsak (*Allium sativum* L.) ekstraktı ilavesinin ince bağırsak histomorfolojisi ve sekal mikroflora üzerine etkilerinin incelenmesidir.

MATERYAL ve YÖNTEM

Çalışmada, toplam 384 adet bir günlük yaşta Ross 308 genotipli etlik civciv rastgele olacak şekilde kontrol ve sarımsak ekstraktı ilave edilen deneme grubu olmak üzere ikiye ayrılmıştır. Her iki deneme grubu için 2 × 2 m büyüklüğünde 12 deneme bölmesi kullanılmış olup, her deneme bölümüne 16 adet civciv yerleştirilmiştir. Civcivler, 5 - 8 cm kalınlığında talaş serilerek hazırlanan deneme bölmelerine ±0.1 g hassasiyetle tek tek tartılarak yerleştirilmiştir.

Yetiştirme döneminde 1-14. günler arasında, sarımsak ekstraktı (5 mg allisin/ml) civcivlerin içme suyuna 1ml/L düzeyinde günlük olarak katılmıştır. Denemedeki tüm piliçler mısır-soya küspesi içeren etlik piliç başlangıç ve büyütme yemleri ile beslenmiştir (1-35. günler arasında). Araştırmada, 1 - 14 günlük yaş döneminde 3042 kcal ME/kg, % 22.3 ham protein içeriğine sahip toz formda civciv başlangıç yemi; 15 - 35 günlük yaş döneminde ise 3233 kcal ME/kg ve % 21.6 ham protein içeriğine sahip pelet formda piliç büyütme yemi kullanılmıştır. Deneme süresince yem ve su ad-libitum düzeyde sunulmuştur.

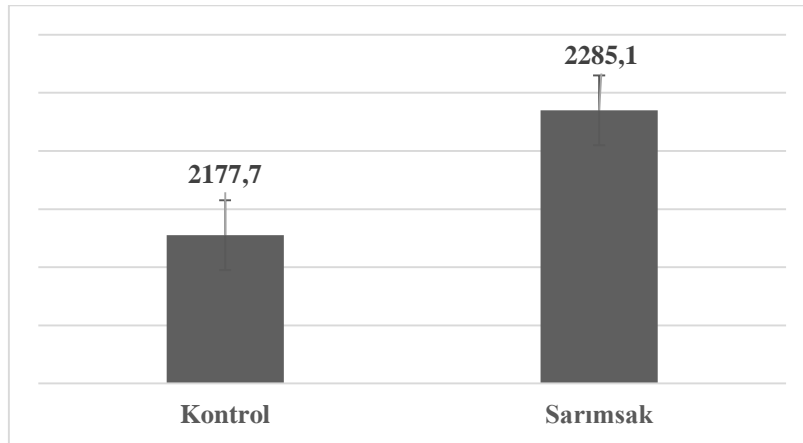
Besi döneminin sonunda 35 günlük yaşta her deneme grubundan rastgele 12 adet piliç seçilmiştir. Bu piliçler ±1 g hassasiyetle tartılarak, dönem sonu canlı ağırlık (g) değerleri belirlenmiştir. Seçilen piliçler servikal dislokasyon yöntemi ile öldürülerek, ince bağırsaktan jejunum ve sekum örnekleri dikkatli bir şekilde alınmıştır. Alınan doku örnekleri yıkandıktan sonra % 10'luk tamponlu formalin ile tespit edilmiştir. Ardından, parafin bloklama işlemi ile elde edilen doku örnekleri mikrotom (Leica, RM2155, Almanya) ile 5 µm kalınlığında kesilmiş ve Hematoksilen x Eosin boyası ile boyanmıştır (Gridley, 1960, Sakamoto ve ark., 2000). Bu



işlemeden sonra hazırlanan örnekler bir görüntü işleme ve analiz programı (Leica Application Suite, LAS Version 3.7.0, Leica Microsystems, İsveç) kullanılarak mikroskopik incelemeye tabi tutulmuştur. Yapılan incelemelerde, jejenum için villüs yüksekliği, villüs genişliği, villüs yüzey alanı, kript derinliği ve *Tunica muscularis* kalınlığı belirlenmiştir. Sekal mikroflora analizinin yapılabilmesi için, sekum içeriği steril tüplere dikkatli bir şekilde aktarılmış ve *Staphylococcaceae*, *E.coli*, *Klebsilla-Enterobacteriaceae* ve *Lactobacillus spp.* sayımı McDonald ve ark. (1983) ve Horn ve ark. (1996) tarafından belirtilen yöntemlere göre yapılmıştır. Sekal mikrobiyal popülasyon koloni oluşturan birim (kob)/g sekal içerik olarak verilmiştir. Çalışma tesadüf parselleri deneme desenine göre planlanmıştır. Etlik piliçlerde içme suyuna sarımsak ekstraktının ilavesinin dönem sonu canlı ağırlık, ince bağırsak histomorfolojisi ve sekal mikroflora üzerine etkilerini belirlemek amacıyla bağımsız iki örnek t-testi kullanılmıştır. İstatistiksel analizler SAS (Versiyon 9.2) paket programı kullanılarak belirlenmiştir. Verilerin istatistiksel analizleri $P < 0.05$ olasılık düzeyinde yapılmıştır.

BULGULAR ve TARTIŞMA

İçme suyuna sarımsak ekstraktı ilavesinin etlik piliçlerde 35 günlük yaşta canlı ağırlık üzerine etkisi Şekil 1’de gösterilmiştir. İçme suyuna sarımsak ekstraktı ilave edilen deneme grubundaki piliçlerin kontrol grubundakilere göre daha yüksek canlı ağırlığa sahip olduğu gözlenmiştir ($P < 0.001$). Elde edilen bu bulgu Lewis ve ark. (2003), Elagib ve ark. (2013) tarafından bildirilen sonuçlarla paralellik göstermektedir.



Şekil 1. Kontrol ve sarımsak ekstraktı ilave edilen gruplarda canlı ağırlığın karşılaştırılması

Etlik piliçlerde içme suyuna sarımsak ekstraktı ilavesinin jejenum histomorfolojik özellikler üzerine etkisi Tablo 1’de verilmiştir. Villüs yüksekliği sarımsak ekstraktı ilave edilen deneme grubunda (875.5 μm) kontrol grubuna göre daha yüksek (662.8 μm) bulunmuştur ($P < 0.01$). Villüs genişliği ve villüs yüzey alanının da sarımsak ekstraktı ilave edilen deneme grubunda daha yüksek ortalama değere sahip olduğu gözlenmiştir. *Tunica muscularis* kalınlığı ise kontrol grubunda 157.8 μm , sarımsak ekstraktı ilave edilen grupta ise 125.8 μm olarak bulunmuştur ($P < 0.01$). Sarımsak ekstraktı ilave edilen grupta villüs yüksekliği, genişliği ve alanın daha yüksek bulunması bu gruptaki piliçlerde bağırsakta besin maddelerinin emiliminin daha yüksek olduğunu göstermekte olup, bu bulgular Adibmoradi ve ark. (2006) tarafından da desteklenmektedir. Nitekim, sarımsak ekstraktı ilave edilen gruptaki piliçlerin dönem sonu canlı ağırlıklarının yüksek bulunmuş olması bu bulguyu destekler niteliktedir.



Tablo 1. Etlik piliçlerde içme suyuna sarımsak ekstraktı ilavesinin jejenum histomorfolojik özellikleri üzerine etkisi

Parametreler	Deneme grupları		Standart hata	P Değeri
	Kontrol	Sarımsak		
Villüs yüksekliği (µm)	662.8	875.5	13.1	<0.01
Villüs genişliği (µm)	98.5	113.6	10.8	0.014
Villüs alanı (µm ²)	79875	95867	5085	<0.01
Kript derinliği (µm)	79.4	81.4	6.7	0.366
<i>Tunica muscularis</i> (µm)	157.8	125.8	14.7	<0.01

n: 12 örnek/deneme grubu

Etlik piliçlerde içme suyuna sarımsak ekstraktı ilavesinin sekal mikroflora üzerine etkisi Tablo 2’de verilmiştir. Sarımsak ekstraktı ilavesi sekumda *Staphylococcaceae*, *E. coli*, *Klebsilla-Enterobacteriaceae* popülasyonunu azaltıcı yöne etki ederken, *Lactobacillus spp.* popülasyonunu ise artırıcı yönde etki etmiştir (P<0.01). Sekal mikroflorada meydana gelen değişimler incelendiğinde, sarımsak ekstraktının bağırsak ortamında patojenik bakterilerin çoğalmasını inhibe edici ve *Lactobacillus spp.* popülasyonunu artırarak bağırsakta yararlı bakterilerin çoğalması yönünde etki gösterdiği ifade edilebilir. Bu bulgular Sugiharto (2016) ve Zhui ve ark. (2018) tarafından da desteklenmektedir.

Tablo 2. Etlik piliçlerde içme suyuna sarımsak ekstraktı ilavesinin sekal mikroflora üzerine etkisi

Parametreler	Deneme grupları		Standart hata	P Değeri
	Kontrol	Sarımsak		
<i>Staphylococcus spp.</i> (kob)	7.6 * 10 ³	3.5* 10 ³	1.4	<0.01
<i>E.coli</i> (kob)	5.3 * 10 ⁴	2.5 * 10 ⁴	1.2	0.002
<i>Klebsilla-Enterobacter</i> (kob)	2.4 * 10 ⁴	1.1 * 10 ⁴	0.8	0.007
<i>Lactobacillus spp.</i> (kob)	1.5 * 10 ⁴	5.8 * 10 ⁴	1.1	<0.01
<i>Salmonella</i> (kob)	0	0	-	-

n: 12 örnek/deneme grubu

SONUÇ

Sonuç olarak, bağırsak histomorfolojisi ve sekal mikroflorada gözlenen değişimler dikkate alındığında, sarımsak ekstraktının etlik piliçlerde bağırsak sağlığı, sindirilebilirlik ve patojen kontrolünde etkili bir stimülant katkı maddesi ve antibiyotiklere alternatif doğal bitkisel bir ürün olarak kullanılabileceği sonucuna varılmıştır.



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19-20 June, Izmir-TURKEY



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GENETIC DIVERSITY OF 46 ACCESSIONS FROM *Triticum boeoticum* BOISS.

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ABSTRACT

The evaluation of phenotypic diversity to identify groups with similar genotypes is important for utilizing genetic resources for investigation the diversity of breeding materials. Therefore the aim of this study was to evaluate the genetic diversity of 46 wild einkorn genotypes maintained in the national collection of Bulgaria by using of multivariate analysis. The study is carried out in the experimental field of IPGR-Sadovo, Bulgaria during 2015-2017 growing seasons. The accessions were sown in harvest plots each of 1 m² in three replications, in the randomized block design. From each accessions, 30 plants were collected for biometrical measurements. Data were recorded for plant height, number of productive tillers per 1 m², length of spike with awn, length of spike without awn, number of spikelets per spike, weight of the spike, weight of grain per spike, number of grains per spike, and weight of 1000 grains. Analysis of variance indicated highly significant differences between wild einkorn wheat accessions. The estimates of phenotypic coefficient of variation were higher than genotypic coefficient of variation. High phenotypic coefficient of variation and genotypic coefficient of variation were observed in traits: number of productive tillers per 1 m² and weight of 1000 grains. Heritability revealed that characters like weight of 1000 grains exhibited highest heritability followed by number of productive tillers per 1 m², number of grain per spike and plant height. Genetic advance revealed that it was high for number of productive tillers per 1 m², weight of grain per spike, number of grains per spike, weight of 1000 grains and plant height. PC analysis showed that the first component explains 39,471% of the total variation, the second – 18,537% and the third 17,128%. The all three components explain total 75,136% of the variation in the experiment. Cluster analysis based on the two factors grouped the varieties into four different groups. The characters number of productive tillers per 1 m², number of grains per spike and weight of 1000 grains, exhibited high heritability coupled with a high genetic advance indicating that simple selection scheme would be sufficient for these traits to bring genetic improvement in desired direction. Evaluation of genetic diversity with cluster analysis based on PCA can be useful for the selection of the most efficient genotypes. The genotypes B6E0405 and B6E0004 may be used for the improvement of number of spikelets per spike, number of grains per spike and weight of the spike and weight of 1000 grains in breeding programs. Genetically the most distant were B6E0406 and B6E0388.

Keywords: Genetic diversity, gcv, genetic advance, heritability, pcv, pca, variability, wild einkorn wheat



ABBREVIATION

Number of productive tillers per 1 m² (NPT), plant height (PH), length of spike with awn (LSWA), length of spike without awn (LSWOA), number of spikelets per spike (NSS), weight of the spike (WS), weight of grain per spike (WGS), number of grains per spike (NGS), and weight of 1000 grains (WTG), Environmental variance (EV), Genotypic variance (GV), Phenotypic variance (PhV), Phenotypic coefficient of variability (PhCV), Genotypic coefficient of variability (GCV), Heritability (H), Genetic advance (GA), Genetic advance, % of means (GAM)

INTRODUCTION

The knowledge of genetic diversity and relatedness in the germplasm is a pre-requisite for crop improvement programmes. Diversity studies of einkorn wheat based on morphological traits, isozymes and molecular markers have generally concerned a reduced number of accessions (Knupffer, 2009). Germplasm improvement and genetic diversity is a key to reliable and sustainable production of the food crops. The evaluation of phenotypic diversity to identify groups with similar genotypes is important for utilizing genetic resources for investigation the diversity of breeding materials (Franco et al., 2001). Criteria for the estimation of genetic diversity can be morphological traits and the success of a breeding program depends upon the amount of genetic variability of these traits present in the plant materials (Pasandi et al., 2015). The uses of multivariate techniques are an important strategy for germplasm classification and study of genetic relationships among genotypes (Mohammadi and Prasanna, 2003; Saif et al., 2013). There are various analyses and statistical approaches for genetic diversity identification - cluster analysis, PCA and factor analysis (Mohammadi and Prasanna, 2003; Eivazi et al., 2007; Khodadadi et al., 2011). Hierarchical cluster analysis can be used to estimate genetic dissimilarity and similarity in collections. According to Peeters and Martinelli (1989) the analysis could have applications for the selection of parental lines for which varying degrees of segregation are sought. Grouping genotypes at the basis of studied characteristics is one of the suitable methods for determining nearness, distance and closeness of them. Factor analysis has been used by many researchers to determine the factors which contributed to the variation of quantitative traits in common winter wheat.

The aim of this study was to evaluate the genetic diversity of 46 wild einkorn genotypes maintained in the national collection of Bulgaria by using of multivariate analysis.

MATERIAL and METHODS

The study is carried out in the experimental field of Institute of Plant Genetic Resources "Konstantin Malkov"-Sadovo, Bulgaria during 2015-2017 growing seasons. Forty six wild einkorn accessions were examined. The accessions were sown in harvest plots each of 1 m² in three replications, in the randomized block design. Normal agronomic and cultural practices were applied to the experiment throughout the growing season. The agronomic characters were taken after harvesting the plants. From each accessions, 30 plants were collected for biometrical measurements. Data were recorded for plant height (PH, cm), number of productive tillers per 1 m² (NPT), length of spike with awn (LSWA, cm), length of spike without awn (LSWOA, cm), number of spikelets per spike (NSS), weight of the spike (WS, g), weight of grain per spike (WGS, g), number of grains per spike (NGS), and weight of 1000 grains (WTG, g). The mean data from all nine characters were used to analysis of variance according to Lidansky (1988). Genotypic and phenotypic variances, genotypic and phenotypic coefficient of



variability, broad sense heritability were calculated according to Singh & Chaudhary (1985). Genetic advance in terms of percentage of means was assessed by Brim et al. (1959). PC-analysis was applied to group accessions according to similarity on the basis of the investigated in three components in the factor plane by using SPSS 13 software and the related clusters were plotted based on the main components.

RESULTS and DISCUSSION

Analysis of variance

The results of analysis of variance are shown in Table 1. The values of mean squares for all nine characters indicated highly significant differences between wild einkorn wheat accessions with probability $F < p < 0.001$. (Table 1). According to many researcher as, Shashikala (2006), Yousaf et al. (2008), Kalimullah et al. (2012), Kumar et al. (2014), Desheva et al. , Desheva and Kyosev (2016, 2017), this means the existence of a high degree of genetic variability in the material to be exploited in breeding program.

Table 1. Analysis of variance for various quantitative traits in wild einkorn wheat genotypes

Characters	N	Minimum	Maximum	Mean		Mean squares
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
NPT	46	248,20	724,00	478,86	16,74	64438,42***
PH	46	126,00	182,00	159,33	1,98	903,16***
LSWA	46	12,20	20,36	16,09	0,28	17,41***
LSWOA	46	7,70	12,80	10,00	0,16	6,15***
NSS	46	25,20	35,60	30,74	0,41	38,18***
NGS	46	26,00	57,60	40,70	1,15	304,92***
WS	46	0,60	1,58	1,09	0,03	0,22***
WGS	46	0,28	0,87	0,54	0,02	0,10***
WTG	46	6,38	17,74	12,68	0,33	24,84***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Genotypic, phenotypic and environmental variance (GV, PhV and EV), genotypic coefficient of variability (GCV), phenotypic coefficient of variability (PCV), broad sense heritability and genetic progress expressed as percentage of mean (GPM) for seven characters are presented in Table 2.

Table 2. Genetic parameters of various yield components of 46 wild einkorn wheat genotypes

Characters	EV	GV	PhV	GCV	PhCV	H, %	GA	GAM
NPT	262,82	12835,12	13097,94	23,66	23,90	97,99	23102,86	48,25
PH	60,42	168,55	228,97	8,15	9,50	73,61	2294,57	14,40
LSWA	2,07	3,07	5,14	10,89	14,09	59,72	278,88	17,33
LSWOA	1,23	0,98	2,22	9,92	14,89	44,40	136,20	13,62
NSS	12,09	5,22	17,31	7,43	13,54	30,14	258,32	8,40
NGS	3,27	60,33	63,60	19,09	19,60	94,86	1558,39	38,30
WS	0,03	0,04	0,07	18,07	23,74	57,93	30,94	28,33
WGS	0,02	0,02	0,03	24,34	33,39	53,16	19,82	36,57
WTG	0,06	4,96	5,02	17,55	17,66	98,77	455,77	35,94



Phenotypic variance ranged from 0,03 (WGS) to 13097,94 (NPT). Values of genotypic variances ranged between 0,02 (WGS) and 12835,12 (NPT). Environmental variances ranged from 0,02 (WGS) to 262,82 (NPT) (Table 2). Relatively the highest phenotypic variance values of 13097,94 for NPT and 228,97 for PH were recorded in the study. Likewise, the genotypic and environmental variances for these traits were also high, indicating that the genotype could be reflected by the phenotype and the effectiveness of selection based on the phenotypic performance for these traits (Degewione et al., 2013). Result of present study concurs with that of Cheema et al. (2006), Yousaf et al. (2008), Kalimullah et al. (2012) and Kumar et al. (2014), Desheva and Cholakov (2014), Kyosev and Desheva (2015).

The GCV ranged from 7,43% for NSS to 24,34% for WGS, whereas, PCV ranged from 9,50 % for PH to 33,39% for WGS (Table 2). The high PhCV and GCV were observed in traits: NPT (PCV=23,90%, GCV=23,66%) and WGS (PCV=33,39%, GCV=24,34%). The high PCV and GCV indicated that selection may be effective based on these traits and their phenotypic expression would be good indication of the genotypic potential (Singh et al., 1994). Moderate PhCV and GCV were found for NGS (PhCV =19,60% and GCV=19,09%). On the other hand, PH showed low GCV and PhCV (8,15% and 9,50%), indicating less scope of selection as it is under the influence of environment. Phenotypic coefficients of variation were generally higher than genotypic coefficients of variation for all traits studied, indicating the influence of growing environments (Table 2). These findings were in agreement with those of Panwar et al. (2002), Dwivedi et al. (2004) Gashaw et al. (2010), Abinasa et al. (2011), Kumar et al. (2014), Desheva and Cholakov (2014), Kyosev and Desheva (2015), and Desheva and Kyosev (2017). In most of cases, the two values differ slightly, indicating less influence of environmental factors. Wide difference between PCV and GCV values were observed in LSWOA, NSS and WS indicate the high contribution of the environmental variance to the phenotypic variance.

Heritability in broad sense is the ratio of genotypic variance to the total variance. It plays an important role in deciding the suitability and strategy for selection of a character (Kumar et al., 2014). In the present study heritability estimated ranged from 30,14% to 98,77 % (table 2). High estimates of heritability (above 60%) in broad sense were recorded for four characters studied (NPT-97,99%, PH-73,61%, NGS- 94,86% and WTG-98,77%). The highest heritability values indicate that heritability may be due to higher contribution of genotypic component. Heritability alone provides no indication of amount of genetic improvement that would result from selection of individual genotype; hence knowledge about genetic advance coupled with heritability is most useful (Anshuman *et al.*, 2013). The expected genetic advance expressed as a percentage of the mean varied between 8,40% for NSS and 48,25% for NPT (Table2). Genetic advance as percentage of mean was high for NPT (48,25%) followed by NGS (38,30%), WGS (36,57%) WTG (35,94%) and plant height (30.62%). Genetic advance was low for NSS (8,40%). High heritability accompanied with high expected genetic advance in case of NPT, NGS and WTG, indicates that most likely the heritability is due to additive gene effects and selection may be effective in early generations for these traits. Gupta and Verma (2000) and Desheva and Cholakov (2015) also reported high values of heritability and high genetic advance for number of grain per spike. Kyosev and Desheva (2015) reported for high values of heritability and high genetic advance for WTG in emmer. For NSS moderate heritability coupled with low expected genetic advance indicates non-additive gene effects. Moderate heritability with low genetic progress indicates slight chances of improvement of this trait in subsequent generations as discussed by Kalimullah et al. (2012).



Principal component analysis (PCA) and cluster analysis based on principal component

PCA was applied to arrange accessions by their similarity. The analysis was carried out on the basis of presented above nine traits by three components in the factor plane. The values of the three components to each of the studied parameters were calculated empirically (Table 3).

The analysis showed that the first component explains 39,471% of the total variation, the second – 18,537% and the third 17,128%. The all three components explain total 75,136% of the variation in the experiment. The most effective by the first component were five characters: NPT, NSS, NGS, WS and WGS. The second component correlated to LSWA and LSWOA. The third component was in relationship with PH and WTG.

Cluster analysis based on the three factors grouped the varieties into four groups (Fig. 1). Average of factors for each cluster is shown in table 4. In the first cluster, 31 accessions were classified including 67,39% of total genotypes. Accessions in this cluster were in the highest rate with respect to third factors. Genotypes of this cluster had the highest PH and WTG and the least NSS and can be used for increase in WTG in breeding programs. Second group comprises 9 accessions including 19,56% of total genotypes. Members of this group can use for increase in NSS, NGS, WS and WTG. In the third group, 2 genotypes were classified including 4,36% of total accessions. Genotypes in this cluster had highest mean with respect to second factor. Genotypes of this cluster had the highest LSWA and LSWOA. The fourth cluster included 8,69% of genotypes.

Table 3. Weighted factors (PC1, PC2 and PC3) of descriptive characteristics on the rotated matrix with three factors

Characters	Component		
	1	2	3
NPT	-0,591	-0,192	0,143
PH	0,018	0,209	0,641
LSWA	-0,051	0,925	0,199
LSWOA	0,348	0,867	-0,071
NSS	0,569	0,101	-0,679
NGS	0,902	-0,004	-0,115
WS	0,803	0,251	0,280
WGS	0,882	-0,001	0,377
WTG	0,499	-0,087	0,736
Eigen values	3,552	1,668	1,542
Proportional variance,%	39,471	18,537	17,128
Cumulative variance, %	39,471	58,008	75,136

Cluster analysis based on the three factors grouped the varieties into four groups (Fig. 1). Average of factors for each cluster is shown in table 4. In the first cluster, 31 accessions were classified including 67,39% of total genotypes. Accessions in this cluster were in the highest rate with respect to third factors. Genotypes of this cluster had the highest PH and WTG and the least NSS and can be used for increase in WTG in breeding programs. Second group comprises 9 accessions including 19,56% of total genotypes. Members of this group can use for increase in NSS, NGS, WS and WTG. In the third group, 2 genotypes were classified including 4,36% of total accessions. Genotypes in this cluster had highest mean with respect to



second factor. Genotypes of this cluster had the highest LSWA and LSWOA. The fourth cluster included 8,69% of genotypes.

Results showed that cluster analysis based on PCA is precise indicator of differences among wild einkorn wheat genotypes. Genetically the most distant were B6E0406 and B6E0388.

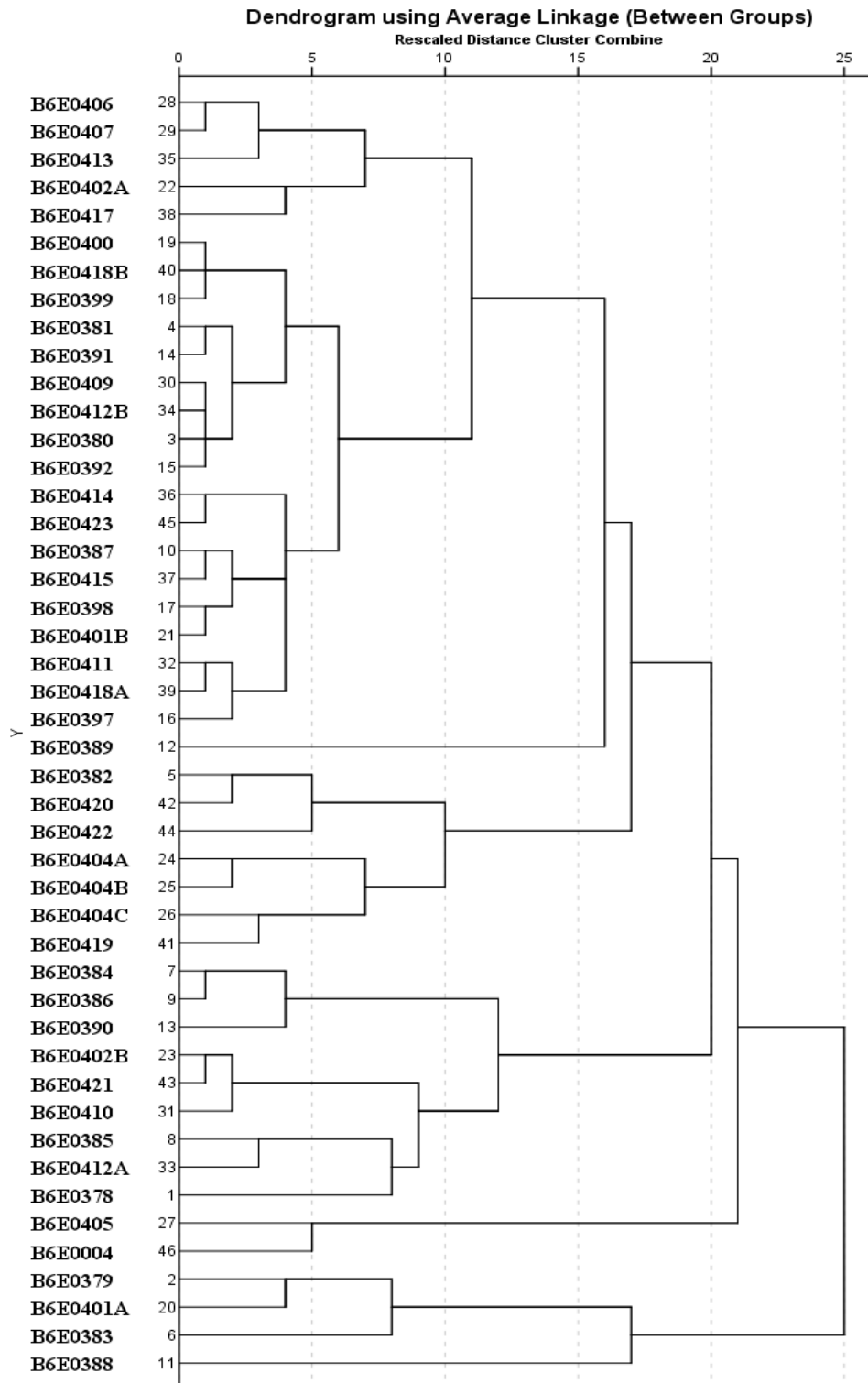


Figure 1. Tree diagram of 46 genotypes for 3 extracted factors using hierarchical cluster analysis (Between-group linkage method and Square Euclidean distance)



Table 4. The average of traits for achieved groups from cluster analysis based on factor analysis in 46 wild einkorn wheat genotypes

	Factor 1	Factor 2	Factor 3
Cluster 1	-0,415	-0,233	0,160
Cluster 2	1,256	0,837	-0,115
Cluster 3	0,834	0,892	0,676
Cluster 4		-0,025	-2,054

CONCLUSIONS

Analysis of variance revealed highly significant differences among the accessions for all the parameters. The characters number of productive tillers per 1 m², number of grains per spike and weight of 1000 grains, exhibited high heritability coupled with a high genetic advance indicating that simple selection scheme would be sufficient for these traits to bring genetic improvement in desired direction.

Evaluation of genetic diversity with cluster analysis based on PCA can be useful for the selection of the most efficient genotypes. The genotypes B6E0405 and B6E0004 may be used for the improvement of number of spikelets per spike, number of grains per spike and weight of the spike and weight of 1000 grains in breeding programs. Genetically the most distant were B6E0406 and B6E0388.

ACKNOWLEDGMENTS

This work was financially supported by the National Science Fund, Ministry of Education and Science, bilateral project between Bulgaria and China: DNTS/China 01/11-16.12.2016.



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TUZ STRESİNİN FASULYE (*Phaseolus vulgaris* L.) ÜZERİNDEKİ ETKİLERİ VE TUZA TOLERANSI ARTIRMAK İÇİN YAPILAN UYGULAMALAR

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ÖZET

Dünya nüfusunun hızlı yükselişi insanların besin ihtiyacını giderek artırmaktadır. Bu ihtiyacın giderilmesinde tarımsal üretim büyük önem arz etmektedir. Sürdürülebilir tarımda toprakta meydana gelen tuz problemi bitkisel üretimi olumsuz etkilemektedir. Baklagiller arasında yer alan fasulyenin tuz stresine karşı hassas olması, tuz konsantrasyonu olan toprakta yetiştiriciliğinde büyük sorun teşkil etmektedir. Yapılan bu çalışmada tuz stresi probleminin fasulye bitkisine göstermiş olduğu etkiler verilmiştir. Ayrıca tuz konsantrasyonlarına karşı toleransı artırmak için yapılan çalışmalar derlenmiştir.

Anahtar Kelimeler: Fasulye, *Phaseolus vulgaris* L., tuz stresi, tolerans, verim



**EFFECTS OF SALT STRESS ON BEANS (*Phaseolus vulgaris* L.) AND
APPLICATIONS TO INCREASE SALT TOLERANCE**

ABSTRACT

The rapid increase in the world population increases the nutritional needs of people. Agricultural production is of great importance in meeting this need. The salt problem in the soil in sustainable agriculture negatively affects plant production. The sensitivity of the bean, which is among the legumes, to salt stress poses a major problem in its cultivation in soils with salt concentrations. In this study, the effects of salt stress problem on bean plant are given. In addition, studies to increase tolerance to salt concentrations have been compiled.

Keywords: Bean, *Phaseolus vulgaris* l., salt stress, tolerance, yield



GİRİŞ

Fasulye insanların beslenmesinde önemli yeri olan sebzeler arasında yer almakta ve kültür bitkisi olarak bilinmektedir. Anavatanı Meksika, Guatemala, Kolombiya ve Orta ve Güney Amerika ülkeleridir (Eşiyok, 2012). FAO 2019 verilerine göre Dünya yeşil fasulye üretimi 26.981.784 ton iken kuru fasulye üretimi 28.902.672 tondur (FAO, 2021). Ülkemizde TÜİK 2020 verilerine göre taze fasulye üretimi 547.349 ton olmakla birlikte kuru fasulye üretimi ise 279.518 tondur (TÜİK, 2021). Taze baklaları ve daneleri ile tohumları farklı şekillerde değerlendirilebilmektedir. Bununla birlikte konserve edilerek dondurularak güneşte veya yapay yollarla yeşil olarak kurutulularak tüketilme imkanı vermektedir. Ülkemizde yetiştirilen fasulyeler *Phaseolus vulgaris* türü içinde yer almaktadır. Bu *Phaseolus vulgaris* bitkileri tek yıllık bir bitkidir. *Phaseolus vulgaris* L. Var. *Comminus* (sırık fasulye) ve *Phaseolus vulgaris* L. Var. *Nannus* (yer fasulye) olmak üzere iki formu bulunmaktadır. Tohumların çimlenmesinden sonra meydana gelen kazık kök 15-20 cm uzadıktan sonra büyüme durmakta ve kazık kök etrafında sekonder kökler ve onlardan çıkan saçak kökler gelişmeye devam etmektedir. Ayrıca kökler üzerinde havanın serbest azotunu fikse eden nodozitler bulunmaktadır. Böylece havadaki serbest azotu bünyesine bağlamaktadır. Fasulye toprak isteği bakımından seçici bir bitki olmamakla birlikte organik madde miktarı yüksek, su tutma kapasitesi iyi olan tınlı topraklarda başarılı sonuçlar vermektedir (Eşiyok, 2012). Yaş ve kuru fasulye olarak üretilen bu bitki Türkiye de Karadeniz ve Akdeniz bölgesinde yetiştirilmektedir (Bozkurt, 2009). Baklagiller diğer bitki türleri ile karşılaştırıldığında tuza en hassas grup içerisinde yerini almaktadır (Ashraf ve Wu 1994). Tüm dünyada yaygın olarak yetiştiriciliği yapılan Fasulye (*Phaseolus vulgaris* L.) kullanım alanı çok geniş olmakla birlikte tuzluluğa karşı oldukça hassastır (Marchner 1995). Bununla birlikte 2 ds/m'in altında dahi fasulyede önemli verim kayıpları gözlemlendiği bildirilmiştir (Gama et al., 2007).

Artan dünya nüfusu ile birlikte tarım alanlarının amaç dışı ve bilinçsiz kullanımı insanların beslenmesinde önemli bir sorun oluşturmaktadır. Bu sorunların çözümü için alternatif arayışlar devam etmektedir. Yetiştiricilikte yapılan yanlış veya eksik uygulamalar toprak yapısını bozmakta ve dolayısıyla bitkilerin strese girmesine neden olmaktadır. Bir ortamda yetiştirilen bitkilerin bir veya birden fazla faktörün etkisiyle büyüme ve gelişmesinin olumsuz etkilenmesi ile verim, kalite parametrelerinde düşüş göstermesi stres olarak tanımlanmaktadır (Wang et al., 2000). Açık alanlarda yetiştirilen bitkiler doğrudan veya dolaylı olarak biyotik ve abiyotik streslere maruz kalmaktadır. Abiyotik stresler arasında yer alan tuz stresi, osmotik etkisi ile kullanılabilir su içeriğini kısıtlamakta iken iyonik etkisi ile iyon içeriğinin toksik düzeye ulaşmasına neden olmaktadır (Çulha ve Çakırlar, 2011). Dünyadaki toplam tarım arazilerinin %6'sında (800 milyon ha) tuzluluk sorunu yaşanmaktadır (Zurnacı, 2019; Munns, 2002). Ülkemiz topraklarında ise yaklaşık 1.5 milyon ha tarım arazilerinde tuzluluk sorunu bulunmakta ve bu durum tarımsal üretimde sorun teşkil etmektedir (Ekmekçi ve ark., 2005). Tuz stresi bitkiler üzerinde önemli fizyolojik bozukluklara neden olmaktadır. Bitkilerde vejetatif ve generatif aksamalarında büyümeyi sınırlandırması ile birlikte dölleme bozukluğu, meyvelerin küçük kalması gibi negatif etkileri olduğu bildirilmiştir (Dölerslan ve Gül, 2012). Tuzluluk, bitkiler üzerindeki doğrudan etkisini osmotik ve iyon stresi yaparak göstermekte iken, dolaylı (sekonder) etkisini ise stres sonucu bitkide meydana gelen yapısal bozulmalar ve toksik bileşiklerin sentezlenmesi ile göstermektedir. Ayrıca potasyum alınımının engellenmesi, metabolik toksisite, fotosentezin inhibisyonu ve hücre ölümü, tuzluluğun (NaCl) neden olduğu sekonder etkiler arasında sayılabilmektedir (Botella et al., 2005; Hong et al., 2009). Tuz stresi ile birlikte toprak çözeltisinde artan tuz konsantrasyonu ve su potansiyelinin azalması ile bitki hücrelerinde osmotik potansiyelin düşmesine neden olmaktadır. Böylece bitki kök bölgesinde



osmotik stres meydana gelmektedir (Hussain et al., 2013). Tuzlu koşullarda yetiştirilen bitkilerde büyüme ve gelişmede gerileme gözlenme sebeplerinden bir diğeri ise bitki besin elementlerinin alınımı ve taşınımının engellenmesidir (Cramer ve Nowak, 1992).

Bununla birlikte tuzlu topraklarda toprak çözeltilisindeki düşük su potansiyeli fizyolojik kuraklığı teşvik etmektedir. Böylece hormonal dengesizlikler, stoma açılımının azalması, transpirasyon kaybı, CO₂ alımının azalması, kloroz, büyüme ve gelişmenin azalmasına neden olmaktadır (Edreva, 1998; McKersie and Leshem, 1994; Schwarz, 1985; Schwarz, 1995). Ayrıca buna karşın bitkiye dışarıdan ilave olarak uygulanan makro besin elementleri içerisinde Ca ve K uygulamaları bitkileri tuz stresinden büyük ölçüde koruduğu ve tuz etkisini azalttığı bildirilmiştir (Cramer, 2002).

Bu çalışmada tuz stresi altında yetişen fasulye bitkilerinde stresin etkileri, bitkinin strese vermiş olduğu cevaplar ve stresin etkilerinin azaltılması yönünde alternatif yöntem ve uygulamalar hakkında daha önce yapılmış ulusal ve uluslararası çalışmalar derlenmiştir.

TUZ STRESİNİN FASULYE BİTKİSİNE ETKİLERİ

Tuzlu koşullarda yetişen bitkilerde büyüme ve gelişme, yaprak alanı, tomurcuk oluşumu ve stomalar üzerine olumsuz etki göstermektedir. Bu durum verim ve kalitede büyük ölçüde düşümlere sebep olmaktadır (Allakhverdiev et al., 2000). Daha önce yapılan çalışmalarda fasulye bitkisinin kuraklığa ve tuz toleransına karşı duyarlı olduğu bununla birlikte tuza toleransı artırmak için birçok farklı uygulamalar ve yöntemler olduğu bildirilmiştir.

Fasulye (*Phaseolus vulgaris* L.) ve Börülce (*Vigna unguiculata* L.) bitkileri üzerinde farklı tuz konsantrasyonlarının (0-50-100-150-200 mM) çimlenme üzerinde etkilerinin belirlenmesi amacıyla yapılan çalışmada çimlenme oranları (%), radikula ve plumula uzunlukları (cm), radikula ve plumula yaş ağırlıkları (gr), radikula ve plumula kuru ağırlıkları (gr) araştırılmıştır. Çalışma sonucunda sırasıyla Fasulyede çimlenme oranı %90 ile %27.5, Plumula uzunluk 0.05 ile 2.32 cm, Radikula kuru ağırlık 0.05 – 0.21 gr, Radikula yaş ağırlık 0.36-1.36 gr, plumula yaş ağırlık 0.40-2.55 gr arasında değişkenlik gösterdikleri ve en iyi sonucun 50 mM dozunda tespit edilmiştir. Ayrıca radikula uzunluk 0.05 ile 3.21 cm arasında olduğu ve en iyi sonucun kontrol (0 mM) dozunda elde edilirken, Plumula kuru ağırlık 0.05-0.26 gr arasında en iyi sonuçların kontrol ve 50 mM dozlarında saptanmıştır (Özkorkmaz ve Yılmaz, 2017).

Farklı 20 adet fasulye genotiplerine farklı dozlarda (25 mM ve 50 mM) tuz konsantrasyonu uygulanmış ve yapılan çalışmada 4 gün ara ile tuz uygulamaları normal sulama suyu ile birlikte verilmiştir. Çalışma sonucunda artan tuz konsantrasyonları ile yaprak sayısı, sürgün çapı ve yaş ağırlığı, K, K/Na, Ca/Na oranlarında azalma gözlemlendiği ancak Kalsiyum ve sodyum miktarlarında ise artış olduğu bildirilmiştir (Fidan ve Ekincialp, 2017).

Farklı tuz konsantrasyonları (0-25-50 mM NaCl) iklim odasında 20 adet fasulye genotipine uygulanmış ve yapılan çalışmada antioksidan miktarı, toplam fenol ve P, Mg, Fe, Cu, Mn ve Zn besin element içerikleri incelenmiştir. Çalışma sonucunda artan tuz konsantrasyonlarına paralel olarak antioksidan miktarı ve toplam fenol içeriğinde düşüş gözlemlendiği ve tuz uygulamalarının genotiplerin üzerinde olumsuz etki gösterdiği bildirilmiştir. Bununla birlikte yeşil aksamda besin içeriklerinde sırasıyla P içeriğinin 25 ve 50 mM dozlarında, Fe içeriğinin ise 50 mM doz da arttıkları saptanırken Mg, Zn, Cu içeriklerinin 25 ve 50 mM dozda, Mn içeriğinin ise 50 mM dozda azaldıkları tespit edilmiştir. Kökte ise 25 mM tuz uygulamasında Fe, Mg, Mn içeriklerinde azalış gözlemlendiği fakat artan tuz konsantrasyonuna bağlı olarak P, Mg, Cu, Mn ve Zn içeriklerinde artış olduğu saptanmıştır (Kıpçak ve ark., 2019).

Farklı tuz konsantrasyonlarında (1.2, 11.2 ve 24.9 dS/m) fasulye, bezelye, buğday bitkileri yetiştirilmiştir. Yapılan çalışmada tuz uygulamalarının bitkiler üzerindeki etkileri incelenmiş ve çalışma sonucunda tuz uygulamalarında dozların artmasıyla tüm bitkilerde çimlenme oranı



ve verimde düşüşler gözlemlenmiştir. Ayrıca bu üç bitki arasında en toleranslı bitkinin ise buğday olduğu bildirilmiştir (Steppuhn et al., 2001).

Farklı doz tuz (NaCl) konsantrasyonlarında (0, 50, 100 ve 150 mM) 3 farklı fasulye çeşidi (Simav, Erzincan Çalı, Manyas Horoz) yetiştirilmiş ve yapılan çalışmada tohumların çimlenmesi ve fidelerin gelişimi üzerine etkileri araştırılmıştır. Çalışma sonucunda artan tuz uygulamalarına bağlı olarak tüm çeşitlerde sırasıyla çimlenme oranı, fidelerdeki yaprak nispi su içeriği, yaprak yaş ağırlığı ve protein içeriğinde düşüş gözlemlenmekte iken yaprak kuru ağırlığı, prolin miktarında artış tespit edildiği saptanmıştır. Ayrıca bu çalışmada tuz toleransına en belirgin çeşidin Simav fasulye çeşidi olduğu bildirilmiştir (Eroğlu, 2007).

FASULYEDE TUZ STRESİNE TOLERANSI ARTIRMAK İÇİN YAPILAN UYGULAMALAR

Bitkileri tuz stresinden kurtarmak için yapılabilecek birçok yöntem bulunmaktadır. Bu yöntemlerden biri toprakta biriken tuzların yıkanarak ortamdan uzaklaştırılmasıdır. Ancak yüksek maliyetli olması, üreticileri farklı alternatiflere yönlendirmektedir. Bu probleme çözüm olarak tuza toleransı yüksek tür ve çeşitler tercih edilmektedir (Khalid et al., 2001).

Değişik tuz konsantrasyonlarında (0, 50, 100 ve 150 mM) yetiştirilen fasulye bitkisine farklı şekillerde (kontrol, sadece toprak, sadece yaprak ve hem toprak hem de yaprak) humik asit uygulaması yapılmıştır. Çalışma sonucunda humik asitin hem topraktan hemde yapraktan uygulanması ile bitki verimi, K ve Ca konsantrasyonlarını 50 mM tuz uygulamasına karşı koruma sağladığı bildirilmiştir (İzci, 2019). Fasulye (*Phaseolus vulgaris* L.) bitkisine değişik dozlarda tuz uygulanmış ve toprağa uygulanan humik asit ve hidrojele karşı tepkileri incelenmiştir. Çalışmada tuz stresinin bitki gelişimini ve kuru madde miktarını olumsuz etkilediği ancak hidrojel ve humik asit uygulamalarının ise tuz stresinin negatif etkilerini azalttığı saptanmıştır. Çalışma sonucunda ise bitkilere olan tuz zararı etkisinin azaltılması ve fasulyenin toprak neminden faydalanmasında hidrojin maliyetli olması sebebiyle humik asitin tuz stresi ile mücadelede kullanılabilirliği daha iyi olduğu bildirilmiştir. Bununla birlikte hidrojel ve humik asit uygulamalarının tuz stresi bulunan topraklarda tarla kapasitesi, EC değeri, yarayıslı nem kapasitesi, daimi solma noktası ve doyumluk yüzdesinde etkili olduğu bildirilmiştir (Kant ve Aydın, 2008).

Tuz stresi (20 mM NaCl) koşullarında yetiştirilen fasulye çeşit ve genotiplerine (Akman-98, şeker fasulye çeşitleri ve Gevaş genotipleri) farklı dozlarda potasyum (0 - 50 - 1000 - 2000 ppm) uygulanmıştır. Yapılan çalışmada besin maddesi ve fide gelişim parametreleri incelenmiştir. Çalışma sonucunda artan potasyum konsantrasyonlarına bağlı olarak besin maddesi içeriklerinde kalsiyum ve magnezyum alımının artış gösterdiği ve K/Na oranında ise potasyum konsantrasyonlarına paralel olarak artış olduğu bildirilmiştir. Bununla birlikte yetiştirilen bitkilerde potasyum uygulamalarının ölüm oranında azaltıcı etki gösterdiği saptanmıştır (Erdoğan ve ark., 2014).

İklim kontrollü bir serada farklı tuz konsantrasyonlarında (kontrol, 6, 12 dS/m NaCl) fasulye (*Phaseolus vulgaris* L.) bitkisi dört tekrarlamalı olarak saksı ortamında yetiştirilmiş ve bu bitkiye yine farklı dozlarda biyokömür (kontrol, %10 ve %20) uygulaması yapılmıştır. Yapılan çalışmada bitkide fitohormon parametreleri incelenmiştir. Çalışma sonucunda fasulye yaprak ve kökünde Na konsantrasyonu, poliamin oksidaz (PAO) aktivitesi, poliamin, absisik asit (ABA), 1-aminosiklopropan-1-karboksilik asit (ACC), jasmonik asit (JA) ve salisilik asit (SA) içeriğinin tuz stresi altında arttığı tespit edilmiştir. Biyokömür uygulanan bitkilerde ise Na konsantrasyonu, PAO aktivitesi, poliaminler, ABA, ACC ve JA içeriklerinde azalmalar gözlemlenmiştir. Biyokömür uygulamalarının İAA içeriğini, kök ve sürgün büyümesini artırdığı bildirilmiştir. Tuzlu koşullardaki fasulyede Poliamin içeriği açısından ise %20 doz



biyokömür uygulamasındaki sonuç %10 dozdaki uygulamaya göre daha iyi sonuç verdiği saptanmıştır. Sonuç olarak tuzsuz koşulda yetişen fasulye bitkilerinde biyokömür uygulanması, fitohormon içeriğinde değişiklik göstermezken, tuzlu koşullarda yetişen fasulyelere biyokömür uygulanması tuz stresinin etkilerini azalttığı bildirilmiştir (Farhangi-Abriz ve Torabian, 2017). Değişik tuz konsantrasyonlarında (0, 20, 40 ve 60 mM NaCl) yetişen fasulye bitkisine farklı dozlarda PGPR uygulamaları (Kontrol, R15/1, R38/1, R54/2 ve 66/3) yapılmıştır. Yapılan çalışmada PGPR dozlarının fasulye bitkisinde besin elementi içerikleri ve fide gelişim parametrelerine bakılmıştır. Yapılan çalışmada tuz konsantrasyonlarının bitki büyüme gelişmesine negatif etki gösterirken PGPR uygulamalarının ise bitki gelişiminde farklı etkiler saptandığı bildirilmiştir. Fidelerde sürgün çapında en iyi PGPR uygulamasının R54/2 bakteri izolatu olduğu tespit edilmiştir. Besin elementlerinin (Makro ve mikro) alımında yine tuz uygulamalarının olumsuz etki gösterdiği bildirilirken PGPR uygulamalarında ise yine farklı sonuçlar saptanmıştır. Magnezyum alımında R15/1, çinko ve bakır alımında R54/2, Mangan alımında ise 66/3 bakteri izolatlarının pozitif etki gösterdikleri bildirilmiştir. PGPR uygulamalarının genelinde bitkide klorofil miktarında artış olduğu saptanmıştır (Dilan, 2017). Sera koşullarında değişik tuz konsantrasyonlarında (0, 25, 50 mM NaCl) yetiştirilmiş fasulye bitkisine farklı dozlarda biyokömür (0, 5, 15 t/ha) uygulanmıştır. Yapılan çalışmada biyokömürün tuza duyarlı fasulye bitkisine etkileri araştırılmıştır. Çalışma sonucunda tuz uygulamalarının fasulyede oluşturduğu stres ile sürgün büyümesini, biyokütle birikimini, toplam klorofil ve karetonoid içeriğini azaltırken, uygulanan biyokömürler ile bu parametrelerin tuz stresi etkilerini azalttığı bildirilmiştir. Artan hidrojen peroksit (H₂O₂) içeriği ile izlenen tuzluluk kaynaklı oksidatif stres ve yaprakların hücre zarı geçirgenliği sadece 5 t/ha biochar uygulaması ile azaltıldığı tespit edilmiştir (Karabay ve ark., 2021).

Farklı tuz dozlarında (1000, 2000, 3000 ve 4000 ppm) saksı ortamında fasulye (*Phaseolus vulgaris* L.) bitkisi yetiştirilmiştir. Çalışmada fasulye bitkisinde büyüme, gelişme ve enzim aktivesi parametrelerinde tuz sorununun negatif etkisini gidermek için *Bacillus megaterium*, Arbusküler mikoriza mantarı (AMF) ve kontrol olmak üzere 3 farklı uygulama yapılmıştır. Çalışma sonucunda tüm tuz uygulamaları ile yetiştirilmiş fasulyelerde *Bacillus megaterium* ve AMF uygulaması yapılan bitkiler, bakteri aşısı yapılmamış (kontrol) uygulamaya göre bitkideki tuz stresinin etkilerini azalttığı ve sırasıyla vejetatif büyüme, bitki taze ve kuru ağırlığı, klorofil ve antioksidan enzimatik aktiviteyi önemli ölçüde iyileştirdiği, bununla birlikte verimde ise kontrol uygulamasına karşı artış gözlemlendiği bildirilmiştir (Abdel Motaleb et al., 2020).

Sabit tuz konsantrasyonunda (50mM) farklı fasulye çeşitleri (Önceler, Şeker, Terzibaba ve Şehirali) üç farklı arbusküler mikoriza mantarı (*Glomus mosseae*, *Glomus intraradices* ve *Glomus fasciculatum*) uygulanarak yetiştirilmiştir. Çalışmada N, P, K, Ca, Mg, Fe, Cu, Mn ve Zn besin elementleri, sürgün yüksekliği, gövde çapı, kök uzunluğu, yaprak alanı gibi bitki büyüme parametreleri incelenmiştir. Çalışma sonucunda Arbusküler mikoriza mantarlarının bitki büyümesi ve besin elementi alımında pozitif etkileri olduğu saptanmıştır. Bununla birlikte fasulye çeşitlerinden Önceler ve Terzibaba, arbusküler mikoriza mantarı türlerinden ise *Glomus mosseae* bitki gelişimi için en iyi sonucu verdiği bildirilmiştir (Çiftçi et al., 2010).

Kontrollü iklim odasında farklı tuz konsantrasyonları (0, 50, 100, 150 mM) ve leonardit dozlarında (0, 20, 30 ve 40 g/kg) Göynük-98 fasulye (*Phaseolus vulgaris* L.) çeşidi saksılarda yetiştirilmiştir. Çalışmada tuz stresinin fide dönemindeki fasulyeye etkileri araştırılmıştır. Çalışma sonucunda leonardit uygulamalarının tuz stresi bulunan fasulye bitkilerine iyon alımı ve gelişimlerinde pozitif etki gösterdiği bildirilmiştir (Kiyas, 2020).



SONUÇ

Dünya nüfusunun artması ile bitkisel üretimin önemi gün geçtikçe artmaktadır. Bununla birlikte toprakların sürdürülebilirliği de oldukça önem arz etmektedir. Toprağın amaç dışı kullanımı, bilinçsiz gübreleme ve sulama ile toprak yapısı bozulmakta ve tuz girdisi artmaktadır. Tarım alanlarındaki bu tuz sorunu bitkilerde fizyolojik bozukluk, ürün kaybı, kalite bozukluğu ve dolayısıyla ekonomik zarar gibi negatif etkilere sebep olmaktadır. Böylece tuz sorunu üreticiler bakımından büyük sorun oluşturmakta ve alternatif yollara yönlendirmektedir. Daha önceki çalışmalarda da bildirildiği gibi tuz stresine toleransı çok düşük olan fasulye bitkilerinde biyokömür, mikoriza aşılması, PGPR, hidrojel, humik asit, leonardit, kalsiyum ve potasyum uygulamaları bitkilerde tuz stresi etkilerini hafiflettiği tespit edilmiştir. Tuz stresi sorunu karşısında devlet destekleri daha da artarak toprak ıslahı yapılmalı, besin içeriği yüksek kültür bitkilerinin ve tuz stresine toleransı yüksek tür ve çeşitlerin gelişmesi için teşvikler artırılmalıdır. Böylece üreticilerin yetiştiricilikte düşük maliyet ile maksimum verim alması sağlanmalıdır.



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THE RELATIONSHIP BETWEEN RAINFALL AND FORAGE PRODUCTION IN SUMMER RANGELAND OF KIASAR, IRAN

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ABSTRACT

Precipitation is the main factor that has direct effects on plant productions. Knowing of forage production is suitable tools for rangeland management too. Therefore, determination of relationship between plants production and precipitation can be predicted forage production in different sites. The Kiasar rangelands is located in Sari in north of Iran. The elevation of this area is between 1500 to 2400m that has semi-humid climate with 1300mm annual precipitation. For measuring of plants production 20 sites were selected in this area. These sites were similar in physiographic and lithologic factors. The sampling was done by 50 plots 1m² in each site randomly. Production was measured based on clipping and weighing method in each plot. Then, the average production was calculated for each site. The monthly rainfall of each site was obtained based on 11 climatology station. The data analysis was done by correlation coefficient in SPSS22 software. Monthly and seasonal rainfall correlation with plants productions showed that precipitation and production had significant relationship in May, November and September ($P \leq 0.5$) July, August and October ($P \leq 0.01$), but there was no significant relations among April, Jun, December, January, February, March. There was a significant relationship between production and precipitation in summer with yield of 662 Kg/ha ($P \leq 0.01$), spring and autumn with yield of 311 and 298 Kg/ha, respectively ($P \leq 0.5$) but there was no relation in winter. This research showed that there is a high correlation between precipitation and forage production in July and August. This subject can be useful to management of livestock grazing by means of determine of grazing time in rangelands. The main reason of the effects of precipitation on yield can be due to drought stress in some months and seasons. By considering the climatic effective factors on yield, we suggest that soil parameters should be considered for exact estimation. We can predict the plants production based on temporal and spatial relation of precipitation and vegetation while there is no accessible information.

Keywords: Rainfall, forage production, summer rangeland, Kiasar, Iran



INTRODUCTION

Precipitation is the main factor that has direct effects on plant productions (Freckleton et al, 1999; Gadgil et al, 1999; Sun and Ward, 2007). Also, knowing of forage yield is suitable tools for rangeland ecosystems management (Holechek et al, 1989). Hosseini et al (2002) studied the relationship between precipitation and *Medicago sativa* yield in Hamand-Absard rangelands of Iran. They estimated forage yield by using precipitation in March and May based on reliable model. George et al (2002) analyzed the relationship between precipitation and grasses yield in Colorado rangeland and realized that rainfall in April had a special and meaningful effect on rangeland yield. Westcott et al (2005) showed the reaction of *Zea mays* to rainfall by national climate services in America. They declared that production had a high correlation with high and low precipitation in comparison to medium precipitation in July. Measuring of forage yield in summer rangelands such as Kiasar rangeland of Sari in north of Iran is difficult because these regions are located in high altitude and impassable areas. Therefore determination of relationship between plants production and precipitation can be useful for prediction of forage yield in different sites.

MATERIALS and METHODS

The Kiasar rangeland is located in Sari of Mazandaran province in $54^{\circ} 10'$ to $54^{\circ} 35'$ E longitude and $36^{\circ} 26'$ to $36^{\circ} 36'$ N latitude (Fig.1). The elevation of this area is between 1500 to 2400m that has moderate climate with 1300mm annual precipitation. There are perennial plants such as shrubs, grasses, and forbs in this region. The most important plants are *Onobrychis cornuta*, *Thymus kotschyanus*, *Astragalus* sp and *Acontholimon* sp.

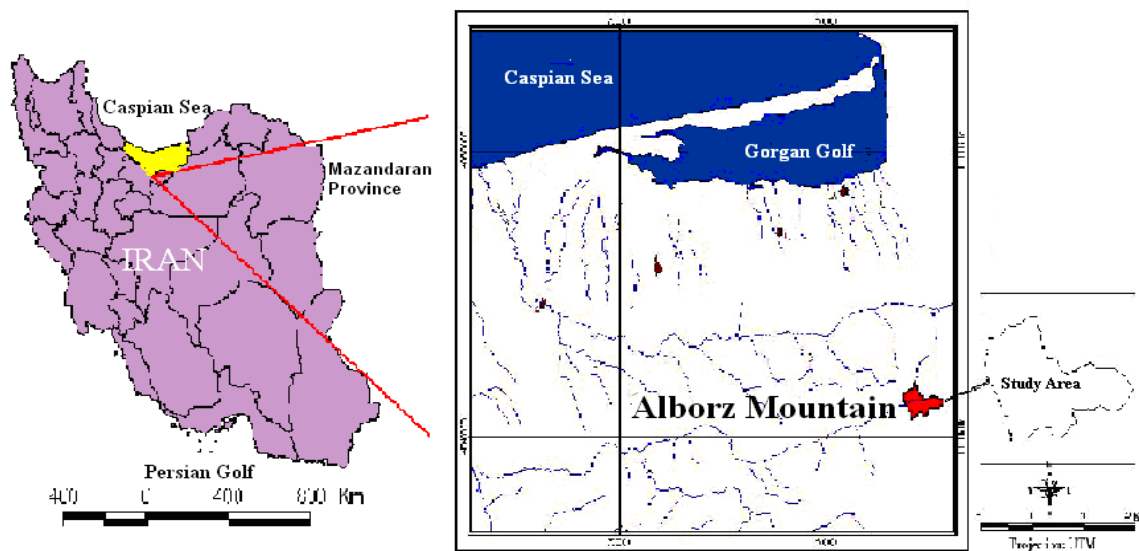


Figure 1. Location of study area in Mazandaran Province.

For measuring of plants production 20 sites were selected in this research. These sites were similar in physiographic and lithologic factors. The sampling was done by 50 plots 1m² in each site randomly. Production was measured based on clipping and weighing method in each plot. Then, the average yield was calculated for each site. The monthly rainfall of each site was obtained based on 11 climatology station in 2009 separately. Some of these stations were contained several sites. The data analysis was done by correlation coefficient in SPSS10 software.



RESULT and DISCUSSION

Monthly and seasonal rainfall correlation with plants yields (Table 1 & 2) showed that precipitation and yield has significant relationship in May, July, August, September, November and October but there is no significant relations among April, Jun, December, January, February, March. There is a significant relationship between yield and precipitation in spring, summer and autumn but there is no significant relation in winter.

Table1. Correlation between monthly rainfall and yield

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Yield (Kg/ha)	161 ^{ns}	41 ^{ns}	185 ^{ns}	140 ^{ns}	316 ^{**}	121 ^{ns}	626 ^{***}	523 ^{***}	485 ^{**}	349 ^{***}	214 [*]	111 ^{ns}

ns: none significant; *: $P \leq 0.5\%$; **: $P \leq 0.1\%$; ***: $P \leq 0.01\%$

Table 2. Correlation between seasonal rainfall and yield

Season	Spring	Summer	Autumn	Winter
Yield (Kg/ha)	311 [*]	662 ^{***}	298 [*]	91 ^{ns}

ns: none significant; *: $P \leq 0.5\%$; **: $P \leq 0.1\%$; ***: $P \leq 0.01\%$

CONCLUSION

Precipitation changes are one of the most important factors that changes plants production during a year. According to this factor can be calculate production in impassable zones (Moghaddam, 2002). This research shows that there is a high correlation between precipitation and forage yield in July and August. This subject can be useful to management of livestock grazing by means of determine of grazing time in rangelands. This is similar to the findings of George et al (2002). The main reason of the effects of precipitation on yield can be due to drought stress in some months and seasons. Holechek et al (1989) expressed that in the humid regions the rainfall factor has the most correlation with yield but in semi-dry regions, soil moisture is a determinant factor. By considering the climatic effective factors on yield, we suggest that soil parameters should be considered for exact estimation. The results also showed that we can predict the plants production based on temporal and spatial relation of precipitation and vegetation while there is no accessible information.



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TÜRKİYE'DE ARAZİ TOPLULAŞTIRMASI PROBLEMİ

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ÖZET

Dünya nüfusunun en temel gereksinimi olan beslenme ihtiyacı genel olarak toprak kaynaklı olan ürünlerle karşılanmaktadır. Ürünlerin yetiştiriciliğinin yapıldığı toprak miktarı ise artan nüfus ile aynı oranda artmayacağından dolayı kullanılan tarım arazilerinin yüksek düzeyde verim kapasitesine sahip olması gerekmektedir. Dünya'nın birçok ülkesinde olduğu gibi Türkiye'de de ekonomi, tarım ve hayvancılığa bağlı olarak önemli ölçüde değişim göstermektedir. Bu sebeple ülkemizde tarım alanlarının yönetimi oldukça önem verilmesi gereken bir konudur. Tarım arazilerinin miras ile küçük parçalar halinde bölünmesi, zamanla verimli ve üretken tarımın yürütülebilmesine sebebiyet vermektedir. Sürdürülebilir tarımın uygulanabilmesi için üretimin doğru arazi yapısı ile belirlenebilmesi ve bu arazilerin niteliklerine uygun bir şekilde kullanılabilmesi gerekmektedir. İşlenebilir arazilerimizde istenilen artışın oluşmaması, üretim yapılan bölgelerdeki nüfus baskısının artmasına neden olmaktadır. Bu durum aynı zamanda tarım arazilerinin parçalanmaya devam edeceğinin açık bir göstergesidir. Dağınık ve parçalı arazilerin varlığı ile tarım üretiminde yaşanan düzensizlikler verim kapasitesini artıracak tedbirlerin alınmasını zorlaştırmakta ve üretim maliyetlerinin de artmasına sebep olmaktadır. Ülkemizde tarım ile ilgili birçok arazinin sulama kanallarına olan yasal yolu ve doğrudan erişimi bulunmamaktadır. Bu sebeple kaynakların verimli kullanımı gerçekleşememekte ve bununla birlikte sosyal sorunlar da oluşabilmektedir. Parçalı arazilerde işçilik giderleri, toplu arazilere kıyasla oldukça yüksektir. Parseller çok küçük olduğundan dolayı, işgücü verimli olarak değerlendirilememektedir. Tarım işletmelerinde verimin artırılması; temelde dolaylı ve direkt yollarla küçülen ve bölünen ya da şekil kaynaklı olarak değerlendirilemeyen alanların birleştirilmesi metoduyla uygulanabilecek arazi toplulaştırılması çalışmalarıyla desteklenebilmektedir. Arazi toplulaştırması için çiftçilerle sürekli toplantılar düzenlenerek farkındalık oluşturulmalıdır. Toplulaştırmanın tarım ile ilgilenen şahıslara ne gibi kazanımlar sağlayacağı aşılı olarak bireylerin birlikte çalışma isteği uyandırılmalıdır. Bu derlemede, ülkemizde arazi toplulaştırması sürecinde yaşanan gelişmeler ve sorunlar, gerçekleştirilen uygulamalar ile birlikte değerlendirilmiştir.

Anahtar Kelimeler: Arazi toplulaştırması, tarım, verim



LAND CONSOLIDATION PROBLEM IN TURKEY

ABSTRACT

The nutritional requirement, which is the most basic requirement of the world population, is generally met with soil-sourced products. Since the amount of land where crops are cultivated will not increase at the same rate as the increasing population, the agricultural land used must have a high level of yield capacity. As in many countries in Turkey's economy shows considerable variation depending on agriculture and animal husbandry. For this reason, the management of agricultural lands in our country is an issue that should be given great importance. The division of agricultural land into small parts by inheritance leads to the inability to carry out productive agriculture over time. In order to sustainable agriculture to be implemented, production must be determined with the correct land structure and used in accordance with the qualifications of these lands. The fact that the desired increase does not occur in our arable lands causes an increase in the population pressure in the production regions. This situation is also a clear indication that agricultural land will continue to fragment. The existence of scattered and fragmented lands and irregularities in agricultural production make it difficult to take measures to increase yield capacity and cause an increase in production costs. Many agricultural lands in our country do not have a legal way or direct access to irrigation channels. For this reason, efficient use of resources cannot be realized, and social problems may occur along with this. Labor expenses in fragmented lands are quite high compared to collective lands. Since the parcels are very small, the labor force cannot be evaluated as efficient. Increasing productivity in agricultural enterprises; can be supported by land consolidation studies that can be applied by combining areas that are basically reduced and divided by indirect and direct means or that cannot be evaluated due to shape. Awareness should be formed by holding meetings with farmers for land consolidation. Individuals' desire to work together should be encouraged by instilling the benefits of land consolidation for people interested in agriculture. In this review, the developments and problems experienced during the land consolidation process in our country are evaluated together with the practices implemented.

Keywords: Land consolidation, agriculture, yield



GİRİŞ

Tarımsal faaliyetleri çeşitli nedenlerle ekonomik olarak sürdürmeye fırsat vermeyecek şekilde dağılmış, parçalanmış, bozuk şekilli parsellerin günümüzde yürütülmesi gereken tarım işletmesi esaslarına göre uygun bir biçimde şekillendirilmesi, birleştirilmesi ve yeniden düzenlenmesi işlemlerine “Arazi Toplulaştırması” denilmektedir (Erçakar ve Efe 2019). Arazi toplulaştırması yalnızca teknik olarak yürütülen bir çalışma değildir. Sosyal etmenleri de içerisinde barındırmaktadır. Hayvancılık ve kültür bitkileri yetiştiriciliği ile beraber kırsal alanlarda yaşamını sürdüren insanların geçim kaynağı olan arazilerde insan-toprak ilişkisi sayesinde aidiyet duygusuyla birlikte “mal canın yongasıdır” kavramı doğmuştur. Bu olgu ile birlikte sosyal sorunlar da ortaya çıkmıştır. Bu sebeple arazi toplulaştırmasında asıl amaç daha az işgücü, zaman, sermaye kullanarak üretimi ve işletme verimliliğini artırmanın yanı sıra işletme bölgesindeki nüfusun yaşam standartlarını da yükseltmektir. Arazi toplulaştırması proje çalışmalarında insan ilişkilerinin sonucu olarak ortaya çıkan sosyal sorunlara da çare bulunmaktadır (Demiraslan ve ark. 2019).

Arazi parçalanması, çok sayıda parçalara ayrılan bir işletme toprağının, toprak genişliğinin küçülmesi olarak nitelendirilmektedir. Arazi parçalanması neticesinde tarımsal bir işletme, verimli olamayacak seviyelerde küçülebilmekte, tarım arazileri birbirlerinden uzak yerlerde ve dağınık olarak bulunabilmektedir. Ülkemizde tarım işletmelerinin çoğu yeterli büyüklükte değildir. Tarım toprakları oldukça parçalanmış ve verimli bir şekilde işlenemeyecek hâle gelmiştir. Tarım işletmelerinde verimliliği büyük oranda düşüren arazi parçalanmasının nedenlerini genel olarak; “bölünerek ve hisseli yapılan satış işlemleri ile parçalanmalar” ve “intikal ve miras yoluyla parçalanmalar” oluşturmaktadır. Bunların dışında daha az etkili olan; “işgücü ve sermaye yetersizliğin sebebiyle yapılan ortakçılık ve kiracılık yoluyla parçalanmalar”, “muhtelif nedenlerle oluşan kamulaştırma yoluyla parçalanmalar” ve “topoğrafik ve coğrafi konum sebebiyle oluşan parçalanmalar”a da rastlanmaktadır (Yağanoğlu ve ark 2000).

Arazi dağınıklığının ve parçalılığının giderilmesi, arazi yapılarının düzeltilmesi, çiftçilerin yaşam şartlarının iyileştirilmesi gibi yapısal ve sosyal önlemlerin alınması arazi toplulaştırması çalışmaları çerçevesinde yürütülebilmektedir. Tarım alanlarında üretimin artırılması, kırsal alanlarda yürütülmesi gereken fiziksel düzenlemelere bağlıdır. Kırsal alanların düzenlenmesinde; su ve toprak kaynaklarından optimum düzeyde yararlanma ve bu kaynakların korunması ile geliştirilmesine dair çalışmaları yer almaktadır. Ayrıca işletmelerin yapısal dönüşümlerini de kapsayan kültür-teknik tedbirleri bu çalışmalar içerisinde çok önemli bir yer tutmaktadır (Girgin, 1982; Köse, 2009).

TARIM ARAZİLERİNDE YAŞANILAN PROBLEMLER

Tarım arazilerinin verimli bir şekilde kullanılabilmesi için bu alanlara yönelik ulaşım ve su yollarının etkin bir şekilde sağlanması ve değişik sebeplerle parçalanmış arazilerin bir araya getirilerek işletilmesi gerekmektedir. Dünya nüfusunun yükselmesi ile birlikte tarım ürünlerine olan gereksinim artmaktadır. Ancak artan nüfusa karşılık gıda ihtiyacına olan talepleri yerine getirebilecek düzeyde tarım alanları etkin kullanılamamaktadır. Ekonomik ve sosyal gelişmeler, kentlerdeki yaşam standartlarını yükseltmiş ve metropoller büyük nüfus kitleleri için cazibe merkezi haline gelmiştir. Özellikle ülkemizde artan nüfus ile birlikte çok sayıda mal bölüşümü yüzünden tarım işletmelerinin sayıları önemli düzeyde artmıştır. Teknolojik gelişmeler ile birlikte kırsal alanlara iş yükünü azaltan tarım makineleri taşınmış olmasına rağmen ve parçalı araziler yüzünden düşen gelir seviyesi nedeniyle kentlere göç sayıları giderek artmıştır. Bu sebeple kırsal alanlardaki bölünmüş araziler, kullanılmayan boş



araziler olarak bırakılmıştır. Diğer taraftan bu durum, tarımsal faaliyetlerdeki emeğin niceliğine ve niteliğine de olumsuz etkilerde bulunmuştur. (Yoğunlu, 2013)

Arazi toplulaştırması çalışmaları günümüzde amaç ve uygulamalar çerçevesinde ülkeler arası farklılıklar göstermektedir. Planlama, etüt, örgütlenme ve toplulaştırma süreçlerinde faydalanıcıların katılımları ve yatırımcı kuruluşların fonksiyonları gibi pek çok sebeple ülkelerin birbirinden oldukça farklı uygulamalarını görmek mümkündür. Ülkemizde tarım sektöründe yapısal problemlerin başında işletme ölçeklerinin küçük, tarım arazilerinin parçalı ve çok hisseli olması gelmektedir. Ortalama olarak 11 parçalı ve 59 dekarlık arazilerde tarım yapılmaktadır. Her bir işletme için 11 parsel düşmektedir. Çoğu parselin yasal yolu ve sulama kanalı erişimi bulunmamaktadır. Bu nedenle kaynakların verimli olarak kullanılması sağlanamamakta ve bununla birlikte sosyal sorunlar da ortaya çıkmaktadır (Küsek ve Ark., 2015).

Ülkemizde arazi parça sayısının artması ile su kanalları, yollar ve parsel sınırları için daha fazla alan ayrılmış ve bununla birlikte tarım alanlarındaki kayıplar artmıştır. Dağınık ve parçalı araziler tarım makina ve aletlerinin iş gücü verimini azaltmakta ve üretim için ayrılan masrafları artırmaktadır. Parçalılığın çok fazla olduğu bölgelerde; arazi ıslahı/tesviyesi, drenaj ve sulama gibi hizmetler işletmelerin her parçasına götürülememektedir. Parsellerin çoğunda sulama kanalına ve yola doğru cephenin olmayışı su kullanımı ve geçiş hakları olarak sorun oluşturmaktadır. Mera arazilerindeki parçalılık ve dağınıklıkta da benzer sorunlarla birlikte toprağın aşınması ve çevre sorunlarının artması gibi problemler görülmektedir (Küsek, 2014). Bugün itibarıyla 24 milyon hektar tarım alanında 40 milyondan fazla hisse bulunmaktadır. Buna göre, ortalama olarak her tarım işletmesi 13 hissedarlık arazileri işlemektedir. Hisseli araziler için çoğunluğu kentte yaşayan hissedarlar da toprağı işleyenler de mağdur konumundadır. Her iki taraf da tarım arazisinden beklenen faydaları yeterince alamamaktadır. Ayrıca, miras yoluyla parçalanmanın yanı sıra yıllardır süregelen kontrol dışı alım ve satım işlemleri, toplulaştırma olmadan yapılan demiryolu, otoyol ve karayolu gibi kamu yatırımları yatırım harcamalarını artırmış ve tarım alanlarının tarımsal bütünlüğünü bozmuştur. Tüm bu sorunlar arazi toplulaştırması çalışmalarını zorunlu kılmıştır (Küsek ve Ark., 2015).

TÜRKİYE’DE ARAZİ TOPLULAŞTIRMASI

Türkiye’de arazi toplulaştırması uygulamaları 3083 sayılı “Sulama Alanlarında Arazi Düzenlenmesine Dair Tarım Reformu Kanunu” (Değişik 4626 S.K.) ve 5403 sayılı “Toprak Koruma ve Arazi Kullanımı Kanunu” (Değişik 5578 S.K.) hükümlerince uygulanmaktaydı (Resmî Gazete 1984; 2007). 28.04.2018 tarihinde ise resmî gazete ile yayınlanmış olan 7139 sayılı “Devlet Su İşleri Genel Müdürlüğünün Teşkilat ve Görevleri Hakkında Kanun ile Bazı Kanunlarda ve Gıda, Tarım ve Hayvancılık Bakanlığının Teşkilat ve Görevleri Hakkında Kanun Hükmünde Kararnamede Değişiklik Yapılmasına Dair Kanun” yürürlüğe girmiştir. Bu kanun ile Tarım Reformu Genel Müdürlüğü’nce yürütülen Arazi Topplulaştırma projeleri Devlet Su İşleri Genel Müdürlüğü’ne verilmiştir (Demiraslan ve ark. 2019).

Son yıllarda, arazi toplulaştırması çalışmaları tüm dünyada ve ülkemizde oldukça yaygınlaşmış ve geniş alanlarda uygulama imkânı bulunmuştur. Her mühendislik çalışmasında olduğu üzere arazi toplulaştırması projelerinde de proje teknikleri ile uyumlu olarak çalışmaların gerçekleştirilmesi ve beklenen faydanın sağlanması gerekmektedir. Bu sebeple, toplulaştırma çalışmaları, proje öncesi durumları dikkate alınarak, farklı yönlerden değerlendirilmekte ve bu değerlendirmelere göre projelerin başarı seviyesi belirlenebilmektedir. Proje başarısının değerlendirilebilmesi için değişik kriterler kullanılmaktadır. Bunlar arasında parsel şekli, ortalama parsel büyüklüğü, toplulaştırma oranı, yol şebekesinin durumu, işletme başına düşen parsellerin parçalılık durumu, parsel yer değiştirme oranı, derecelendirme haritalarının niteliği



ve mülk sahiplerinin memnuniyet oranı en çok kullanılanlardır. Bu kriterlerin birlikte değerlendirildiği çok sayıda araştırma gerçekleştirilmiştir (Erbatur, 2020)

Türkiye’de arazi toplulaştırma çalışmaları ilk olarak Konya’nın Çumra ilçesinin Kargın köyünde yürütülmüştür. 1965 yılında Burdur-Bucak yöresinde devam eden toplulaştırma projelerini 1967 yılında İzmir ve Manisa illerini kapsayan ‘Aşağı Gediz Sulama Projesi’ izlemiştir (Yoğunlu 2013). Yıllar içerisinde arazi toplulaştırması projelerinin devamı gelse de bu projelerin sayısı ve kapladığı alan yetersiz düzeylerde kalmıştır. Son yıllarda yürütülen bazı arazi toplulaştırma projeleri şu şekildedir;

Kesin kabulü 23/05/2006 tarihinde tamamlanan TİGH (Tarla İçi Geliştirme Hizmetleri) ve Uygulanan AT (Arazi Toplulaştırması) projesi sonucunda 1300 hektar arazi toplulaştırılmıştır. Toplulaştırması tamamlanan arazilerin 900 hektarlık kısmı sulamaya açılmıştır (Yoğunlu, 2013).

Özer (2010) Çanakkale’nin, Biga ilçesi Yeniçiflik Köyü’nde arazi toplulaştırması sonrasında toplulaştırmanın etkinliğini gözlemek amacıyla yürütmüş oldukları çalışmada; toplulaştırmanın ulaşım etkinliğini, sulama etkinliğini, parsel büyüklüğünü, şeklini, sayısını incelemiş ve toplulaştırma sonrası toplam parsel sayısında %63’lük bir azalma olduğunu, sulama oranının ise %81,6 olarak gerçekleştiğini tespit etmiştir.

Çelebi (2010) Karaman ilindeki bazı arazi toplulaştırmaları için; miras yoluyla oluşan hisselenmeler, toplam parsel sayısı, yoldan ve kanaldan doğrudan faydalanan parsel sayıları, yol uzunlukları, kanal uzunlukları, bir maliğe düşen parsel sayısı ve sınır kayıpları ile ilgili toplulaştırma öncesi ve sonrası değerlerini kıyaslamış ve toplulaştırmalardan sonra sulamadan ve yoldan doğrudan faydalanan parsel oranını %100 olarak tespit etmiştir.

Eser ve Uçan (2012) Gaziantep ilinin Nurdağı ilçesine bağlı Gedikli Köyü’nde yapılan arazi toplulaştırmasının etkinliğini belirlemişlerdir. Çalışmada temel olarak toplulaştırmanın ulaşım etkinliğine, sulama etkinliğine, parsel sayısına, büyüklüğüne ve şekline etkisini araştırmışlardır. Toplulaştırılma sonrasında dikdörtgen parsel sayısının %15,46’dan %51,02’ye yükseldiğini, parsel sayısında toplam %52 azalma olduğunu tespit etmişlerdir. Toplulaştırma oranının %47 ve sulama oranının %92,96 olarak gerçekleştiğini belirtmişlerdir. Ayrıca, toplulaştırma sonrası tüm parsellerin yol ağına bağlandığını, ekonomik ve sosyal açıdan mevcut işletmelerin %80,6’sında yaşam şartlarının iyileştiğini ve %83,9’unda gelir artışı sağlandığını bildirmişlerdir.

Arslan ve Tunca (2013) Samsun’un Kızılırmak deltasında yer alan Sol sahilinde yürütülen arazi toplulaştırması çalışmalarını değerlendirmişlerdir. Araştırmada toplulaştırmalı ve toplulaştırmaz şartlarda sulama ve drenaj yoğunluğu, sulama şebekesinin sulama oranı, kamulaştırma maliyetleri ve toplulaştırma oranı gibi performans parametrelerini incelemişlerdir. Arazi toplulaştırmaz halde iken parsel sayısı 1315, sulama oranı % 27, drenaj yoğunluğu ve sulama sırasıyla, 24,53 m/ha ve 23,79 m/ha değerlerinde tespit edilmiştir. Toplulaştırma sonrasında ise drenaj ve sulama şebekelerinin yapılması ile birlikte sulama oranının % 95,84, parsel sayısının 616 ve toplulaştırma oranının %53 olarak gerçekleştiğini bildirmişlerdir.

SONUÇ

Kırsal kesimlerdeki tarım işletmelerinin sayısının düşürülmesi ve tarım arazilerinin ulaşım ve su imkanlarını sağlayan toplulaştırmalar, kırsal kalkınmanın en önemli aşamalarındandır. Kırsal kalkınma adına yapılacak arazi toplulaştırmaları için mutlaka önceden detaylı planlamalar yapılmalı, toplulaştırma içeriğinde olan alanlara dair temalar belirlenmeli, toplulaştırmadan faydalanacak ve toplulaştırma çerçevesinde doğrudan ve dolaylı yollarla etki altında kalacak kişiler ile düzenli bir şekilde iletişim ağları kurulmalıdır. Toplulaştırmanın ekonomik açıdan



sürdürülebilir olması devletin sağlayacağı bazı teşvik ve imkanlar ile desteklenebilir. Arazi toplulaştırması çalışmaları için tüm çalışma aşamalarında farklı meslek gruplarının ortak bir şekilde çalışmasına ihtiyaç duyulmaktadır. Proje içeriklerinde genel olarak jeoloji, harita ve ziarat uzmanlık alanlarındaki mühendisler ile inşaat ve harita teknikerlerinin yanı sıra projenin niteliğine göre değişkenlik göstermekle birlikte elektrik, makina ve inşaat mühendislerinin ve sosyologların da görev almaları gerekmektedir. Proje alanlarında bulunan çiftçilerle sürekli olarak toplantılar düzenlenerek toplulaştırmanın faydaları ile ilgili farkındalık oluşturulmalıdır. Toplulaştırmadan etkilenecek kişilere toplulaştırmanın kendilerine ve köyelerine neler kazandıracığına dair yeterli bilinç aşılmalı ve toplulaştırma için birlikte çalışma isteği uyandırılmalıdır.

Arazi toplulaştırma projelerinin başarısı, çiftçi isteklerinin yerine getirilmesi ve sürdürülebilir işletme büyüklüklerinin korunması yollarıyla artmaktadır. Köyden şehirlere göçlerin azaltılması, arazi toplulaştırmalarının artması ile mümkün olacaktır. Bu sebeple arazi toplulaştırma projelerinin çiftçilerinde görüşleri alınarak ve tekrar tekrar gözden geçirilerek işleme alınması gerekmektedir.

Kırsal yörelerdeki yaşam koşullarının uygun bir ekonomik ve sosyal seviyeye erişmesi için sadece tarımsal yapının iyileştirilmesi yeterli olmamaktadır. Bu sebeple, arazi toplulaştırması çalışmaları, yalnız tarım alanlarını değil, köyleri de kapsayacak biçimde gerçekleştirilmelidir. Özellikle kırsal yörelerdeki insanların kendi yaşam alanı olan köylerde, yaşam ve çalışma koşullarının iyileştirilmesi, arazi toplulaştırması çalışmaları adına büyük önemi taşımaktadır.



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A STUDY OF RELIEF EFFECT ON GRAZING IN SUMMER RANGELANDS OF MAZANDARAN PROVINCE, IRAN

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ABSTRACT

Grazing in mountain rangelands is not balanced due to relief changes. Topography effects on livestock distribution and changes utilization percentage in summer rangelands. The aim of this study was to investigation of the impact of topography on utilization in mountain rangeland of Mazandaran province in north of Iran. The five grazing units were determined by overlaying of topographic maps (aspect, slope and altitude layers) and field controlling. Percentage of utilization was measured in each unit by height to weight method. In order to determine relation between percentage of utilization and topographic factors, analysis of variance, correlation and regression methods was used in SPSS10 software. Utilization percentage was determined as a dependent variable and slop, aspects and height were inserted in the model as independent variables. Stepwise regression method was used to find of the most effective factors on livestock grazing. The findings showed that slope was the most effective factor on the livestock utilization and aspect had less effect on utilization. Altitude hadn't effect on utilization in this region.

Keywords: Relief, distribution, livestock, utilization, mazandaran, Iran



INTRODUCTION

Grazing pressure may not be due to livestock increasing but incorrect distribution of animal in rangelands cause to grazing intensity (Andreasen et al, 2001). Grazing is affected by topography, plant growth stage and water distribution in mountain rangelands (George et al, 2007). Therefore, mixed parameters are usually the most effective way to grazing management. In order to choose of suitable method for grazing distribution in mountain rangelands, relief effect on grazing should be investigated. Vegetation type, relief, grazing time and kind of animal influence on grazing and mountain's high slopes prevent to suitable grazing (Arnold, 1987). Stuth (1991) believed that rocky area, sharp slopes and relief limit grazing too. Mesdaghi (2000) showed that in rangeland with none-homogenic vegetation, topography is the most important factor on grazing and pressure of grazing is more than non-slope area. Gholami (2004) in forest park of Golestan showed that richness in north facing slopes is more than southern aspects due to increase of humidity and animals distribution was intensive in these zones. Also, different animals due to the effect of topographic factors show different utilization intensities (Mesdaghi, 2004; Delcurto et al, 2005). Some studies revealed that distribution of animal is one of the most important factors for rangelands managers (Hund, 2002; Hunt et al, 2007). This study was done to determine of topographic effective factors on grazing distribution of Sari summer rangelands in center of Mazandaran province as a suitable tool for the best management in this area.

MATERIAL and METHODS

Sari summer rangeland is located in mountainous regions of Mazandaran province in north of Iran. The location is 36° 9' to 36° 16' N latitude and 54° 00' to 54° 40' E longitude. The whether is humid and mean annual precipitation is 500 to 600 mm that occurs mostly in February. Winter is cold and means annual temperature is 5.8°C. The elevation is 2500-3700m a.s.l. The dominant plant communities are grasses, forbs and shrubs in this area. For evaluation of relief effect on grazing, the area grazing units map was provided by overlaying of altitude, aspect, slope and vegetation maps. Five homogenic grazing units were selected based on kind of animal and type of vegetation in land unit map. These units were controlled by field survey too. Then, the percentage of utilization was measured by high to weight method in each grazing unit. The relation between amount of percentage utilization and topographic parameters was done by analysis of variance, correlation and regression methods in SPSS10 software. The percentage of utilizations considered as dependent variable and slope, aspect and altitude were as independent variables. Also, classification of variance was used to find the amount variability of these differences in the grazing units. Comparison of means was done by LSD method ($p \leq 5\%$). The most effective factors were determined by multiple regressions and stepwise method.

RESULTS and DISCUSSION

Analysis of variance of utilization percentage in each grazing units showed that there were significant differences in these units (Table 1).

Table 1- Comparison of utilization percentage in the five grazing units

Source of Variation	Degree of Freedom	Sum of Square	Mean Square	F value
Utilization Percentage	4	4025.46	1006.36	15.98**
Error	187	11769.67	62.93	
Total	191	15795.1426		

ns: none significant; *: $P \leq 5\%$; **: $P \leq 1\%$



Correlation of different variables in five grazing units showed that correlation had existed between utilization percentages and slope in the unit1, unit2, and unit4. Aspect had correlation with utilization in the unit3, and aspect and slope had the correlation with utilization in the unit5 (Table 2).

Slope had the most negatively effect on utilization percentage in the unit1 and unit4 whereas slope and aspect had the most effect on utilization in the unit2 and unit5. Aspect had only the most effect on utilization percentage in the unit3 (Table 3).

Table 2- Correlation between different variables in the grazing units

Unit1	Slope	Aspect	Height	Utilization
Slope	1			
Aspect	-0.66**	1		
Height	0.20 ^{ns}	-0.23 ^{ns}	1	
Utilization	-0.60**	0.35 ^{ns}	0.20 ^{ns}	1
Unit2	Slope	Aspect	Height	Utilization
Slope	1			
Aspect	0.41**	1		
Height	-0.03 ^{ns}	0.07 ^{ns}	1	
Utilization	-0.35*	0.23 ^{ns}	0.26 ^{ns}	1
Unit3	Slope	Aspect	Height	Utilization
Slope	1			
Aspect	-0.13 ^{ns}	1		
Height	-0.36**	0.20 ^{ns}	1	
Utilization	-0.24 ^{ns}	-0.59**	0.14 ^{ns}	1
Unit4	Slope	Aspect	Height	Utilization
Slope	1			
Aspect	-0.15 ^{ns}	1		
Height	0.27 ^{ns}	0.28 ^{ns}	1	
Utilization	0.97**	0.21 ^{ns}	0.25 ^{ns}	1
Unit5	Slope	Aspect	Height	Utilization
Slope	1			
Aspect	0.35*	1		
Height	0.04 ^{ns}	-0.39**	1	
Utilization	-0.91**	0.50**	-0.11 ^{ns}	1

ns: none significant; *: P≤5%; **: P≤1%

Table 3- The most effective factors on utilization percentage (Y) in utilization units

Dependent Variables	Independent variables			R ²	Regression equations
	Slope (X ₁)	Aspect (X ₂)	Altitude (X ₃)		
Utilization in Unit1	×	-	-	0.37	Y = 93.8 - 0.18X ₁
Utilization in Unit2	×	×	-	0.31	Y = 89.0 - 0.12 X ₁ + 0.03 X ₂
Utilization in Unit3	×	-	-	0.35	Y = 85.13 + 0.03 X ₁
Utilization in Unit4	×	-	-	0.95	Y = 104.8 - 0.58 X ₁
Utilization in Unit5	×	×	-	0.71	Y = 97.90 - 0.40 X ₁ - 0.03 X ₂

Interaction of slope and aspect in the grazing units 1, 2 and 3 showed that utilization is affected by these factors significantly that caused to increasing of R². Interaction of slope and height on utilization were affected in the unit4. Interaction of relief variables entered to the model in the unit5 and didn't increase R². Therefore it was omitted (Table 4).



Table 4- Interaction between variables in grazing units

Dependent variables	Independent variables	R ²	Regression equation
Utilization in Unit1	Slope, interaction of slope & aspect	0.45	$Y = 89.0 + 0.02 X_2 - 3.61X_1 X_2$
Utilization in Unit2	Slope, interaction of slope & aspect	0.34	$Y = 92.33 - 0.21 X_1 - 0.001X_1 X_2$
Utilization in Unit3	Slope, interaction of slope & aspect	0.39	$Y = 85.13 - 0.12 X_1 - 1.30X_1 X_2$
Utilization in Unit4	Slope, height and interaction of slope & height	0.97	$Y = 102.0 - 0.60 X_1 - 0.01X_3 - 2.60 X_1 X_3$
Utilization in Unit5	-	-	-

The result of this study showed that the slope had the highest effect on utilization factor. The relationship between slope and utilization was indirect as increasing of slope decreased the utilization. This is due to decrease of animal activity and movement in sharp slopes. Slope is one of the most import factor that limited use of vegetation by animal, especially cow. The cow grazes in low slope such as flat, valley bottom and low areas between drainage, while the sheep can grazes up to 45% slope (Holechek et al., 2001). Some result show that grazed grasslands by cow caused to uniform utilization as residual vegetation was very less in low slope to sharp slopes (Bailey, 2004). In the San Joaquin of California grasslands, animal distribution is affected by slope strongly as 80% of grazed sites occurs under 10% slope (Harris et al., 2002). The second effective factor on utilization was aspect which factor due to cold weather and snow cover in north facing slopes caused to less utilization and few distribution of animal than to the south facing slopes. Plants growth was faster and grazing time was sooner in south slopes and grazing pressure was intensive due to optimum condition of temperature. The plants green up earlier in the south aspect than the north aspect that caused to the more desirable grazing areas (Defosse, 1997; Ohlenbush and Harner, 2003). But this subject can be different in special rangelands as some studies showed that there wasn't any relation in different aspects with individual cow grazing in foothill rangeland (Bailey et al, 2001; Vanwagoner et al, 2006).

CONCLUSION

Height factor was less effective on the unitization percentage. This was probably due to the effect of other parameters on vegetation. Some research in the north of Iran showed that the height increasing can increase the UV ray and decrease temperature. This matter can effect on decrease of plant diversity and grazing intensity indirectly (Ebrahimi, 2003).



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TARIM ALANLARINDA DRON TEKNOLOJİSİNİN KULLANIMI

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ÖZET

Hızla gelişen teknoloji, ülkeler arasında dijital bir dönüşüm yarışı oluşmasına neden olmuştur. Tam otomasyona sahip entegre akıllı sistemlerin geliştirilmesi ile makine-insan ve makine-makine etkileşimi artmıştır. Bilgi teknolojilerinin tarımla kaynaştırılması ile yeni teknolojik terimler günümüz dünyasında hızla daha çok duyulmaya başlamıştır. Tarımda kalite ve verimin artırılması için bitki yetiştiriciliğinin ve besi hayvanlarının düzenli takip edilmesi ve yetiştiricilik için gerekli uygulamaların en doğru zamanda yapılması gerekmektedir. Bu sebeple gelişen teknolojiye faydalanmak adına tarım sektöründe işgücünden tasarrufu ve doğru zaman yönetimini sağlayan araçlara ihtiyaç duyulmaktadır. Dronlar, kolay kullanılabilirliği ve basit teknik yapıda olması sayesinde tarım alanlarında değerlendirilebilecek en uygun teknolojik araçlar arasında yer almaktadır. Sahip oldukları yüksek çözünürlükteki kameralar ve sensörler ile tarım faaliyetleri için yetiştiricilere kaçınılmaz imkanlar sunmaktadır. Bitki türlerini ayırt etme, ürünlerin gelişimini izleme, hastalık ve zararlı tespiti, hasar tespiti, rekolte tespiti, alan yönetimi, tarımsal sigortalama ve tarımsal organizasyon gibi birçok uygulama dron sistemleri ile yürütülebilmektedir. Hava ve çevre koşullarının kötü olduğu zamanlarda bile dron sistemlerinin kullanılabilir olması, alışlagelmiş eski yöntemlerin geride bırakılmasına ve tarımda ileri düzeyde gelişmeler yaşanabileceğine işaret eder. Dron sistemleri, güvenli veri toplama, detaylı iletişim ağı sağlama ve düşük maliyetleri ile tarımda yenilikçi bir teknoloji seçeneği olarak umut vadetmektedir. Kullanım alanlarının genişliği ile de dron sistemlerinin ileri zamanlarda popülerliğini koruyacağı düşünülmektedir. Sürdürülebilir tarımın geleceği için vazgeçilmez faktörlerden olacağı düşünülen drone sistemlerinin tarım alanlarında hızlı bir şekilde yaygınlaştırılmasına yönelik teşvik ve tanıtım çalışmaları artırılmalıdır.

Anahtar Kelimeler: Dron, İHA, tarım teknolojisi, sürdürülebilir tarım



USE OF DRONE TECHNOLOGY IN AGRICULTURAL AREAS

ABSTRACT

Rapidly developing technology has caused a digital transformation race between countries. With the development of fully automated integrated smart systems, machine-human and machine-machine interaction have increased. With the integration of information technologies with agriculture, new technological terms have started to be heard more rapidly in today's world. In order to increase the quality and efficiency in agriculture, it is necessary to follow up on plant cultivating and livestock regularly and to make the necessary practices for breeding at the right time. For this reason, in order to benefit from developing technology, tools that provide labor saving and accurate time management are needed in the agricultural sector. Drones are among the most suitable technological tools that can be used in agricultural areas, thanks to their easy use and simple technical structure. They offer unavoidable opportunities to growers for agricultural activities with their high-resolution cameras and sensors. Many applications such as differentiating plant species, monitoring the development of crops, disease and pest detection, damage detection, harvest detection, field management, agricultural insurance and agricultural organization can be carried out with drone systems. The fact that drone systems can be used even when the weather and environmental conditions are bad is a sign that traditional old methods are left behind and advanced developments in agriculture can be experienced. Drone systems promise as an innovative technology option in agriculture, with secure data collection, providing detailed communication network and low costs. It is thought that drone systems will maintain their popularity in the future with their wide range of usage areas. Incentives and promotional activities should be increased for the rapid spread of drone systems, which are considered to be indispensable factors for the future of sustainable agriculture, in agricultural areas.

Keywords: Drone, UAV, agricultural technology, sustainable agriculture



GİRİŞ

Hızla değişen bilim teknolojileri, ülkelerin dijital dönüşüm üzerine yarışa girmesine neden olmuştur. 4 temel unsurla şekillenen bu sürecin parametreleri; kitlesel özelleştirme ve tüketici talepleri, yeni iş modelleri ve verinin önemi, sürdürülebilirlik ve kaynak kısıtları ile kaliteli insan gücüne geçiştir. Dijitalleşme, itici güç görevi ile sanayide dönüşümün merkezinde yer almaktadır. Tam otomasyonlu ve entegre akıllı sistemlerin yaygınlaşması, makine-insan ve makine-makine etkileşimlerinin yanında, nitelikli iş gücüne olan talepleri de artırmaktadır. Bu durum, sadece sanayi sektöründe dijital dönüşüm ile oluşan yeniliklere uyum sağlayabilecek nitelikli iş gücünün yetiştirilmesi anlamına gelmemektedir. Aynı zamanda, bu iş gücünün 4. Sanayi Devrimi sonrası gereksinim duyulan bilgilere vâkıf olabilmesi adına pek çok eğitim programıyla yeniden eğitilmesini ve bilhassa, karar verici konumdaki kişilerin dönüşüm stratejisi ve anlayışına sahip olmalarını zorunlu kılmaktadır (Anonim 2017). Son on yılda dijital dönüşüm süreci dünyanın işleyişini değiştiren iletişim ve bilgi teknolojilerinde genel bir gelişimin yolunu açmıştır (Anonim 2019).

Bilgi teknolojileri; bilginin edinilmesi/üretilmesi, işlenmesi/değerlendirilmesi, kullanılması, aktarılması ve depolanmasını kapsayan geniş bir konu çerçevesine sahiptir. Bilgi kullanma ve işleme süreçlerine yönelik, çoğu araç-gereç halihazırda geliştirilmiş ve piyasada mevcut durumdadır. Bu araçlardan bazıları mikro-işlemciler, sensörler, uydular, yazılımlar ve bilgisayarlardır. Bilgi teknolojilerinin tarım ile kaynaştırılmasıyla, pek çok yeni teknik terim günümüzde duyulmaya başlanmıştır. Bu terimler; dijital tarım, hassas tarım, akıllı tarım, çiftlik idaresi ile ilgili yazılımlar ve otonom (sürücüsüz) araçlar şeklinde sıralanabilir. Bunlardan en çok kullanılan ise akıllı tarımdır. Akıllı tarım; kontrol, bilgisayar, elektronik ve veri tabanı ile hesap bilgilerinin hep birlikte değerlendirildiği gelişmiş bir sistemdir. Bu modelin bileşenleri; coğrafi bilgi sistemleri, küresel konum belirleme sistemleri, uzaktan algılama ve değişken oranlı girdi uygulama gibi temel sistemlerdir (Anonim 2019). Dronların tarımsal amaçlı kullanılması özellikle sürdürülebilir ve akıllı tarım uygulamaları açısından son derece önemlidir. Tarımsal açıdan dronlar ürün gözlemi, su kaynaklarının kontrolü, haritalama, bina ve ekipman gözlemi, verim kontrolü, su stresi kontrolü, toprak erozyonu kontrolü, hastalık, zararlı ve yabancı ot tespiti ve mücadeleleri gibi değişik alanlarda kullanılabilir (Türkseven, 2016; Özgüven, 2018; Şin ve Kadioğlu 2019).

TARIM'DA DRON KULLANIMI

Dron sistemleri, askeri tatbikatlar en başta olmak üzere yabani hayvan takibi, spor faaliyetlerinin izlenmesi, doğal afetlerin yönetimi, trafik denetimi ve tarımsal uygulamalar gibi pek çok alanda analiz veya çözümün güvenli ve hızlı olarak gerçekleştirilmesini sağlamaktadır (Merç ve Bayılmış 2011). Tarım sektöründe üretimin ve ürün kalitesinin artırılması, yetiştiriciliği yapılan bitkilerde gelişim sürecinin iyi takibine ve gerekli işlemlerin en doğru zamanda yapılabilmesine bağlıdır. Kolayca kullanılabilmesi ve basit teknik yapıları sayesinde dron sistemleri; üzerindeki kamera ve sensörler ile yüksek çözünürlükte yakaladıkları resimlerle üç boyutlu görüntü tasarlayarak tarım faaliyetlerinde çiftçilere plan yapma imkânı sunmaktadır. Dronlar ile hastalık ve zararlı tespiti, kuraklık tespiti, bitki türleri ayırma, ürün gelişimi izleme, otomatik hasat, rekolte tayini, toprak nemi sınıflandırma, meyve-sebze sınıflandırma, alan yönetimi, tarımsal sigortalama ve tarım faaliyeti organizasyonları gibi durumlara yönelik çalışmalar yapılabilir (Tan ve ark. 2015).

Dronlar mevcut kullanımlara yönelik; bitki tozlaşması kontrolü, hassas gübre planlaması, arazi ve ağaç haritalaması gibi amaçlarla kullanılabilir. Yüksek etkili sıvı gübrelerin yaprak gübresi halinde uygulanmasında da toz geçirmeyen, suya dayanıklı, tarım için geliştirilmiş



dronlar kullanılmaktadır. İlaçlama yapılması gerektiği zamanlarda traktörle yapılacak ilaçlamaya kıyas edilecek olunursa daha hızlı ve hassas bir çalışma ile dronlar ilaçlama yaparak maliyetleri düşürülebilmektedir (Şekil 1). Ayrıca yetiştiriciliği yapılan ürünler içerisinde traktör dolaşmayacağı için ürüne de zarar verilmemiş olacağı aşikardır. Böcek ve hastalık salgınlarında ilaçlama yapılacak bölgelerin dronlar ile daha önceden tespit edilecek olması, yalnızca bu bölgelere ilaç verilmesini sağlayacak ve maliyetin düşürülmesinin yanı sıra çevre koruma bakımından da büyük üstünlük oluşturacaktır (Aslan ve ark 2019). Sürdürülebilir tarımın geleceğine ışık tutan dronlar, tarımsal üretimde istenilen hedeflere ulaşmak için öncü olmaktadır. Dronlar sayesinde, tarımsal alanlarda düşük maliyette, daha doğru ve hızlı veriler oluşturulabilmektedir (Aslan ve ark 2019).

Dron sistemlerinin tarımda 5 temel kullanımı bulunmaktadır (Grassi 2014). Bunlar;

Sulama sistemi izleme: Geniş alanlarda yayılmış olan mısır gibi bazı bitkilerin belirli bir boya eriştikten sonra ihtiyaç duyduğu suyun temin edilmesi için sulama sistemleri izlenebilmektedir.

Ürün durumu izleme: Gelişmekte olan bitkilerini çiftçiler, yakın kızılötesi (NIR) veya Normalize Fark Vejetasyon İndeksi (NDVI) sensörlerine sahip dronlar ile daha etkili ve hızlı bir şekilde inceleyebilmektedir.

Değişken oranlı uygulamalar: Uydu görüntüleri veya yer tabanlı görüntülerle yapılmakta olan uygulamalarda bulunan değişken oranlı haritalar yerine dron sistemlerinde NDVI sensörlerinin kullanılmasıyla pratik ve hızlı olarak değişken oranlı haritalar hazırlanabilmektedir. Bu sayede gübre ve ilaç maliyetleri düşürülmekte ve ürün verimi artmaktadır.

Yabani ot tanımlama: Normalize fark vejetasyon indeksi sensör verilerinin ve uçuş sonrası alınan görüntülerin işlenmesi ile yabancı ot haritaları oluşturulabilmektedir. Böylece çiftçiler kolay bir şekilde sağlıklı bitkilerle büyümekte olan yüksek yoğunluktaki yabancı ot alanlarını ayırabilmektedir.

Sürü idaresi ve izlenmesi: Serbest yetiştirilen büyükbaş veya küçükbaş hayvan miktarlarının ve bu hayvanların aktivite düzeylerinin dron sistemleri ile yukarıdan izlenme olanağı bulunmaktadır (Özguven ve ark. 2020).



Şekil 1. Dron yardımı ile ilaç ve gübre uygulaması

Kaynak: <https://www.theneweconomy.com/technology/agricultural-drones-need-time-to-take-root>



Dronlar verimin artırılması, tarımın kalkındırılması, arazi kontrolünün düzenli yapılması noktasında günümüze ve geleceğe ışık tutmaktadır. Bu imkanları sağlayan dronlar çiftçilere yeni bir yaklaşım ve bakış açısıyla üretim yapma imkânı sunmaktadır.

Dronların çiftçilere sağladığı diğer bazı olanaklar şu şekilde sıralanabilir:

- Geleneksel pestisit püskürtücülerin yerine artık dron sistemleri kullanılmaktadır. Dronlar ile pestisit uygulamasının hızı, geleneksel pestisit püskürtücülerin yaklaşık 40 katı kadardır. Ayrıca akıllı sulama sistemleriyle %30-40 pestisit ve %90 su tasarrufu sağlanmaktadır.
- Dronlar büyük ölçekli arazilerde iş yükü ve gereken süreyi azaltıp verimliliği artırmaktadır. Ayrıca bu arazilerde riskleri öngörerek daha güvenilir ve kesin bilgileri vermekte, ürün kalitesini optimum düzeye ulaştırmaktadır.
- Topoğrafya durumları nedeniyle çalışılması zor olan ve erişilemeyen alanlarda ya da görsel kapsamı az olan alanlarda dronlar ekonomik olarak etkin bir şekilde izlenebilirliği sağlamaktadır.
- Dron sistemleri ile güvenilir ve tartışmasız sonuçlar elde edildiği için bilimsel araştırmalarda bu sistemler rahatlıkla kullanılabilir. Dronlar; kapsamlı iletişimleri, düşük maliyetleri ve güvenilir veri toplamaları ile umut vadeden teknolojik ürünlerdir. Kötü hava ve çevre şartlarına rağmen dronların istikrarlı ve kolay bir şekilde kullanılabilmesi, konvansiyonel yöntemlerin geride bırakılarak tarımda kayda değer ölçülerde ilerleme yaşanabileceğinin kanıtıdır. Kullanım alanları ve yapılmasına imkân sağladığı tüm araştırmalar, dronların gelecekte de kullanılacağına ve devamlı olarak gündemde kalacağına işaret etmektedir (Aslan ve ark 2019).

SONUÇ

Dijital teknolojilerin tarım uygulamalarında kullanılması, maliyetlerin azalmasına, ürün verimlerinin artmasına, daha az ürün kaybına, yakıt, su ve gübrelerin minimum kullanılmasına yol açmaktadır. Tüketiciler açısından bu durum daha kaliteli ve ucuz ürünler anlamına gelmektedir. Global rekabetçilik indeksinde, özellikle eğitim ve inovasyon alanlarında yukarı sıralarda bulunan ülkeler, başarılarını tarımda akıllı sistem uygulamaları ile yansıtmışlardır. Bu sayede tarım ürünleri ve teknolojilerinde önemli birer ihracatçı konumuna gelmişlerdir. Bu ülkelerin yaşadığı tecrübeler şunu göstermiştir ki, tarım çok kapsamlı politikalarla desteklenmesi gerekli olan önemli bir sektördür. Artan dünya nüfusunun ve anî iklim değişikliklerinin sonucunda tarıma daha profesyonel yaklaşmak gerekmektedir. Tarım sektörü, eski metotlarla üretim yapılan, devamlı olarak devletin teşviklerine bağımlı olan, verim kapasitesi düşük bir sektör değil, yüksek teknolojilerin kullanılabilirdiği, verim ve maliyet yönünden kârlı ve teknolojik gelişmelere açık gelişmelerle öne çıkarılmalıdır. Yüksek teknolojiye sahip tarım modelleri için özellikle ölçek ekonomilerinin oluşturulması gerekmektedir. Bu yüksek teknolojinin önemli parametrelerinden olan dron teknolojisi de ülkemiz için tanıtılması ve yaygınlaşması gereken en önemli teknolojik gelişmelerdendir.



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PRODUCTIVITY OF EXPRESS SUN OIL-BEARING SUNFLOWER (*HELIANTHUS ANNUUS* L.) BY INFLUENCE OF SOME HERBICIDES, HERBICIDE TANK MIXTURES AND HERBICIDE COMBINATIONS

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ABSTRACT

During the period 2018 - 2020 a field experiment was carried out with the oil-bearing sunflower hybrid P64LE121 (*Helianthus annuus* L.). It is a sulfo tolerant hybrid by ExpressSun technology. A total of 25 variants were investigated. They included untreated control, 2 herbicides: Fluence SG and Evorelle express; 10 herbicide tank mixtures: Fluence SG + Fusilade forte 150 EC, Fluence SG + Targa max, Fluence SG + Shogun 100 EC, Fluence SG + Stratos ultra, Fluence SG + Centurion super, Evorelle express + Fusilade forte 150 EC, Evorelle express + Targa max, Evorelle express + Shogun 100 EC, Evorelle express + Stratos ultra, Evorelle express + Centurion super; 10 herbicide combinations: Dual gold 960 EC + Fluence SG, Indipen SC + Fluence SG, Fen 24 EC + Fluence SG, Pledge 50 WP + Fluence SG, Modown 4 F + Fluence SG, Dual gold 960 EC + Evorelle express, Indipen SC + Evorelle express, Fen 24 EC + Evorelle express, Pledge 50 WP + Evorelle express, Modown 4 F + Evorelle express. Herbicides Fluence SG and Evorelle express were used in addition with adjuvant Trend 90. Soil-applied combined herbicides were treated during after sowing before emergence period of the sunflower. Foliar-applied herbicides were treated during 3-4 leaf sunflower stage. The highest seed yield is obtained by herbicide tank mixture Fluence + Fusilade forte, followed by herbicide tank mixture Evorelle express + Stratos ultra. High seed yields are also obtained by use of herbicide combinations Indipen + Evorelle express and Dual gold + Fluence. The single use of foliar-applied herbicides Fluence and Evorelle express in single or double treatment, without foliar-applied antigraminaceous herbicides or soil-applied herbicides, increases yields less than herbicide tank mixtures and herbicide combinations. Increase in seed yield is due to the greatest degree of increase in indexes seeds number per head, seed weight per head and 1000 seeds weight.

Keywords: Oil-Bearing sunflower, herbicides, herbicide tank mixtures, herbicide combinations, seed yield, structural elements



INTRODUCTION

A large number of authors are studying the efficacy of a number of herbicides and herbicide combinations to combat problem weeds in different sunflower technologies (Malidza et al., 2006; Vrbnicanin et al., 2008; Suresh and Reddy, 2010; Suzer and Buyuk, 2010; Jocić et al., 2011; Knežević et al., 2011; Brighenti et al., 2012; Simić et al., 2012; Delchev, 2021). It was found that if sunflower is weedy during the first weeks after germination, the yield decreased over 40 % (Konstantinović et al., 2010).

From an economic and environmental point of view, the combination of chemical and mechanical weed control is very positive. Limiting tillage for mechanical weed control reduces the risk of soil erosion, especially in hilly areas, and reducing herbicide treatments reduces the risk of soil and water contamination (Dawoud et al., 2006; Pajić et al., 2009; Korpanov et al., 2010).

Conventional, ClearField and ClearField Plus sunflower growing technologies use a variety of antibroadleaved herbicides. At present, only one antibroadleaved herbicide is used in ExpressSun technology – herbicide Express 50 SG (Delchev, 2018 and 2020).

The purpose of this investigation was to establish the changes in the seed yield and structural elements of yield by influence of some herbicides, herbicide tank mixtures and herbicide combinations in ExpressSun oil-bearing sunflower under different meteorological conditions.

MATERIAL and METHODS

During the period 2018 - 2020 a field experiment was carried out with the oil-bearing sunflower hybrid P64LE121 (*Helianthus annuus* L.). It is a sulfo tolerant hybrid by ExpressSun technology. It was carried out a field experiment as a block method in 4 repetitions, on a 20 m² harvesting area, on pellic vertisol soil type, after durum wheat predecessor. A total of 25 variants were investigated. They included untreated control, 2 herbicides: Fluence SG and Evorelle express; 10 herbicide tank mixtures: Fluence SG + Fusilade forte 150 EC, Fluence SG + Targa max, Fluence SG + Shogun 100 EC, Fluence SG + Stratos ultra, Fluence SG + Centurion super, Evorelle express + Fusilade forte 150 EC, Evorelle express + Targa max, Evorelle express + Shogun 100 EC, Evorelle express + Stratos ultra, Evorelle express + Centurion super; 10 herbicide combinations: Dual gold 960 EC + Fluence SG, Indipen SC + Fluence SG, Fen 24 EC + Fluence SG, Pledge 50 WP + Fluence SG, Modown 4 F + Fluence SG, Dual gold 960 EC + Evorelle express, Indipen SC + Evorelle express, Fen 24 EC + Evorelle express, Pledge 50 WP + Evorelle express, Modown 4 F + Evorelle express. Active substances of preparations and their doses are shown in Table 1. Soil-applied combined herbicides were treated during after sowing before emergence period of the sunflower. Foliar-applied herbicides were treated during 3-4 leaf sunflower stage. All of herbicides and herbicide tank mixtures were applied in a working solution of 200 l/ha. The mixing of the tank mixtures is done in tank of the sprayer. Due to of low adhesion of the herbicides Fluence SG and Evorelle express were used in addition with adjuvant Trend 90 – 0.1 %.

At ExpressSun oil-bearing sunflower maturity all plots were evaluated for seed yield and yield components – head diameter, seeds number per head, seed weight per head and 1000 seeds weight, to evaluate the influence of the herbicides, herbicide tank mixtures and herbicides combinations on sunflower seed yield and yield components. It was investigated and changes who made of the tested factors in the plant height. Analysis of variance method was used to study the influence of herbicide treatments on ExpressSun oil-bearing sunflower.



RESULTS and DISCUSSION

The weed flora present during the 3-year experiment was quite varied.

Table 1. Investigated variants

№	Variants	Active substance	Doses	Treatment period
1	Control – untreated	-	-	-
Herbicides				
2	Fluence SG	tribenuron-methyl	40 g/ha	3-4 leaf
3	Fluence SG	tribenuron-methyl	20 g/ha + 20 g/ha	3-4 leaf 7-8 leaf
4	Evorelle express	tribenuron-methyl + thiphensulfuron-methyl	60 g/ha	3-4 leaf
5	Evorelle express	tribenuron-methyl + thiphensulfuron-methyl	30 g/ha + 30 g/ha	3-4 leaf 7-8 leaf
Herbicide tank mixtures				
6	Fluence SG + Fusilade forte 150 EC	tribenuron-methyl fluzifop-P-butyl	40 g/ha 1.30 l/ha	3-4 leaf 3-4 leaf
7	Fluence SG + Targa max	tribenuron-methyl quizalofop-P- ethyl	40 g/ha 750 ml/ha	3-4 leaf 3-4 leaf
8	Fluence SG + Shogun 100 EC	tribenuron-methyl propaquizafop	40 g/ha 800 ml/ha	3-4 leaf 3-4 leaf
9	Fluence SG + Stratos ultra	tribenuron-methyl cycloxydim	40 g/ha 2 l/ha	3-4 leaf 3-4 leaf
10	Fluence SG + Centurion super	tribenuron-methyl clethodim	40 g/ha 1.6 l/ha	3-4 leaf 3-4 leaf
11	Evorelle express + Fusilade forte 150 EC	tribenuron-methyl + thiphensulfuron-methyl fluzifop-P-butyl	60 g/ha 1.30 l/ha	3-4 leaf 3-4 leaf
12	Evorelle express + Targa max	tribenuron-methyl + thiphensulfuron-methyl quizalofop-P- ethyl	60 g/ha 750 ml/ha	3-4 leaf 3-4 leaf
13	Evorelle express + Shogun 100 EC	tribenuron-methyl + thiphensulfuron-methyl propaquizafop	60 g/ha 800 ml/ha	3-4 leaf 3-4 leaf
14	Evorelle express + Stratos ultra	tribenuron-methyl + thiphensulfuron-methyl cycloxydim	60 g/ha 2 l/ha	3-4 leaf 3-4 leaf
15	Evorelle express + Centurion super	tribenuron-methyl + thiphensulfuron-methyl clethodim	60 g/ha 1,6 l/ha	3-4 leaf 3-4 leaf
Herbicide combinations				
16	Dual gold 960 EC + Fluence SG	S-metolachlor tribenuron-methyl	1.5 l/ha 40 g/ha	ASBE 3-4 leaf
17	Indipen SC + Fluence SG	pendimethalin tribenuron-methyl	5 l/ha 40 g/ha	ASBE 3-4 leaf
18	Fen 24 EC + Fluence SG	oxifluorfen tribenuron-methyl	625 ml/ha 40 g/ha	ASBE 3-4 leaf
19	Pledge 50 WP + Fluence SG	flumioxazin tribenuron-methyl	80 g/ha 40 g/ha	ASBE 3-4 leaf
20	Modown 4 F + Fluence SG	bifenox tribenuron-methyl	1.5 l/ha 40 g/ha	ASBE 3-4 leaf
21	Dual gold 960 EC + Evorelle express	S-metolachlor tribenuron-methyl + thiphensulfuron-methyl	1.5 l/ha 60 g/ha	ASBE 3-4 leaf
22	Indipen SC + Evorelle express	pendimethalin tribenuron-methyl + thiphensulfuron-methyl	5 l/ha 60 g/ha	ASBE 3-4 leaf
23	Fen 24 EC + Evorelle express	oxifluorfen tribenuron-methyl + thiphensulfuron-methyl	625 ml/ha 60 g/ha	ASBE 3-4 leaf
24	Pledge 50 WP + Evorelle express	flumioxazin tribenuron-methyl + thiphensulfuron-methyl	80 g/ha 60 g/ha	ASBE 3-4 leaf
25	Modown 4 F + Evorelle express	bifenox tribenuron-methyl + thiphensulfuron-methyl	1.5 l/ha 60 g/ha	ASBE 3-4 leaf

Herbicides Fluence SG and Evorelle express were used in addition with adjuvant Trend 90 – 0.1 %.
ASBE – after sowing, before emergence



Dominant weeds that determine weeding in the sunflower fields are annual broadleaved species *Amaranthus retroflexus* L., *Amaranthus albus* L., *Chenopodium album* L., *Xanthium strumarium* L., *Polygonum aviculare* L., *Solanum nigrum* L., *Datura stramonium* L., *Abutilon theophrasti* Medic., a lesser amount *Amaranthus blifoides* W., *Hibiscum trionum* L., *Tribulus terrestris* L., *Portulaca oleracea* L.

Annual graminaceous weeds are represented by *Echinochloa crus-galli* L., *Setaria viridis* Beauv., *Setaria glauca* Beauv., *Panicum sanguinale* L. In a lesser amount are *Avena fatua* L., *Setaria verticillata* Beauv., *Echinochloa coarctata* Vas.

Perennial species in experiment are broadleaved weeds *Cirsium arvense* Scop. and *Convolvulus arvensis* L. and graminaceous weeds *Cynodon dactylon* Pers., *Agropyrum repens* L. and *Sorghum helepense* Pers. by rhizomes and by seeds.

Table 2. Influence of some herbicides, herbicide tank mixtures and herbicide combinations on sunflower seed yield (2018 - 2020)

Variants	2018		2019		2020		Mean	
	kg/ha	%	kg/ha	%	kg/ha	%	kg/da	%
Control – untreated	2070	100	1944	100	2222	100	2079	100
Herbicides								
Fluence – 40 g/ha	2443	118.0	2327	119.7	2835	127.6	2535	121.9
Fluence – 20+20 g/ha	2474	119.5	2376	122.2	2869	129.1	2572	123.7
Evorelle express – 60 g/ha	2449	118.3	2333	120.0	2840	127.8	2541	122.2
Evorelle express – 30+30 g/ha	2484	120.0	2360	121.4	2871	129.2	2574	123.8
Herbicide tank mixtures								
Fluence + Fusilade forte	2583	124.8	2475	127.3	3044	137.0	2701	129.9
Fluence + Targa max	2552	123.3	2453	126.2	3011	135.5	2672	128.5
Fluence + Shogun	2525	122.0	2372	122.0	2955	133.0	2617	125.9
Fluence + Stratos ultra	2554	123.4	2459	126.5	3022	136.0	2678	128.8
Fluence + Centurion super	2540	122.7	2401	123.5	2989	134.5	2643	127.1
Evorelle express + Fusilade forte	2556	123.5	2455	126.3	3022	136.0	2678	128.8
Evorelle express + Targa max	2552	123.3	2449	126.0	3018	135.8	2673	128.6
Evorelle express + Shogun	2521	121.8	2362	121.5	2962	133.3	2615	125.8
Evorelle express + Stratos ultra	2577	124.5	2469	127.0	3037	136.7	2694	129.6
Evorelle express + Centurion super	2525	122.0	2393	123.1	2997	134.9	2638	126.9
Herbicide combinations								
Dual gold + Fluence	2540	122.7	2413	124.1	3000	135.0	2651	127.5
Indipen + Fluence	2521	121.8	2401	123.5	2980	134.1	2634	126.7
Fen + Fluence	2476	119.6	2346	120.7	2911	131.0	2578	124.0
Pledge + Fluence	2488	120.2	2356	121.2	2942	132.4	2592	124.7
Modown + Fluence	2453	118.5	2313	119.0	2867	129.0	2544	122.4
Dual gold + Evorelle express	2511	121.3	2399	123.4	2984	134.3	2631	126.6
Indipen + Evorelle express	2542	122.8	2414	124.2	3003	135.2	2653	127.6
Fen + Evorelle express	2467	119.2	2333	120.0	2900	130.5	2567	123.5
Pledge + Evorelle express	2484	120.0	2362	121.5	2935	132.1	2594	124.8
Modown + Evorelle express	2461	118.9	2321	119.4	2871	129.2	2551	122.7
LSD 5 %	119	5.7	107	5.5	121	5.4		
LSD 1 %	135	6.5	122	6.3	138	6.2		
LSD 0.1 %	149	7.2	136	7.0	154	6.9		

Data on the influence of the herbicides, herbicide tank mixtures and herbicide combinations included in the experiment on the seed yield of oil-bearing sulfo tolerant sunflower by ExpressSun technology (Table 2) show that there is a positive correlation between biological efficacy of the herbicides, herbicide tank mixtures and herbicides combinations against weeds and sunflower seed yields.

The largest increase in seed yield was obtained by herbicide tank mixture Fluence + Fusilade forte – 129.9 % above the untreated control, followed herbicide by tank mixture Evorelle



express + Stratos ultra – 129.6 % above the control. High yields are also obtained by the other mixtures of Fluence and Evorelle express with Fusilade forte, Stratos ultra, as well as with those with herbicide Targa max. The differences between these variants are small and have not been mathematically proven. These herbicide tank mixtures have very high herbicide efficacy against all annual and perennial broadleaved and graminaceous weeds.

Seed yields are lower by herbicide tank mixtures of Fluence and Evorelle express with Shogun and Centurion super. This is due to the higher phytotoxicity of sulfo-tolerant sunflower hybrid P64LE121 after treatment with these herbicide tank mixtures.

The highest seed yields by herbicide combinations are obtained by the use of foliar-applied herbicides Fluence and Evorelle express after soil-applied herbicides Dual gold and Indipen – from 126.6 % to 127.6 % above the untreated control. In these variants, not only perennial graminaceous weeds from rhizomes can be controlled, but those germinated from seeds can be controlled.

Herbicide combinations of Fluence and Evorelle express with the soil-applied herbicides Fen and Pledge produce lower seed yields. Apart from perennial graminaceous weeds, some of annual graminaceous weeds cannot be controlled.

Herbicide combinations Modown + Fluence and Modown + Evorelle express have even lower yields. The reason for this is the lack of an antigraminaceous effect in these variants.

The single use of foliar-applied herbicides Fluence and Everelle express in a single or double treatment, without foliar-applied antigraminaceous herbicides or soil-applied herbicides, significantly increased seed yield compared to the untreated control from 121.9 to 123.8 %. This increase of yields is lower than the increase of yields by herbicide tank mixtures and by herbicide combinations. The reason for this is the lack of effective control of annual and perennial graminaceous weeds. It is therefore necessary to apply herbicides Fluence and Evorelle express as herbicide tank mixtures together with foliar-applied antigraminaceous herbicides or as herbicide combinations with soil-applied antigraminaceous herbicides.

To explain changes in seed yield of oil-bearing sunflower by ExpressSun technology were investigated some of the structural elements that determine it (Table 3). Differences in the efficacy and selectivity of the studied herbicides, herbicide tank mixtures and herbicide combinations lead to changes in the values of the indicators head diameter, seed number per head, the seed weight per head and 1000 seed weight. The differences are mathematically proven. On average for the period, the largest increase is in the indicators seed number per head, the seed weight per head and 1000 seed weight compared to weedy check is obtained by herbicide tank mixture Fluence + Fusilade forte, followed by herbicide tank mixture Evorelle express + Stratos ultra. Increasing the head diameter is less, but it is also proven mathematically. The head diameter has a lesser influence on the seed yield value. The head may be very large, but in its central circles it will contain a larger number of non-fertile, sterile seeds, which are made up only by peels. In the harvest, they are blow away by the harvester and are not involved in the formation of the economic yield.

Studied herbicide, herbicide tank mixtures and herbicide combinations have an influence on plant height. It is lowest in the untreated weedy control. This is due to competition between existing in the control weeds and sunflower plants. Eliminate the negative effect of weeds leads to an increase in plant height of the sunflower. The highest values of the indicator are by the herbicide tank mixtures of antibroadleaved herbicides Fluence and Evorelle express with antigraminaceous herbicides Fusilade forte, Stratos ultra and Targa max, followed by the



Table 3. Influence of some herbicides, herbicide tank mixtures and herbicide combinations on structural elements of the yield (mean 2018 - 2020)

Variants	Head diameter, cm	Seeds per head, number	Seed weight per head, g	1000 seeds weight, g	Plant height, cm
Control – untreated	16.0/17.8	1132.4	48.24	42.6	188.8
Herbicides					
Fluence – 40 g/ha	19.9/19.6	1330.6	66.50	49.0	201.8
Fluence – 20+20 g/ha	19.9/19.8	1339.9	66.66	49.0	202.7
Evorelle express – 60 g/ha	18.4/20.0	1380.1	66.52	48.7	202.6
Evorelle express – 30+30 g/ha	18.5/20.1	1387.4	66.71	48.9	202.8
Herbicide tank mixtures					
Fluence + Fusilade forte	19.6/21.0	1519.1	75.60	49.7	210.8
Fluence + Targa max	19.5/20.7	1514.1	74.49	49.1	209.0
Fluence + Shogun	18.8/20.1	1479.2	72.85	49.0	205.3
Fluence + Stratos ultra	19.6/20.6	1518.5	74.52	49.4	210.5
Fluence + Centurion super	19.2/20.7	1489.6	73.55	49.4	199.4
Evorelle express + Fusilade forte	19.4/20.8	1514.2	74.50	49.2	210.2
Evorelle express + Targa max	19.4/20.4	1511.6	73.37	49.0	209.1
Evorelle express + Shogun	18.7/20.1	1477.2	72.80	49.0	205.3
Evorelle express + Stratos ultra	19.5/20.9	1518.0	75.11	49.5	210.0
Evorelle express + Centurion super	19.0/20.2	1466.6	72.72	49.6	199.2
Herbicide combinations					
Dual gold + Fluence	19.2/20.4	1467.3	72.78	49.6	208.0
Indipen + Fluence	18.9/20.3	1481.2	72.86	49.2	207.8
Fen + Fluence	18.5/20.1	1387.4	66.71	48.9	202.8
Pledge + Fluence	18.8/20.5	1391.7	66.85	49.0	202.9
Modown + Fluence	18.4/20.1	1380.2	66.54	48.7	202.7
Dual gold + Evorelle express	18.7/19.5	1500.7	72.22	49.9	207.3
Indipen + Evorelle express	19.8/21.2	1520.2	73.07	48.6	208.0
Fen + Evorelle express	19.9/19.8	1339.9	66.66	49.0	202.7
Pledge + Evorelle express	18.9/20.7	1395.8	66.92	49.0	203.0
Modown + Evorelle express	18.5/20.1	1382.3	66.58	48.8	202.7
LSD 5%	1.1/1.4	68.8	6.9	3.3	6.5
LSD 1%	2.5/3.2	90.3	10.1	6.4	9.8
LSD 0.1%	5.3/6.1	110.9	15.0	10.2	13.9

herbicide combinations of soil-applied herbicides Dual gold and Indipen with foliar-applied herbicides Fluence and Evorelle express. At the herbicide tank mixtures Evorelle express + Centurion super and Fluence + Centurion super the plant height is lower. As this reduction is accompanied by an increase in seed yield compared to untreated weedy control, as a result of the high herbicide efficacy, these herbicide tank mixtures have a retardant effect rather than a phytotoxic effect. This is a further positive effect of their use as it reduces the risk of pulling down or breaking of the plants in a storm and downfall of the yield.

CONCLUSION

The highest seed yield is obtained by herbicide tank mixture Fluence + Fusilade forte, followed by herbicide tank mixture Evorelle express + Stratos ultra. High seed yields are also obtained by use of herbicide combinations Indipen + Evorelle express and Dual gold + Fluence. The single use of foliar-applied herbicides Fluence and Evorelle express in single or double treatment, without foliar-applied antigraminaceous herbicides or soil-applied herbicides, increases yields less than herbicide tank mixtures and herbicide combinations. Increase in seed yield is due to the greatest degree of increase in indexes seeds number per head, seed weight per head and 1000 seeds weight.



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SOLUCAN GÜBRESİ VE MİKROBİYOLOJİK GÜBRELERİN NOHUTTA VERİME VE BAZI VERİM ÖGELERİNE ETKİSİ

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ÖZET

Bu araştırma, 2018 yılında Muğla Fethiye koşullarında farklı mikrobiyolojik gübreler ve solucan gübresi dozlarının nohut çeşitlerinde verim ve verim öğelerine etkisinin araştırılması amacıyla yürütülmüştür. Çalışmada İnci ve Hasanbey çeşitleri kullanılmıştır. Araştırmada iki farklı mikrobiyolojik gübre (rhizobium ve bacillus) ve dört farklı solucan gübresi dozu (0 (kontrol), 250, 500 ve 750 kg/da) uygulanmıştır. Deneme bölünen bölünmüş parseller deneme desenine göre üç tekrarlamalı olarak yürütülmüştür. Kullanılan iki nohut çeşidinde farklı mikrobiyolojik gübre ve solucan gübre dozlarının bitki boyu, bitkide bakla ve tane sayısı, baklada tane sayısı, dekara verim ve hasat indeksine etkisi incelenmiştir. Çalışmanın yapıldığı yıl İnci çeşidi daha yüksek verim (139 kg/da) değerine sahip olmuştur. Bacillus bakterisi uygulamasından 141.4 kg/da verim alınırken Rhizobium bakterisi ile arasındaki fark önemsiz bulunmuştur. Solucan gübresi uygulamaları bakımından elde edilen en yüksek verim 143.3 kg/da ile 750 kg/da solucan gübresi uygulamasından alınmış olup 500 kg/da ile arasındaki fark önemsiz bulunmuştur.

Anahtar Kelimeler: Nohut, solucan gübresi, mikrobiyolojik gübre, verim, verim öğeleri

NOT: Bu araştırma, doktora çalışmasının bir bölümüdür.



THE EFFECTS OF VERMICOMPOST AND MICROBIYOLICAL MANURES ON THE YIELD AND SOME YIELD COMPONENTS IN CHICKPEA (*Cicer arietinum* L.)

ABSTRACT

The aim of this study was to research the effect of different microbial manure and vermicompost levels on the yield and yield components in chickpea cultivars under Muğla Fethiye conditions in 2018. İnci and Hassanbey chickpea cultivars were used in this study. In this research, two microbial manure (rhizobium and bacillus) and four different vermicompost levels (0 (control), 250, 500 and 750 kg/da) were applied. The study was conducted by using split-split plot design with the three replications. Effect of microbial manure and vermicompost levels, plant height, numbers of pod per plant and numbers of seed per plant, numbers of seed per pod, grain yield per plant, seed yield and harvest index were investigated for two chickpea cultivars. In the year of the study, İnci variety had a higher yield (139 kg/da). While 141.4 kg/da yield was obtained from Bacillus bacteria application, the difference between Rhizobium bacteria was found to be insignificant. In terms of vermicompost applications, the highest yield was obtained from 143.3 kg/da to 750 kg/da vermicompost application, and the difference between 500 kg/da and 500 kg/da was found to be insignificant.

Keywords: Chickpea, microbial manure, vermicompost, yield, yield components



GİRİŞ

Nohut %18-30 oranında protein içeriği (Güler ve ark., 2001) ile büyük ölçüde insan beslemesinde kullanılıp aynı zaman da vitamin ve lif içeriği yönünden ve potasyum, çinko, kalsiyum, magnezyum ve demir yönünden de oldukça zengindir. Nohut bitkisi köklerinde ortak yaşam sürdüren *Rhizobium ciceri* bakterileri aracılığı ile havanın serbest azotunu toprağa bağlayarak dekara yılda ortalama 6-15 kg arasında azot bağlar (Akçin A., 1988).

Biyolojik (Mikrobiyal) gübrelerin kültür bitkilerine çok sayıda yararı bulunmaktadır. Birçok tarla ve bahçe bitkisinde hastalık riskini ve girdi maliyetlerini azaltıp ürün verimini artırır (Arcak ve Güder, 2004).

Vermikompost terimi, solucanların kullanıldığı organik atıkları kompostlaştırma işlemi sonucunda elde edilen ürün için kullanılmakla beraber, vermikompost ürünü genelde vermikest (solucan dışkısı; gübresi) veya kısaca kest olarak adlandırılmaktadır (Edwards ve Bohlen 1996). Solucan Gübresi, simbiyotik bakteri (*Rhizobium*) ve asimbiyotik mikroorganizmalardan azot fiksasyonu yapan bakteri (Azotobakter) ve mikoriza mantarlarını içerir. Bu özellikleri ile toprağın canlı yapısına hareketlilik kazandırır. Mikroorganizmalar, toprak içinde bulunan ancak bitki tarafından alınamayan besin maddelerini parçalayarak, alınabilir hale dönüştürürler. Bu çalışma tarım ve turizm potansiyelinin çok yüksek olduğu özellikle nohut yetiştiriciliğinin yoğun olarak yapıldığı ve gerek kış gerekse yaz sezonunda eko köy hayatının benimsenerek yaşama uygulandığı yerlerden biri olan Muğla'nın Fethiye ilçesi Kayaköy mahallesinde yürütülmüş olup organik tarım uygulamalarında gerek ekim nöbetinde gerekse toprağın yapısının iyileştirilmesinde vazgeçilmez olan baklagil bitkilerinden biri olan nohutta organik yollarla üretilen farklı dozlardaki solucan gübresinin (vermikompost) ve iki farklı mikrobiyal gübrenin verim ve bazı verim öğeleri üzerine etkilerinin belirlenmesi amaçlanmıştır.

MATERYAL ve YÖNTEM

İnci: Çukurova Tarımsal Araştırma Enstitüsü tarafından tescil edilen bu çeşidin bitki boyu 63 cm, ilk bakla yüksekliği 32 cm olup makineli hasada uygundur. Tane rengi bej, tane şekli kuşbaşıdır. Bu çeşidin yüz tane ağırlığı 38-42 g ve ortalama tane verimi 210-336 kg/da'dır.

Hasanbey: Çukurova Tarımsal Araştırma Enstitüsü tarafından 2011 yılında tescil edilen bu çeşit introüksiyon metodu ile ıslah edilmiştir. Yarı dik gelişen, bitki boyu 32-86 cm, bitkide bakla sayısı 17-35 adet olan bu çeşitte taneler sarı renkte ve köşeli-yuvarlak olup 100 tane ağırlığı 43.7-46.5 g arasındadır.

Çalışmada nohut cinsinde etkili olan azot fikse eden bakteri olarak *Rhizobium ciceri*, fosfat çözücü bakteri olarak ise *Bacillus megaterium* kullanılmış olup, *Rhizobium* bakterisi Ankara Toprak ve Gübre Araştırma Enstitüsü'nden, *Bacillus megaterium* bakterisi ise Atatürk Üniversitesi Ziraat Fakültesi Bitki Koruma Bölümünden temin edilmiştir. Ayrıca % 2 N, % 1 P₂O₅, % 1 K₂O, %3 Ca içeren vermikompost (solucan gübresi) kullanılmıştır.

Denemenin kurulduğu bölgede uygun derinlikten alınan toprak örneklerinin bazı fiziksel ve kimyasal özelliklerin analiz sonuçları Çizelge 1'de verilmiştir.

Çizelge 1. Deneme alanı topraklarının bazı fiziksel ve kimyasal özellikleri

Derinlik (cm)	Tekstür Sınıfı	pH (1:2.5 su)	Kireç (%)	Fosfor (ppm)	Potasyum (me/100g) (%)	Organik Madde (%)	Toplam Tuz	Çinko (ppm)
0-20 cm	Killi-Tın	7.40	7.60	12.92	83.98	2.627	0.011	0.249



Toprak analiz sonuçlarına göre, araştırma alanından alınan toprak örneği killi-tınlı bünyeli, hafif alkali özellik gösteren, organik madde içeriği orta, kireç içeriği bakımından zengin, hafif tuzlu, potasyum ve fosfor içeriği orta, çinko içerikleri bakımından yetersiz özellikler taşıdığı belirlenmiştir.

Araştırmanın yapıldığı bölgenin, uzun yıllar ortalamasına ilişkin toplam yıllık yağış miktarı 170.3 mm. ve ortalama sıcaklık 20.64 °C, ortalama nispi nem %63.32' dir. 2018 yılı yetiştirme sezonunda düşen yağış miktarı 118.6 mm mm'dir. Ortalama sıcaklık 23.08 °C'dir (Çizelge 2). Ortalama nispi nem miktarı % 61.6 olarak gerçekleşmiştir (Anonim, 2019).

Çizelge 2. Muğla ili Fethiye ilçesinde yetiştirme dönemine ait 2018 yılı ve uzun yıllar ortalaması iklim verileri

Aylar	Yağış (mm)		Ort. Sic. (C°)		Nispi nem (%)	
	2018	UYO	2018	UYO	2018	UYO
Mart	67.2	84.9	15.5	13.2	70.3	67.3
Nisan	6.2	43.3	19.5	16.4	62.2	67.1
Mayıs	28.2	28.3	23.9	20.6	59.9	65.4
Haziran	17.0	5.3	26.4	25.1	61.7	59.4
Temmuz	-	8.5	30.1	27.9	51.4	57.4
Toplam	118.6	170.3				
Ort.			23.08	20.64	61.6	63.32

Bu çalışma Muğla ili Fethiye ilçesi Kayaköy mahallesinde yazlık olarak 2018 yılında yürütülmüştür. Araştırmanın yapıldığı Muğla ili Türkiye'nin güneybatı ucunda yer alır. Denemenin kurulduğu Kayaköy Mahallesi Fethiye ilçe merkezinden 146 m yükseklikte, 36° 34' kuzey enlemi ve 29° 5' doğu boylamında yer almaktadır. Araştırma Muğla ili Fethiye ilçesi Kayaköy mahallesinde çifçiye ait arazide yürütülmüştür. Araştırmada iki nohut çeşidi (İnci ve Hasanbey), iki farklı bakteri (Azot fikse eden *rhizobium* bakterisi (*Rhizobium ciceri*), fosfat çözücü bakteri (*Bacillus megaterium*)), dört farklı solucan gübresi dozunun (0 (kontrol), 250, 500 ve 750 kg/da) verim ve verim öğeleri üzerine etkileri araştırılmıştır. Denemeler tesadüf bloklarında bölünen bölünmüş parseller deneme desenine göre üç tekerrürlü olarak yürütülmüş; ana parsellerde çeşitler, alt parsellerde bakteri çeşitleri ve altın altı parsellerde ise solucan gübresi dozları olacak şekilde denemeler kurulmuştur. Denemeler 72 parsel olacak şekilde kurulmuştur. Her parsel 5 sıradan oluşturulmuş, parsellerde sıra arası 30 cm, parsel alan; 1.5 m x 5 m = 7.5m² olacak şekilde planlanmıştır. m²'ye 60 tohum denk gelecek şekilde parselde atılacak tohumluk miktarı belirlenmiştir. Denemede kullanılacak *Rhizobium ciceri* bakterileri buzdolabında bekletilmiş, ekimden birkaç saat önce gölge yerde tohumlar şekerli su ile ıslatılmış daha sonra bakteri kültürü ile iyice karıştırılarak tohumlara bulaşması sağlanmıştır. Laboratuvar şartlarında çoğaltılan *Bacillus megaterium* bakterisi ise ekim öncesinde tohuma uygulanmıştır. Denemede kullanılan nohut çeşitlerine dekara 0 (kontrol), 250, 500 ve 750 kg denk gelecek şekilde solucan gübresi ekimden önce toprağa uygulanmıştır. Ana parsellere çeşitler, alt parsellere ise uygulamalar gelecek şekilde düzenleme yapılmıştır. Hasatta parseli oluşturan 5 sıradan her iki yandaki birer sıra ve sıra başlarından 50 cm içerisinde bulunan bitkiler kenar tesiri olarak gözlem dışı bırakılarak bütün işlemler 0.9 m x 4 m = 3.6 m²'lik alanlar içerisinde tesadüfi olarak seçilen 10'ar adet bitki üzerinden elde edilen veriler kullanılmıştır. Ekim işlemi 17.03.2018 tarihinde markörle çiziler açmak sureti ile elle yapılmıştır. Hasat işlemi 06.07.2018 tarihinde yapılmıştır.



BULGULAR ve TARTIŞMA

Elde edilen değerler varyans analizine tabi tutulmuştur. İncelenen karakterler bakımından faktör seviyeleri ortalamaları “Duncan (%5) Testi”ne göre uygulanmıştır.

Çalışmanın yapıldığı yılda İnci ve Hasanbey nohut çeşitlerinden elde edilen bitki boyu ortalama değerleri sırasıyla 2018 yılında 43.3-41.4 cm olarak bulunmuştur (Çizelge 1). Çalışmada uygulanan bakteri türlerinden elde edilen bitki boyu değerleri 2018 yılında 41.4-43.1 cm, arasında değişmiştir. 2018 yılında 500 kg/da solucan gübresi uygulaması ile 750 kg/da solucan gübresi uygulaması arasındaki fark istatistiksel olarak önemsiz bulunmuştur. Karaköy (2008) iki nohut çeşidi (İnci, İzmir-92) ve 43 yerel nohut genotipi ile Adana’da yaptığı çalışmada bitki boyunun 60.1-70.5 cm arasında değiştiğini bildirmişlerdir. Bajracharya ve Rai (2009), Nepal’da yürüttükleri saksı denemelerinde, solucan gübresinin toprağa eşit oranda uygulandığında nohutun bitki boyuna olumlu etkileri olduğunu ortaya koymuşlardır. Altınkaynak (2019), Fethiye Kayaköy’de İnci nohut çeşidi ile Rhizobium aşılması ve farklı organik gübre kaynakları uygulamaları yaptığı çalışmasında en yüksek bitki boyunun bakteri aşılması yapılan ve tavuk gübresi uygulanan parsellerden 55.2 cm olarak ölçüldüğünü, en düşük değer ise kontrol parselinden 39.1 cm olarak alındığını bildirmiştir (Çizelge 1).

Çizelge 3. 2018 yılında nohut çeşitlerinde mikrobiyolojik gübre ve solucan gübre dozlarının incelenen özelliklerdeki ortalamaları ve oluşan grupları

İncelenen Özellikler	Çeşit		Mikrobiyolojik Gübreler			Solucan Gübre Dozları			
	İnci	Hasanbey	Kontrol	Rhizobium	Bacillus	0 kg/da	250 kg/da	500 kg/da	750 kg/da
Bitki boyu (cm):	43.35 a	41.47 b	41.40 b	42.74 a	43.07 a	42.13 b	41.96 b	42.62ab	42.93 a
Bitkide bakla sayısı (adet/bitki)	13.76	14.37	13.61 c	14.09 b	14.50 a	12.76 c	14.40 b	14.98 a	14.12 b
Bitkide tane sayısı (adet/bitki)	15.93	16.51	15.69 b	16.32 a	16.65 a	14.72 c	16.81 a	17.70 a	16.17 b
Baklada tane sayısı (adet/bakla)	1.15	1.14	1.15	1.15	1.14	1.15	1.16	1.14	1.13
Birim alan tane verimi (kg/da)	139.7 a	134.5 b	130.9 b	139.0 a	141.4 a	124.1 c	139.0 b	142.0 a	143.3 a
Hasat indeksi (%)	25.5 b	25.8 a	25.7 b	26.2 a	25.1 c	25.6 b	27.1 a	25.5 b	24.5 c

Bitkide bakla sayısı yönünden çalışmada çeşitler arasındaki ortalama değerler 13.76-14.37 adet/bitki arasında değişmiştir. Mikrobiyolojik gübrelerde en yüksek değer 14.5 adet/bitki ile Bacillus uygulamasından en düşük değer 13.61 adet/bitki ile kontrolde bulunmuştur. Solucan gübre dozları 12.76-14.98 adet/bitki arasında değişmiştir. En yüksek değer 14.98 adet/bitki ile 500 kg/da solucan gübre dozu uygulamasında tespit edilmiştir. Karahan ve Şehirali (1999), bakteri kültürü ile aşılama ve gübre uygulaması bitkide bakla sayısının kontrol işlemine göre önemli derecede artışlara neden olduğunu, tane verimi bağımlı değişken seçilerek yapılan path analizi sonucunda tane verimi doğrudan ve olumlu yönde etkileyen unsurların bitkide bakla sayısı ve 100 tane ağırlığı olduğunu bildirmişlerdir. Mikrobiyal, organik ve inorganik gübre uygulamaları ile ilgili olarak bitkilerde yapılan çalışmalarda; Kaya ve ark., (2007), organik ve ticari gübrenin nohut bitkisi üzerindeki etkisi üzerine yapmış oldukları çalışmada, en düşük bitkide bakla sayısının kontrol parsellerinden (11.7 adet) elde edildiğini, bunu ticari gübre



uygulamasının (15.2 adet) takip ettiğini ve organik (slempe) gübre uygulamasından en yüksek (17.1 adet) değerlerin elde edildiğini bildirmişlerdir.

Çalışmada bitkide tane sayısı özelliği yönünden İnci ve Hasanbey nohut çeşitlerinden elde edilen bitkide tane sayısı ortalama değerleri 15.93- 16.51 adet/bitki arasında tespit edilmiştir. Mikrobiyolojik gübrelere en yüksek değer 16.65 adet/bitki ile Bacillus uygulamasından en düşük değer 15.69 adet/bitki ile kontrolde bulunmuştur. Solucan gübre dozlarında ise en yüksek değer 17.70 adet/bitki ile 500 kg/da solucan gübre dozu uygulamasından en düşük değer 14.72 adet/bitki ile 0 kg/da solucan gübre dozu uygulamasından bulunmuştur. Kaya ve ark. (2007), organik (slempe) ve ticari gübrenin nohut bitkisi üzerindeki etkisini inceledikleri çalışmada, bitkide en düşük tane sayısının kontrol parsellerinden (14.3 adet) elde edildiğini, bunu ticari gübre (17.6 adet) uygulamasının takip ettiğini ve bitkide en yüksek bakla sayısının ise (19.9 adet) organik (slempe) gübre uygulamasından elde edildiğini bildirmişler, Amin ve Moghadasi (2015) solucan gübresi ve azotlu gübre uygulamalarının nohut bitkisinde tane sayısı üzerine etkisinde ise en düşük değerlerin kontrol parsellerinden elde edildiğini, bunu azotlu gübre uygulamalarının takip ettiğini ve en yüksek değerlerin ise solucan gübresi uygulamasından elde edildiğini bildirmişlerdir.

Baklada tane sayısı özelliği açısından istatistiki olarak uygulamalar önemli şekilde etkilenmemiştir. Değerler 1.13-1.15 adet/bakla arasında değişmiştir. Baklada tane sayısı çeşitlerin genotipine bağlı bir özelliktir. Nohutta baklada tane sayısı çevre koşullarından çok az etkilenmektedir (Sepetoğlu, 1992). Baklagillerde baklada tane sayısının kalıtım derecesi yüksek olduğundan ekolojik çevreden daha az etkilenmektedir (Çiftçi ve Şehirli, 1984). Bu nedenle uygulamalar arasındaki farklar genelde önemsiz bulunmuştur.

Denemenin yürütüldüğü yılda İnci ve Hasanbey nohut çeşitlerinden elde edilen dekara verim ortalama değerleri 139.8-134.5 kg/da tespit edilmiştir. Bakteri uygulamalarından elde edilen dekara verim değerleri 130.9-141.5 kg/da olarak gerçekleşmiştir. En düşük değerler bakteri uygulaması yapılmayan kontrol parsellerinden elde edilmiştir. Solucan dozları uygulamalarından elde edilen genel dekara verim ortalamaları 124.1-143.3kg/da arasında değişmiştir. Dinç (2015), Van koşullarında yürüttüğü nohut adaptasyon çalışmasında İnci çeşidinden ortalama 60.20 kg/da, Hasanbey çeşidinden ise 86.20 kg/da birim alan verimi aldığını ifade etmiş olup araştırmacının bulguları bu çalışmada alınan verim bulgularından düşük bulunmuş olup, iki çalışma arasındaki verim farkının iklim ve uygulama tekniklerinin farklı olmasından kaynaklandığı düşünülmektedir. Kumar ve ark. (2014), Hindistan koşullarında solucan gübresi, biyogübreler ve kimyasal gübrelerin kombinasyonlarının nohuttaki etkilerini tespit etmek amacıyla yaptıkları çalışmada *Rhizobium*, fosfat çözücü bakteri, solucan gübresi ve kimyasal gübre uygulaması yapmışlar ve en yüksek tane verimi ve (kimyasal gübre + 5 t/ha solucan gübresi + *Rhizobium* + fosfat çözücü bakteri) kombinasyonundan elde ettiklerini bildirmişlerdir.

Çalışmada hasat indeksi özelliği yönünden İnci ve Hasanbey nohut çeşitlerinden elde edilen bitkide tane sayısı ortalama değerleri %25.5-25.8 arasında olduğu tespit edilmiştir. Mikrobiyolojik gübrelere en yüksek değer % 26.2 ile *Rhizobium* uygulamasından en düşük değer %25.7 ile kontrolde bulunmuştur. Solucan gübre dozlarında ise en yüksek değer %27.1 ile 250 kg/da solucan gübre dozu uygulamasından en düşük değer %25.6 ile 0 kg/da solucan gübre dozu uygulamasından bulunmuştur. Rudresh ve ark. (2005), araştırmacıların çalışmalarından elde etmiş oldukları sonuçlar ile elde ettiğimiz bulgular benzerlik göstermektedir.



SONUÇ VE ÖNERİLER

Çevre dostu baklagil bitkilerinden biri olan nohutun organik kökenli gübrelerle yetiştirilmesi organik gübrelerimizin doğru değerlendirilmesi, çevre kirliliğinin önüne geçilmesi, topraklarımıza organik gübre kazandırılması ve çok önemli ve kaliteli protein kaynağı elde edilmesi bakımından tavsiye edilmektedir. Çalışma sonucunda bölgede, çeşit, mikrobiyolojik gübre ve solucan gübresi uygulamalarının nohutta verim ve verim öğeleri ile yakın ilişkili karakterlerde önemli artışlar sağladığı belirlenmiştir. Sonuç olarak Muğla ve çevresinde her iki nohut çeşidi de ümit var olup toprak analizi sonuçlarına göre bakteri aşılama ve solucan gübresi uygulamaları önerilebilir.



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TENSILE STRESS-STRAIN CURVE FOR TREATED SUGAR PALM FIBER/ GLASS FIBER REINFORCED POLY(LACTIC ACID) HYBRID COMPOSITE

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ABSTRACT

The paper aims to discuss the tensile stress versus strain curves for treated sugar palm fibre (SPF)/glass fibre (GF) reinforced poly(lactic acid) (PLA) hybrid composite. The treatment of sugar palm fibres was considered in an alkaline solution. Constant weight was considered as a portion of 30% total fibre load and 70% poly(lactic acid). These composites were first prepared by a Brabender plastographer from followed by a hot compression moulding. The result reported that the best tensile curve was recorded after alkaline treatment of SPF for 20/10/70wt% SPF/GF/PLA hybrid composites. Good interfacial bonding between SPF/GF and PLA matrix after alkaline treatment. These treated SPF/GF/PLA hybrid composites could be suitable for fabricating automotive parts.

Keywords: Tensile stress-strain curve, sugar palm fiber, poly(lactic acid) hybrid composite, alkaline treatment



1.0 INTRODUCTION

Recently, there has been increased interest in the utilisation of renewable resources and biodegradable products because of the aim of environmentally friendly customers to save the earth [1]. Many major industries, especially fibre-rich plants, are focused on the creation of natural polymeric materials. Due to this trend, natural fibres are used in polymer composites rather than synthetic fibres. In the development of hybrid composites, both natural and synthetic fibres are used. This combination has excellent structural and mechanical characteristics [2]. Due to the biodegradability derived from natural sources, it gets useful to transform poly(lactic acid) (PLA) and sugar palm fibres into composites [3]. Previous work has shown desirable features with lower cost for good basic mechanical properties for natural fibre-reinforced polymer composites [4]. Composite research into natural polymer fibre is the main challenge of the plant's fibre hydrophilicity. This has led to numerous studies investigating the extent to which fibre-plasticising or surface modification increase interfacial bonding [4–7]. Because of the incompatibility between natural hydrophilic fibres and the hydrophobic polymer matrix, the main challenge is the adhesion between fibre and matrix. This difficulty is partly resolved by the chemical treatment of the surfaces of fibres. Alkaline treatment is one of the most used treatments. The alkaline treatment of natural fibres offers many benefits, for instance, low cost, effective surface modifications, improved mechanical properties and the production of rough fibre surface [8,9]. There are many studies towards alkaline treatments for improving the surfaces of fibres [10–13]. The reduction in hydrophilic character after treatment of fibre makes the fibre compatible with hydrophobic glass fibres and unsaturated polyester matrix which provide better adhesion [9]. This study deal to find the tensile stress versus strain curve for 6% alkaline treated SPF with glass fibre reinforced polylactic acid.

2.0 MATERIALS and METHODS

2.1 Materials

Sugar palm fibres (length of fibre up to 1.19m, average diameter 0.5 mm, and the density of raw sugar palm fibre 1.2-1.3gm/cm³) were purchased from Kampung Kuala Jempol, Sembilan, Malaysia. The poly(lactic acid) (density 1.25gm/cm³ at 21.50C, yield tensile strength is 52MPa and melting point of PLA is 170⁰C), benzoyl chloride with reagent plus 99%, ethanol and E-glass fibres (density 2.53gm/cm³) were provided by Mecha Solve Engineering, Petaling Jaya, Selangor, Malaysia. Sodium hydroxide (NaOH) pellet was delivered by Evergreen Engineering and Services the used in this study.

2.2 Preparation of sugar palm fibres

The sugar palm fibres bundle was crushed by the crusher machine. The dry SPF has been crushed to 10 mm to 15 mm by the use of the crusher machine. The fibres are then washed several times with water to remove contaminants added to the SPFs. The SPFs were kept outside, then dried for 24 hours in an air-circulating oven at 60 °C. The SPFs were modified with the purpose of improving fibre-matrix bonding.

2.3 Alkaline treatment

Alkaline treatment of SPFs has been used. The 50-gram crushed sugar palm fibres (SPFs) have been immersed in alkaline treatment at 6%w/v of the alkaline 1litre solutions, at room temperature for 1 hour. During the soaking period, a magnet stirrer was used for the appropriate treatment. This solution was supplemented with acetic acid until a neutral pH was established. SPFs were then again washed and dried in an oven at 60 °C for 24 hours with purified water and put into plastic bags of zipper.



Table 1. Formulation of hybrid composites

No. of Samples	Matrix PLA (wt %)	Reinforcement	
		SPF Treatment	GF (wt %)
S1	70	6% NaOH	10
S2	70	6% NaOH	15
S3	70	6% NaOH	20

2.4 Preparation of SPF/GF/PLA biocomposites

The treated sugar palm/glass fibres and poly(lactic) acid were mixed in a Brabender plastograph, at 160 °C, for 10 minutes at a rate of 50 rpm, to achieve uniform mixing. Then a crushing machine crushed these mixed samples. The crushed composite samples were then stored 24 hours before hot pressing in an electric oven at 60 °C. For hot-press moulding, a 40-tonne Compression Molding Techno Vation Machine was used. The samples were preheated at 170 °C for 7 minutes before pressed for 6 minutes. Three vent cycles existed. The cold-pressed time at 25 °C was six minutes. The above settings have been utilised to remove voids in the compression moulding. Table 1 shows the formulation of SPF/GF/PLA hybrid composites with 30% total fibre load and 70% poly(lactic acid).

3.0 CHARACTERISTICS OF SPF/PLA COMPOSITES

3.1 Tensile test

A tensile test in accordance with the ASTM standard [14] was done using an Instron3366 Universal Testing Machine (UTM). The composite samples were measured in length of 80mm and the crosshead speed was 2 mm/min using a load cell of 5KN. A total of 3 samples measuring 150mm x 25mm x 3mm were examined for the SPF/GF reinforced poly(lactic acid) (PLA) composites. The final result was based on the three samples averaged.

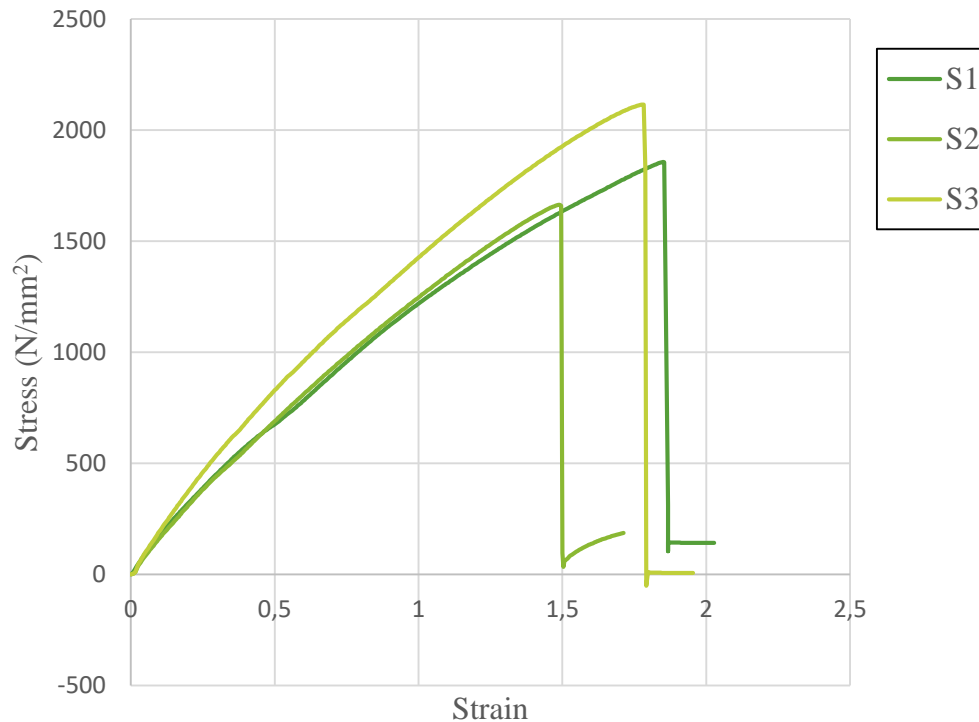


Figure Universal testing machine for tensile testing of Treated SPF/GF/PLA hybrid composite

4.0 RESULTS and DISCUSSION

4.1 Tensile testing

The stress-strain curve measures the relationship between the magnitude of the stress applied to the material and the strain or elongation generated. Since stress-strain curves show a small non-linear response, indicating that there are reductions in modulus of elasticity before fracture. These reductions of modulus of elasticity reflect drops in stiffness of the composite [15]. The tensile test results confirmed that, compared to S1 and S2, the S3 composite exhibited the highest tensile strength, which may be due to the limitation of the mobility and deformability of the matrix. Ultimate stress and the fracture points are visible from the stress-strain plot shown in Figure 1. Since S3 have maximum treated SPF among all composites, therefore this shows that sugar palm fibre treatment improved the tensile strength and permitted greater bonding between the fibre and PLA matrix after the removal of lignin and hemicellulose components [8]. All the stress rises at the beginning with strain linearly before instant loading due to the last and fractures follows the highest value. The curve shows the composite moves very quickly from elastic to plastic behaviour which shows the brittle behaviour of the composite. It also indicates the stress-strain plot for a higher percentage of E-glass (S1 composite) shows the lowest tensile property. It can be clearly seen from the curve that the composite material is brittle when it suddenly reaches the breaking point without any sign of neck formation. A similar curve of stress-strain was revealed by Jenarathanan [16] for E-glass and coconut fibre reinforced polymer matrices composites.



This increase in stress of the composite was due to improved wettability, minor voids, less microscopic cracking which caused better adhesion between sugar palm fibre/GF and PLA matrix [17]. This study concludes that glass hybridization can switch the composite towards the brittle nature, while the alkaline treatment of SPF contents increases the tensile property of hybrid composite improved. The tensile stress that shows the compatibility between treated fibre, glass fibre and polylactic acid improved after adding more alkaline treated SPF. This is because SPF treatment removes contaminants, lignin, and hemicellulose, also increase surface roughness, which helps in improving the adhesion of the fibres to the matrix.

CONCLUSIONS

This study conclude that glass hybridization can switch the composite towards the brittle nature, while increasing the contents of alkaline treatment SPF, the tensile property of hybrid composite improved. Results show that improvement of tensile stress after alkaline treatment of sugar palm fibre and hybridization of glass fibre. The best tensile stress versus strain curve was shown by S3 which is having a maximum percentage of treated sugar palm fibre. The compatibility of SPF, glass fibre and polylactic acid improved the tensile stress increases when additional alkaline treated SPF has been added. SPF treatment eliminates impurities, lignin and hemicellulose and also increases surface roughness that helps improve the matrix adhesion of the fibres. This hybrid composite can be used for automotive applications



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THEILERIA ANNULATA'YA KARŞI AŞILANAN BESİ SİĞIRLARINDA KARACİĞER VE BÖBREK FONKSİYONLARI ÜZERİNE VİTAMİN C'NİN ETKİSİ

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ÖZET

Bu çalışmada *T. annulata*'ya karşı aşılanan sığırlarda karaciğer ve böbrek fonksiyonlarında herhangi bir değişim olup olmadığını ve aşı uygulamasıyla beraber C vitamini takviyesinin bu duruma etkisini araştırmak amaçlanmıştır. Araştırmanın materyalini aynı bakım ve beslenme şartlarında tutulan yaklaşık 2 yaşındaki 20 adet Montofon ırkı besi sığırı oluşturmuştur. Bu sığırlar her grupta 10 sığır olacak şekilde 2 gruba ayrılmış (deney ve kontrol grubu) ve deney grubuna 2.5 ml *T. annulata* aşısı boyun derisi altına tek doz olarak uygulanmıştır. Deney grubundaki sığırlara ayrıca bu aşının uygulaması sırasında da 20 ml C vitamini (ml'de 250 mg askorbik asit içeren) damar içi yolla tek doz olarak yapılmıştır. Kontrol grubuna ise sadece 2.5 ml dozunda *T. annulata* aşısı boyun derisi altına uygulanmıştır. Çalışmadaki sığırların V. jugularis'lerinden tekniğine uygun olarak aşılama esnası (0. gün) ve aşılama sonrası 3., 14. ve 21. günlerde 10'ar ml K3EDTA'lı ve antikoagülanatsız kan örnekleri alınmış, 5000 rpm'de 5 dk santrifüj edilerek plazma ve serumları çıkarılmıştır. Karaciğer ve böbrek fonksiyonlarını değerlendirmek adına bazı biyokimyasal parametrelerin (AST, ALP, GGT, total protein, total bilirubin, direk bilirubin, trigliserid, kan üre azotu (BUN) ve kreatinin) düzeyleri ticari test kitleri yardımıyla otoanalizör kullanılarak belirlenmiştir. Sonuçta, aşılama sonrası sığırların karaciğer ve böbrek fonksiyonlarında bir takım değişimlerin ortaya çıktığı ancak bu değişimlerin geçici olduğu ve aşılama sırasında sığırlara eksojen vitamin C uygulamalarının da bu olumsuz etkileri azalttığı sonucuna varılmıştır.

Anahtar Kelimeler: Sığır, aşılama, karaciğer, böbrek, vitamin C



THE EFFECT OF VITAMIN C ON LIVER AND KIDNEY FUNCTIONS IN BEEF CATTLE VACCINATED AGAINST THEILERIA ANNULATA

ABSTRACT

In this study, it was aimed to investigate whether there is any change in liver and kidney functions in cattle vaccinated against *T. annulata* and the effect of vitamin C supplementation on this situation with vaccine administration. The material of the study consisted of 20 Montofon breeding beef cattle, approximately 2 years old, kept under the same care and nutrition conditions. These cattle were divided into 2 groups (experimental and control group) with 10 cattle in each group and 2.5 ml *T. annulata* vaccine was administered under the skin of the neck as a single dose to the experimental group. During the administration of this vaccine to the cattle in the experimental group, 20 ml of vitamin C (containing 250 mg ascorbic acid per ml) was administered intravenously as a single dose. In the control group, only 2.5 ml dose of *T. annulata* vaccine was administered under the skin of the neck. Blood samples of 10 ml K3EDTA and without anticoagulant were taken from the V. jugularis of the cattle in the study during the vaccination (day 0) and on the 3rd, 14th and 21st days after vaccination in accordance with the technique, centrifuged at 5000 rpm for 5 minutes, plasma and serums were removed. In order to evaluate liver and kidney functions, the levels of some biochemical parameters (AST, ALP, GGT, total protein, total bilirubin, direct bilirubin, triglyceride, blood urea nitrogen (BUN) and creatinine) were determined using an autoanalyzer with the help of commercial test kits. In conclusion, it was concluded that some changes occurred in liver and kidney functions of cattle after vaccination, but these changes were temporary and exogenous vitamin C administration to cattle during vaccination reduced these negative effects.

Keywords: Cattle, vaccination, liver, kidney, vitamin C



GİRİŞ

Tayleriyozis, küçük bir proton paraziti olan ve sığırların eritrositlerini enfekte eden zorunlu hücre içi paraziti *Theileria annulata*'nın neden olduğu bir hastalık olup, ülkemizde görülen önemli sığır hastalıklarından birisidir. Hastalık kan emici kenelerle nakledilerek, özellikle yüksek verimli hayvanlarda canlı ağırlık kaybı, süt veriminin azalması, gebelerde abortuslara ve hatta ölümlere neden olabilmektedir (25). Hastalığın klinik semptomları konakçının duyarlılığına, yaşına ve etkenin patojenitesine göre değişiklik gösterir. Klinik semptomlar genel olarak vücut ısısında artış, lenf yumrularında büyüme, mukozalarda solgunluk, peteşiyel kanamalar, anemi ve zayıflama şeklinde ortaya çıkar (10,12,33).

Yukarıda bahsedilen verim kayıpları ve ölümler yanında hastalığın tedavisi de oldukça maliyetlidir. Tedavide belirli ilaçların kullanılmasına ek olarak aynı zamanda ortaya çıkan bazı sorunların telafisi adına spesifik olmayan tedaviye de ihtiyaç duyulmaktadır. Bu maliyetler ve verim kayıpları göz önüne alındığında, hastalıkta etkili bir kontrol programının uygulanması bir zorunluluk olarak karşımıza çıkmaktadır (8). Hastalıkta kontrol programı iki tür eylemden oluşur; birincisi, vektör kenelerin kontrolü ve ikincisi ise *T. annulata*'ya karşı aşılamalardır (9). Tropikal theileriosis'in kene istilasını önleyerek kontrolü, özellikle kenelerin aktif olduğu mevsimlerde keneler üzerine etkili akarisitlerin periyodik olarak uygulanmasını gerektirir. Ancak bu durum özellikle çok sayıda sığırın meralarda dolaştığı durumlarda pahalı ve sürdürülmesi zor bir işlemdir. Ayrıca akarisit kullanımının çevresel kaygılarına ek olarak, akarisitlerin sürekli kullanımının da akarisite dirençli kene popülasyonlarının gelişimiyle sonuçlandığı bilinmektedir. Bununla birlikte, aşılar için yüksek düzeyde kalite kontrolünün gerekliliği, aşı dağıtımı için soğuk zincire bağımlılık olması ve aşı üretiminde kullanılan etkenlerin kalıcı enfeksiyonlar oluşturma kapasitesi ve dolayısıyla aşılama için bölgesel olarak elde edilen türleri kullanma ihtiyacı bu aşılamanın ideallliğini azaltmaktadır (35).

Vitamin C vücuttaki en önemli serbest radikal temizleyicilerinden biri olup, biyolojik membranların stabilizasyonu ve immun fonksiyonların devamlılığında etkilidir (3,23,30). Stres sırasında immun fonksiyonlar tipik olarak azalmaktadır ve vitamin C ilaveleri özellikle stres yapıcı faktörlerin immunosupressif etkisini ortadan kaldırmaktadır (27).

Aşılamanın yangısal bir cevaba neden olarak böbrek ve karaciğer gibi organların fonksiyonlarında değişimlere neden olabileceği bildirilmiştir (22). Buradan hareketle bu çalışmada *T. annulata*'ya karşı aşılama sığırlarda karaciğer ve böbrek fonksiyonlarında herhangi bir değişim olup olmadığını ve aşı uygulamasıyla beraber C vitamini takviyesinin bu duruma etkisini araştırmak amaçlanmıştır.

MATERYAL ve YÖNTEM

Araştırmanın materyalini aynı bakım ve beslenme şartlarında tutulan yaklaşık 2 yaşındaki 20 adet Montofon ırkı besi sığırı oluşturmuştur. Bu sığırlar her grupta 10 sığır olacak şekilde 2 gruba ayrılmış (deney ve kontrol grubu) ve deney grubuna 2.5 ml *T. annulata* aşısı boyun derisi altına tek doz olarak uygulanmıştır. Deney grubundaki sığırlara ayrıca bu aşının uygulaması sırasında da 20 ml C vitamini (ml'de 250 mg askorbik asit içeren) damar içi yolla tek doz olarak yapılmıştır. Kontrol grubuna ise sadece 2.5 ml dozunda *T. annulata* aşısı boyun derisi altına uygulanmıştır.

Aşılama öncesi detaylı muayeneleri yapılan ve klinik olarak sağlıklı oldukları belirlenen sığırların V. jugularis'lerinden tekniğine uygun olarak aşılama esnası (0. gün) ve aşılama sonrası 3., 14. ve 21. günlerde 10'ar ml K3EDTA'lı ve antikoagülsüz kan örnekleri alınmış, 5000 rpm'de 5 dk santrifüj edilerek plazma ve serumları çıkarılmış olup analiz edilinceye kadar -20°C'de saklanmıştır. Karaciğer ve böbrek fonksiyonlarını değerlendirmek adına bazı



biyokimyasal parametrelerin (AST, ALP, GGT, total protein, total bilirubin, direk bilirubin, trigliserid, kan üre azotu (BUN) ve kreatinin) düzeyleri ticari test kitleri yardımıyla Olympus AU 600 (Optical Co Ltd., Japan) marka otoanalizör kullanılarak belirlenmiştir.

İstatistiksel analizler SPSS 21 (Statistical Package for the Social Sciences for Windows, SPSS Inc., Chicago, IL, USA) programı kullanılarak yapılmıştır. Tüm parametreler için normallik analizi gerçekleştirilmiş ve parametrik test varsayımı karşılanıyorsa, grup içi istatistiksel farklılıklar tekrarlayan ölçümlerde varyans analizi ile belirlenmiştir. Gruplar arası istatistiksel farklılıklar ise bağımsız örneklerde t-testi ile değerlendirilmiştir. İstatistiksel önemlilik derecesi $p < 0,05$ olarak kabul edilmiştir.

BULGULAR

Kontrol ve deney grubundaki besi sığırlarında aşılama esnası ve sonrasında belirlenen bazı biyokimyasal parametrelerin ortalama değerleri, standart sapmaları ve istatistiksel önem dereceleri Tablo 1'de gösterilmiştir.

Tablo 1. Kontrol ve deney grubundaki besi sığırlarında aşılama esnası (0. gün) ve sonrasındaki günlerde (3., 14. ve 21. günler) belirlenen bazı biyokimyasal parametrelerin ortalama değerleri, standart sapmaları ve istatistiksel önem dereceleri.

Parametreler	Gruplar	Örneklemeye Günleri				P değeri
		0	3	14	21	
AST (U/L)	Kontrol	76,60±10,46 ^{AB}	85,30±9,07 ^A	72,20±8,82 ^B	68,60±6,59 ^B	**
	Deney	72,80±11,87	70,30±6,65	70,00±8,03	66,50±6,22	ÖD
	P değeri	ÖD	**	ÖD	ÖD	
ALP (U/L)	Kontrol	52,90±11,20 ^{AB}	60,20±12,80 ^A	53,00±8,06 ^{AB}	44,00±5,91 ^B	**
	Deney	62,70±12,20	61,60±11,56	62,30±11,00	61,70±10,48	ÖD
	P değeri	ÖD	ÖD	*	***	
GGT (U/L)	Kontrol	27,50±4,84	30,40±6,19	28,60±5,48	27,10±5,24	ÖD
	Deney	33,20±7,22	33,80±6,53	32,30±6,02	31,50±7,08	ÖD
	P değeri	ÖD	ÖD	ÖD	ÖD	
T. Protein (g/dL)	Kontrol	7,35±0,15 ^A	7,25±0,14 ^A	7,13±0,16 ^B	7,34±0,15 ^A	**
	Deney	7,27±0,09 ^{ab}	7,18±0,10 ^{ab}	7,17±0,11 ^b	7,27±0,12 ^a	**
	P değeri	ÖD	ÖD	ÖD	ÖD	
T. Bilirubin (g/dL)	Kontrol	0,39±0,07	0,39±0,06	0,38±0,08	0,38±0,06	ÖD
	Deney	0,42±0,10	0,43±0,09	0,42±0,12	0,41±0,09	ÖD
	P değeri	ÖD	ÖD	ÖD	ÖD	
D. Bilirubin (g/dL)	Kontrol	0,06±0,05	0,07±0,05	0,05±0,05	0,05±0,05	ÖD
	Deney	0,05±0,05	0,06±0,05	0,05±0,05	0,05±0,05	ÖD
	P değeri	ÖD	ÖD	ÖD	ÖD	
Trigliserid (g/dL)	Kontrol	13,90±1,91	12,40±1,96	12,10±1,73	13,50±2,01	ÖD
	Deney	11,10±1,73	11,10±0,88	10,90±0,99	11,30±1,89	ÖD
	P değeri	**	ÖD	ÖD	*	
BUN (g/dL)	Kontrol	9,80±1,48 ^B	12,20±2,15 ^A	10,20±1,55 ^{AB}	10,10±1,37 ^{AB}	**
	Deney	11,40±1,71	12,30±1,42	11,60±1,90	10,90±1,20	ÖD
	P değeri	*	ÖD	ÖD	ÖD	
Kreatinin (g/dL)	Kontrol	0,55±0,10 ^{AB}	0,64±0,08 ^A	0,62±0,06 ^A	0,59±0,09 ^B	**
	Deney	0,51±0,14	0,65±0,08	0,59±0,10	0,57±0,15	ÖD
	P değeri	ÖD	ÖD	ÖD	ÖD	

Veriler Ortalama ± Standart sapma olarak sunulmuştur. ÖD: Önemli Değil * $p < 0,05$ ** $p < 0,01$ *** $p < 0,001$

A, B, C: Aynı satırda farklı harf taşıyan kontrol grupları ortalamaları arasındaki fark zaman bakımından önemlidir ($p < 0,05$).

a, b: Aynı satırda farklı harfleri taşıyan deney grupları ortalamaları arasındaki fark zaman bakımından önemlidir ($p < 0,05$).

Tablo 1 incelendiğinde, kontrol grubunda aşılama sırası ve sonrası günlerde belirlenen parametrelerden AST, ALP, T. protein, BUN ve kreatinin düzeyleri bakımından istatistiksel önemler belirlendiği anlaşılmaktadır. Bu farklılıklar dikkate alındığında, AST düzeyleri



bakımından 3. gün ile 14. ve 21. günler arasında $p < 0.01$ düzeyinde; ALP düzeyleri bakımından 3. gün ile 21. günler arasında $p < 0.01$ düzeyinde; T. protein düzeyleri bakımından 14. gün ile 0., 3. ve 21. günler arasında $p < 0.01$ düzeyinde; BUN düzeyleri bakımından 0. gün ile 3. gün arasında $p < 0.01$ düzeyinde ve kreatinin düzeyleri bakımından düzeyleri bakımından 3. ve 14. günlerle 21. gün arasında $p < 0.01$ düzeyinde farklılıkların olduğu anlaşılmaktadır.

Deney grubunda ise sadece T. protein düzeyleri bakımından 14. gün ile 21. gün arasında $p < 0.01$ düzeyinde farklılık saptanmıştır.

Gruplar arasında ise AST düzeyi bakımından sadece 3. günler arasında $p < 0.01$ düzeyinde, ALP düzeyleri bakımından 14. günler arasında $p < 0.05$ ve 21. günler arasında $p < 0.001$ düzeyinde, Triglicerid düzeyleri bakımından 0. günler arasında $p < 0.01$ ve 21. günler arasında $p < 0.05$ düzeyinde ve BUN düzeyleri bakımından sadece 0. günler arasında $p < 0.05$ düzeyinde farklılık saptandığı görülmektedir.

TARTIŞMA

Aşılama işlemi hayvanlarda kompleks bir işlem olmayıp basit şekilde uygulanabilir ve bu sayede çok sayıda hayvanın değişik hastalıklara karşı korunmaları sağlanabilir. Bu nedenle aşılama işlemi, hem hayvan sağlığını hem de iyi hayvan refahını teşvik etmek için son derece etkili bir yoldur. Aşılama öncelikle hayvansal üretimi ve hayvan sağlığını olumsuz etkileyecek salgınlara karşı korunma sağlayarak dolaylı yoldan insan sağlığı ve refahı üzerine de etki gösterir. Aşılama, çiftçiler ve hizmet etiketleri topluluklar için sürdürülebilir ve ekonomik istikrar sağlanmasına yardımcı olur (15,16).

Aşılama, bir hayvanın bağışıklık sisteminin hastalığa neden olan bir etkene karşı kontrollü olarak maruz kalmasıdır. Aşılama işlemi bir eylemdir; immünizasyon ise istenen sonuçtur. Bir aşı, hastalığa neden olan ölü veya zayıflamış bir organizma içerir. Bu organizma, artık hayvanda hastalığa neden olmayacak şekilde (yapay, genetik veya doğal olarak) değiştirilir, ancak yine de onu bu hastalığa karşı korumak için hayvanın bağışıklığını uyarma yeteneğine sahiptir (36). Tayleriozisten korunmak için kullanılan aşılama canlı aşılama olup, parazitle enfekte olmuş lökositlerin in vitro olarak uzun süreli pasajları yoluyla virüslarının azaltılması yoluyla üretilmektedirler ve birçok ülkede başarıyla kullanılmaktadırlar (35).

Özellikle ruminantlarda stres ve uygun olmayan çevre şartları nedeniyle vitamin C gereksinimleri artmaktadır (20). Evcil hayvanlarda soğuk-sıcak, metabolik bozukluklar, nakil, uygun olmayan bakım ve besleme şartları ile aşılama gibi stres durumlarında vitamin C kullanımının arttığı ve karaciğerdeki vitamin C biyosentezinin bu artan talebi karşılayamadığı ifade edilmektedir. Askorbik asit düzeylerinin azalması ise immün sistemin verim kabiliyetini azaltır. Bu gibi durumlarda ekzojen vitamin C uygulamaları yararlı etki gösterir (17). Aşılamanın bir stres faktörü gibi etkiyerek vücuttaki serbest radikal düzeylerini artırabileceği ve vitamin C'nin stresin olumsuz etkilerini azaltabileceği ifade edilmektedir (26,29).

Aşılamanın yangısal bir cevaba neden olarak böbrek ve karaciğer gibi organların fonksiyonlarıyla alakalı homostatik değişimlere neden olabileceği bildirilmiştir (21). Aşılama bir stres kaynağıdır (17). Stres sırasında organizmada bazı organların fonksiyonları etkilenmekte olup, olumsuz olarak etkilenen organlardan bir tanesi de organizma için çok önemli fonksiyonlara sahip bir organ olan karaciğerdir (11,21). Hem insan hem hayvan modellerinde yapılan çalışmalarda stresin karaciğer hastalıklarında etkili olduğu ifade edilmiştir (5,13,14). Genel olarak strese bağlı karaciğerdeki fonksiyonel değişimlerin ortaya çıkmasında sempatik / adrenomedüller sistemin rol aldığı temel mekanizmada, bozulmuş hepatik kan akışının etkili olduğu ifade edilmiştir. Bu sinir aktivasyonu, sonuçta karaciğer hasarını tetikleyen vazospazma ve sentrilobüller hipoksiye yol açar (6).



AST enzimi sığırlarda karaciğer fonksiyon bozukluklarının değerlendirilmesinde kullanılan en duyarlı indikatör olup (19), özellikle hepatosellüler hasarın göstergesi olarak kullanılır (32). ALP enzimi özellikle GGT ile beraber safra kanalı irritasyonu veya kanal tıkanıklığını değerlendirmede kullanılan enzimlerdendir (37). Mevcut çalışmadaki karaciğer fonksiyonlarının değerlendirildiği parametreler dikkate alındığında, kontrol grubunda belirlenen AST, ALP, T. protein düzeyleri bakımından grup içi günler arasında farklılıkların saptandığı anlaşılmaktadır. AST ve ALP enzimleri düzeylerinde 3. gün değerlerinde artışlar saptanmış ancak bu artışlar 14. ve 21. günlerde tekrar normale yaklaşmıştır. T. protein düzeyinde ise 3. ve 14. günde başlangıç değerlerine nazaran bir düşüş saptanmış ancak bu azalma sadece 14. günde istatistiksel olarak anlamlı bulunmuş ve 21. günde tekrar normal düzeylerine ulaşmıştır. Bu enzim düzeylerindeki artışlar ile T. protein düzeylerindeki azalmalar ise sığırlar için bildirilen referans değerler arasında kalmıştır. Referans değerler arasında kalan bu tip değişimlerin ise subakut veya kronik durumları yansıttığı (37) bilgisinden yola çıkarak, aşılama işleminin hafif düzeyde karaciğer fonksiyonlarında değişime neden olduğu ve bu durumun geçici olup kısa sürede normale geçtiği sonucuna varılmıştır. Deney grubunda da aynı kontrol grubunda olduğu gibi T. protein düzeyleri bakımından 3. ve 14. günlerde başlangıç değerlerine nazaran bir düşüş saptanmış ancak bu azalma sadece 14. günde istatistiksel olarak anlamlı bulunmuş ve 21. günde tekrar normal düzeylerine ulaşmıştır. Kontrol grubu ile kıyaslandığında deney grubunda karaciğer fonksiyonlarının göstergesi olarak kabul edilen enzimler bakımından bir değişimin saptanmamış olmasının nedeni olarak ta, deney grubuna aşılama esnasında uygulanan vitamin C'nin stresi önleyici etkisinin rol oynadığı düşünülmüştür.

Böbreklerin organizmada atıkların ve ilaçların uzaklaştırılmasında, sıvı dengesinin sağlanmasında, bazı hormonların sentezinde, kan basıncının düzenlenmesinde, D vitamininin aktifleştirilmesinde, kırmızı kan hücrelerinin üretiminin kontrolünde ve daha birçok olayda önemli rolleri bulunmaktadır (1,18,31). Stres nedeniyle uyarılan otonom sempatik sistem, böbrek üstü bezi medullasından adrenal salgılanmasını artırır. Adrenalinin vücutta birçok etkisi olmakla birlikte böbreklerde vasokonstriksiyona bağlı olarak glomerüler filtratın azalmasına da neden olur (28). Strese neden olan durumların serbest radikallerin üretiminde artışa neden olarak organizmadaki oksidan ve antioksidan sistemler arasındaki dengenin bozulmasına yol açtığı (24) ve artan oksidatif stresin dokularda hasara neden olduğu bilinmektedir (7). Yapılan bazı çalışmalarda (2,4,34) elde edilen verilere göre oksidatif stresin iskemik akut böbrek yetmezliği, akut glomerulonefrit, toksik renal hastalıklar gibi pek çok renal hastalığın patofizyolojisinde etkili olduğu gösterilmiştir.

Çalışma sonuçlarına bakıldığında, böbrek fonksiyonlarının değerlendirildiği parametrelerden BUN ve kreatinin düzeyleri bakımından sadece kontrol grubunda istatistiksel değişimlerin olduğu anlaşılmaktadır. Aşılamanın bir stres faktörü olduğu düşünüldüğünde, BUN ve kreatinin düzeylerinde kontrol grubunda belirlenen artışların nedeni olarak, stresin özellikle böbrekler üzerindeki glomerular filtratın azalmasıdaki etkileri düşünülmüştür. Ancak bu artışlar da referans değerlerler arasında kalmış olup, 3. ve 14 günlerdeki artışların 21. günde tekrar normalleşmeye başladığı görülmektedir. Deney grubunda ise bu parametreler bakımından herhangi bir önemin saptanmaması, aşılama ile beraber vitamin C uygulanmasının muhtemel aşılama stresini ve stresin böbrekler üzerindeki geçici etkisini önlemiş olmasından kaynaklanmış olabilir.

Özetle, aşılamanın bir stres faktörü olarak etkilediği düşünüldüğünde, aşılama sonrası sığırların karaciğer ve böbrek fonksiyonlarında bir takım değişimlerin ortaya çıktığı ancak bu değişimlerin geçici olduğu ve aşılama sırasında sığırlara eksojen vitamin C uygulamalarının da bu olumsuz etkileri azalttığı sonucuna varılmıştır.



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MİKORİZA VE BAKTERİ UYGULAMALARININ TOPRAK AGREGASYONU ÜZERİNE ETKİSİ

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ÖZET

Toprak, bitki ve su ilişkilerinde etkili olan özelliklerden biri de toprakların strüktürel yapısıdır. Toprak strüktürünün değerlendirilmesinde agregatların stabilitesi, agregat büyüklük dağılımı gibi özellikler incelenmektedir. Bu çalışmada; mikoriza ve bakteri uygulamalarının toprakların agregat stabilitesi, agregat büyüklük dağılımı (>2 , $2-1$, $1-0.5$, $0.5-0.25$, <0.25 mm) ve ağırlıklı ortalama çap (AOÇ) özellikleri üzerine etkilerinin değerlendirilmesi amaçlanmıştır. Çalışma, tesadüf parselleri deneme deseninde saksı denemesi olarak yürütülmüştür. Ayrıca, toprağa uygulanan bakteri (*Rhizobium phaseoli*) ve mikoriza mantarlarının etkisini arttırabilmek için farklı yapıştırıcı ajanlar (arabik zambak, melas, deniz yosunu) kullanılmış ve fasulye (*Phaseolus vulgaris* L.) bitkisi yetiştirilmiştir. Toprakların agregat stabilitesi, % 68.43-78.36 arasından istatistiksel olarak önemli ($p<0.01$) seviyede değişim göstermiştir. Agregat stabilitesi en düşük kontrol, en yüksek ise deniz yosununun yapıştırıcı ajan olarak kullanıldığı mikoriza uygulamasında elde edilmiştir. Uygulamaların agregat büyüklük dağılımı üzerine etkisi istatistiksel olarak önemli seviyede belirlenmiştir ($p<0.05$). Kontrol uygulaması ve melas + bakteri uygulamalarında $1-0.5$ mm arası agregatların oranı, mikoriza mantarı uygulamalarında ise genel olarak $2-1$ mm arası agregatların oranı daha yüksek bulunmuştur. Agregat stabilitesi ve agregat büyüklük dağılım oranlarına yapıştırıcı ajanların etkisi önemli seviyede ($p<0.01$) belirlenmiştir. En etkili yapıştırıcı ajan deniz yosunu uygulamaları olarak bulunmuştur. Ağırlık ortalama çap değerleri uygulamalara bağlı önemli seviyede ($p<0.01$) değişkenlik sergilemiş olup mikoriza mantarı uygulamalarının etkisi sonucu AOÇ değeri 1.98 mm, bakteri uygulamalarında ise AOÇ 1.85 mm olarak belirlenmiştir. Yapıştırıcı ajanların ise AOÇ üzerine önemli seviyede etkisi bulunmamıştır. Çalışma sonucunda; toprakların strüktürel özellikleri üzerine mikoriza mantarının etkisi önemli seviyede belirlenmiştir. Ayrıca mikrobiyal gübreleme ile birlikte deniz yosunu yapıştırıcı ajanının uygulanmasının, agregasyonu teşvik edici olduğu ortaya konmuştur.

Anahtar kelime: Toprak strüktürü, agregasyon, mikrobiyal gübreleme, mikoriza



THE EFFECT OF MYCORRHIZA AND BACTERIA APPLICATIONS ON SOIL AGGREGATION

ABSTRACT

Soil structure one of the features that are effective in soil, plant and water relations. In the evaluation of soil structure, features such as stability of aggregates and aggregate size distribution are examined. In this study, it was aimed to evaluate the effects of mycorrhizal and bacterial applications (*Rhizobium phaseoli*) on the aggregate stability, aggregate size distribution (>2, 2-1, 1-0.5, 0.5-0.25, <0.25 mm) and mean weight diameter (MWD) properties of soils. The study was carried out as a pot experiment in a randomized plot design. In order to increase the effect of bacteria and mycorrhizal fungi applied to the soil, different adhesive agents (gum arabic (40 %), molasses (10%), seaweed (1 %)) were used and bean (*Phaseolus vulgaris* L.) plant was grown. Aggregate stability of the soils showed a statistically significant ($p<0.01$) change between 68.43-78.36%. The lowest control and the highest was obtained in the mycorrhiza application in which seaweed was used as the adhesive agent. The effect of the applications on the aggregate size distribution was determined to be statistically significant ($p<0.05$). In the control application and molasses + bacteria applications, the distribution of aggregates between 1-0.5 mm and the aggregates between 2-1 mm in mycorrhizal fungus applications were found to be higher. The effect of adhesive agents on aggregate stability and aggregate size distribution ratios was determined at a significant level ($p<0.01$). The most effective adhesive agent was found to be seaweed applications. Mean weight diameter values showed significant ($p<0.01$) variability depending on the applications, and the MWD value was determined as 1.98 mm as a result of the effect of mycorrhizal fungi applications, and as 1.85 mm in the bacterial applications. Adhesive agents did not have a significant effect on the MWD. In the results of study, the effect of mycorrhiza fungus on the structural properties of the soils was determined at a significant level. It has also been demonstrated that the application of seaweed adhesive agent together with microbial fertilization promotes aggregation.

Keyword: Soil structure, aggregation, microbial fertilization, mycorrhizal



1. INTRODUCTION

Soil structure is one of the most important soil properties in terms of productivity, which is affected by physical, chemical and biological processes. Properties such as water and air movement in the soil, water holding and aeration capacity, availability of plant nutrients, plant root development, macro and micro organism activity are related to soil structure. Appropriate soil structure and high aggregate stability are very important for vegetative production, sustainable soil management and resistance to erosion (Bronick and Lal, 2005; Alagöz and Yılmaz, 2009; Turgut and Aksakal, 2010; Eraslan et al., 2016). The stability of aggregates formed by the flocculation and cementation of primary particles (Duiker et al., 2003) is one of the important parameters used in the evaluation of the structural condition (Six et al., 2000). In addition to aggregate formation, aggregate stability is an important factor for the sustainability of air and water balance suitable for plant growth in the soil (Karaman et al., 2007). Clay minerals, organic colloidal substances, iron, aluminum, manganese oxides and calcium carbonate are among the effective parameters in the formation of aggregates in the soil. In addition, the effect of plant roots, microorganisms, land management and climate, which are effective in aggregation, should not be ignored (Bronick and Lal, 2005). Enzymes secreted by soil organisms are an indicator of biological activity and it is known that enzymes formed by microorganisms during the decomposition of organic material are effective in aggregation (Helgason et al., 2010).

The type and number of microorganisms present in the soil is one of the important features considered as an indicator of soil fertility. Although it is extremely important, studies on the effectiveness of microorganisms have not been taken into account in studies on the evaluation of the structural state of the soil. Microbial activity changes depending on the microorganisms (bacteria, fungi, actinomycetes) that differentiate according to the dynamic properties of the soil, nutrient content and management. It facilitates the formation of microbial decomposition products, clay-organic complex. Small particles of fungal mycelia cluster into clusters. While mechanical bonding is provided by the micelles developed by fungi and actinomycetes, they also show a stabilizing effect with some products they form. Studies have shown that water-resistant aggregation increases with the increase in fungal population (Lalende et al., 1998) and that the filamentous and gel-like structures formed by polysaccharides and polyurenoids formed during microbial decomposition have an effect on soil structure (Sağlam et al., 1993). Vegetable residues and organic fertilizers indirectly affect aggregate formation by increasing microbial activity. In addition, some mycorrhizal fungi surround the soil aggregates with their micelles and contribute to the better formation of soil structure with the enzymes they secrete. It also prevents losses due to soil erosion (Ijdo et al., 2011). Glomalin, a glycoprotein produced by mycorrhizal fungi, promotes soil aggregation. With the formation of glomalin, stable aggregates are produced in the soil (Bonfante Fasolo and Perotto, 1992). In particular, bacteria as cement in the formation of primary and secondary soil aggregates by forming polysaccharides and other sticky substances. In addition, it is thought that the structure can be improved by applying products such as molasses, gum arabic, seaweed, which have a cohesive and adhesive effect.

In this study; It was aimed to evaluate the effects of mycorrhiza (250 g/da) and bacteria (0.02 g *Rhizobium phaseoli*/seed) applications on aggregate stability, aggregate size distribution and mean weighted diameter (MWD) properties of soils with different adhesive agent (gum arabic, molasses, seaweed) applications.



2. MATERIAL and METHODS

The soil used in the study has clay loam texture (35.1% clay, 31.5% silt, 33.4% sand) with slightly alkaline reaction (pH 8.03). The EC content of the soils was determined as 0.2 dS m⁻¹ and the organic matter content was determined as 2.4%. Field capacity and wilting point of the soils were found to be 27.8% and 14.2%, respectively.

Bacteria *Rhizobium phaseoli*-soil crops office and mycorrhizal fungi were applied to the soil (*Glomus intraradices*, *Glomus aggregatum*, *Glomus mosseage*). Mycorrhiza was applied at 250 g/da and bacteria at 0.02 g *Rhizobium phaseoli*/seed level. The soil was sieved through a 4 mm sieve. In addition, gum arabic (4%), molasses (10%), seaweed (1%) were applied to the soil in 75 ml (3 kg). The study was carried out in a randomized plot design with 3 different applications (control, mycorrhiza, bacteria), 4 adhesive agents (control, gum arabic, molasses, seaweed) and 3 replications with a total of 36 pots. Zülbiye bean (*Phaseolus vulgaris* L.) cultivar was used in the study. After planting 15 seeds for each pot, irrigation was carried out up to the field capacity level. Subsequent irrigations were carried out at 75% of the field capacity with 2-3 day intervals. After germination of seeds, dilution was done. Soil samples were taken 60 days after sowing by cutting the upper part of the plant.

Determination of pH and EC in soils was determined according to Kacar (2009) and US Salinity Laboratory Staf (1954), organic matter content was determined using Modified Walkey-Black method and % CaCO₃ using Scheibler calcimeter (Kacar, 2009). Mechanical analysis was obtained by hydrometer method. The amount of moisture held at different tensions was determined with the help of pressure plate (Demiralay, 1993). Dry aggregate size distribution was determined using a wet-dry sieve set at 75 amplitude and 5 min. sieving time conditions. 2.00, 1.00, 0.50, 0.25, mm sieves were used to determine the aggregate size distributions. After the aggregate size distribution curves of the soils were created, the mean weight diameter (MWD) was determined. The wet sieving method (with single sieve diameter) proposed by Kemper and Rosenau (1986) was applied for the analysis of water resistant aggregate stability. MINITAP 16 package program was used in the statistical evaluation of the values obtained as a result of the study. TUKEY, one of the multiple comparison tests, was used to reveal the effects of the applications.

3. RESULTS and DISCUSSION

The effects of the applications on aggregate stability are shown in Table 1. The effect of different microbial fertilizer and adhesive agent applications on aggregate stability showed a statistically significant change ($p < 0.01$). The lowest aggregate stability was determined at the level of 68.43% in the control application, and the highest was obtained with the mycorrhiza + seaweed application (78.36%). An increase of approximately 10% was observed compared to the control application. The highest increase in aggregate stability was determined as mycorrhiza, followed by bacteria and control soil. While the effects of *gum arabic* and *molasses* as adhesive agents were similar (73.16%, 73.52%), the best effect was obtained with *seaweed* application. The effect of adhesive application on bacterial applications was statistically similar to each other. In order for the primary particles in the soil to combine and form aggregates, substances that act as binders and cement are needed. These substances are humus, some secretions that are products of microbial activity, substances such as clay and iron oxide. Fungal mycelia improve soil structure by forming a tight bond around soil particles and bringing materials together, Microorganisms (especially bacteria) forming polysaccharides and other sticky substances, Death and decomposition of microbial cells and fungal mycelium and forming sticky substances (Balestrini et al., 2015).



Table 1. Effect of applications on aggregate stability (%)

	Control	Mycorrhiza	Bacterium	Mean
Control	68.43e*	75.89b	72.45cd	72.25
Gum arabic	69.45de	76.50ab	73.54cd	73.16
Molasses	69.87de	77.80ab	72.89cd	73.52
Seaweed	70.08d	78.36a	74.58c	74.34
Mean	69.45	77.137	73.36	

* There is a significant difference at the $p < 0.01$ level between the values not shown with the same letter.

The effects of the applications on mean weight diameter (mm) are shown in Table 2. The effect of the treatments on the mean weight diameter showed a statistically significant change ($p < 0.01$). The mean weight diameter increased from 1.73 mm in the control application to 1.99mm with the application of Mycorrhiza + Seaweed. Although no significant variability was detected in mycorrhizal and bacterial applications due to adhesive agent applications, control + Gum arabic (1.87 %) and Seaweed (1.89 %) applications caused a statistically significant change in mean weight diameter. Gum arabic and seaweed applications were found to be more effective on mean weight diameter than other applications.

Table 2. Effect of applications on mean weight diameter (mm)

	Control	Mycorrhiza	Bacterium	Mean
Control	1.73c*	1.97a	1.83bc	1.84
Gum arabic	1.87b	1.98a	1.84bc	1.90
Molasses	1.79bc	1.98a	1.84bc	1.87
Seaweed	1.89b	1.99a	1.89b	1.95
Mean	1.82	1.98	1.85	

* There is a significant difference at the $p < 0.01$ level between the values not shown with the same letter.

The effect of the treatments on the different aggregate size distribution showed a statistically significant change ($p < 0.05$). The effects of the applications on aggregate size distribution (%) are shown in Table 3. In the control application and molasses + bacteria applications, the distribution of aggregates between 0.5-1 mm and the aggregates between 1-2 mm in mycorrhizal fungus applications were found to be higher. The rate of micro aggregates (< 0.25 mm) has increased with the Bacterium + Gum arabic and Bacterium + Seaweed applications.



Table 3. The effect of applications on aggregate size distribution (%)

		4-2 mm	2-1 mm	1-0.5mm	0.5 -0.25mm	<0.25mm
Control	Control	5.37c*	21.41b	29.99a	19.37b	20.45d
	Gum arabic	5.91bc	22.00b	20.33c	21.75a	28.00b
	Molasses	6.30b	23.58b	21.13bc	17.25c	27.75b
	Seaweed	6.34b	20.68b	20.68c	19.39b	29.69b
Mycorrhiza	Control	6.31b	25.57a	20.33c	20.54a	24.11c
	Gum arabic	7.50a	26.69a	21.55bc	18.17bc	25.29c
	Molasses	5.95bc	26.30a	21.95bc	19.79b	23.69c
	Seaweed	5.72c	26.59a	22.35bc	20.00b	23.08c
Bacterium	Control	5.48c	18.48c	22.76bc	20.21b	30.88ab
	Gum arabic	5.25c	17.88c	23.17b	20.42b	31.18a
	Molasses	5.02cd	20.28b	28.47a	20.62b	23.57c
	Seaweed	4.78d	16.68c	23.98b	20.83b	31.76a
Mean		5.83	22.18	23.06	19.86	26.62

* In the same column, there is a significant difference at the $p < 0.05$ level between the values not shown with the same letter.

The effects of adhesive agents led to statistically significant changes in aggregate sizes of 2-1 mm and <0.25 mm ($p < 0.05$) (Table 4). An increase in the proportions of microaggregates was determined with seaweed and gum arabic applications. With gum arabic and molasses applications, increases in the ratios of aggregates between 4-2, and 2-1 mm were found.

Table 4. Effect of adhesive agents on aggregate size distribution (%)

	4-2 mm	2-1 mm	1-0.5mm	0.5 -0.25mm	<0.25mm
Control	5.72	21.82	24.36a	20.04	25.15b
Gum arabic	6.22	22.19	21.68b	20.11	28.15a
Molasses	5.76	23.39	23.85a	19.22	25.00b
Seaweed	5.62	21.32	22.34b	20.08	28.18a

* There is a significant difference at the $p < 0.05$ level between the values not shown with the same letter.

In a study, it is assumed that fungi are effective in the formation and stabilization of aggregates in macro ($> 250 \mu\text{m}$) size, while bacteria are effective on aggregates in micro size



(< 250 μm) (Leifheit et al. 2014). Gouzou et al. (1993) stated that as a result of inoculation of a bacteria strain (*Paenibacillus polymyxa*) into a silty loam soil, an increase of 57% was achieved in the soil mass, the mean weight diameter value of the aggregates formed increased and a more porous structure was formed.

4. CONCLUSION

In this study, the effect of mycorrhizal and bacterial applications together with adhesive agents on soil structure was investigated. In the results of study, it was determined that microbial fertilizer and adhesive agent applications were effective in improving the structural condition of the soils. An increase in the proportions of microaggregates was determined with seaweed and gum arabic applications. The effect of mycorrhiza fungus on the structural properties of the soils was determined at a significant level. It has also been demonstrated that the application of seaweed adhesive agent together with microbial fertilization improves aggregation.



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ÖZET

Günümüzde, yaşam şekillerinin değişmesiyle birlikte tüketicilerin sağlıklı beslenmeye yönelik ilgileri artmıştır. Tüketicilerin beslenme yönündeki bilinçlerinin artmasıyla birlikte, fazla yağ tüketiminin çeşitli sağlık sorunlarının nedeni olduğu saptanmıştır. Bu doğrultuda gıdalardaki yağ miktarını azaltmak amacıyla gerçekleştirilen çalışmalar önem kazanmıştır. Gıdalarda düşük yağlı bir formülasyon oluşturmak ve yağ çıkarıldığında kalite kaybını önlemek amacıyla farklı işlemlere sahip yağ ikamelerinin kullanılması gerekmektedir. Yüksek yağ içeriğine sahip olan kek, sıklıkla yağ azaltma çalışmalarında yer alan unlu mamuldür. Yağ kek üretiminde kek lezzetinin oluşmasında rol alan lezzet bileşiklerini taşımakta, kekin kalitesini geliştirmekte ve hava kabarcıklarının etrafını sararak hava kabarcıklarının hamurda daha stabil hale gelmesini sağlamaktır. Aynı zamanda yağ kek hacmini artırmakta, kek içini yumuşatmakta, kekin tazeliğini sağlamakta ve raf ömrünü uzatmaktadır. Formülasyondaki yağ miktarını azaltırken yüksek yağlı gıdaların özelliklerini korumak zordur. Bu nedenle, düşük yağlı bir formülasyonda yağ azaltıldığında oluşabilecek kalite kaybını önlemek amacıyla farklı işlemlere sahip bileşenlerin kullanılması gerekmektedir. Kek gibi yüksek yağ içeren unlu mamullerde kullanılan yağ ikamesi yağ ile benzer özellik sergilemelidir. Hamurun havalandırılmasını, karıştırma aşamasında yağlanmasını teşvik etmeli, ürünün hacmini artırmalı ve son kıvamını iyileştirmelidir. Yağ ikame maddeleri, hacim arttırıcı, jelleştirici, nem tutucu, ağız hissini iyileştirici, kalınlaştırıcı, stabilize edici ve dokuyu iyileştirici etkileri nedeniyle, gıdalarda kullanılmaktadır. Yağ ikame maddelerinin gıdalarda kullanılmasının amacı, gıdalardaki yağın oluşturduğu dokuyu korurken, gıdalardaki yağın neden olduğu kaloriyi azaltmaya yardımcı olmaktır. Yağ ikame maddelerinin çoğunun kalori değeri olmakla beraber sahip oldukları kalori yağdan azdır. Yağın gıdalardan uzaklaştırılması veya azaltılmasıyla beraber ortaya çıkabilecek olan kalite kayıplarını önlemek ve arzu edilen karakteristikleri sağlamak için yağ ikamesinin uygun kombinasyonlarının oluşturulması gerekmektedir. Bu çalışmada kek üretiminde kullanılan yağ ikamelerinin derlenmesi amaçlanmıştır.

Anahtar Kelimeler: Kek, yağ, unlu mamül, üretim



FAT SUBSTITUTES USED IN CAKE PRODUCTION

ABSTRACT

Nowadays, consumers' interest in healthy eating has increased with the change of lifestyles. With the increase in consumers' awareness of nutrition, it has been determined that excessive fat consumption is the cause of various health problems. In this direction, studies carried out to reduce the amount of fat in foods have gained importance. In order to create a low-fat formulation in foods, it is necessary to use fat substitutes with different functions to prevent quality loss when fat is removed. Cake with high fat content is a bakery product often involved in fat reduction studies. Fat carries the flavour compounds that play a role in the formation of cake flavour in cake production, improves cake quality and ensures that the air bubbles become more stable in the dough by surrounding the air bubbles. At the same time, fat increases the cake volume, softens the inside, ensures the freshness of the cake and extends its shelf life. It is difficult to preserve the properties of high-fat foods while reducing the amount of fat in their formulation. Therefore, to create a low-fat formulation, components with different functions must be used to prevent quality loss that can occur when fat is reduced. The fat substitute used in high-fat bakery products such as cakes should exhibit similar properties to fat. It should promote the aeration of the dough, its lubrication at the mixing stage, increase the volume of the product and improve the final consistency. Fat replacers are used in foods because of their bulking, gelling, moisture retaining, mouthfeel, thickening, stabilizing and texture-improving effects. The purpose of using fat replacers in foods is to reduce the calories from fat in foods while preserving the texture formed by fat in foods. Although most fat replacers have caloric value, they have fewer calories than fat. Appropriate combinations of fat substitutes must be created to prevent quality losses that may occur with the removal or reduction of fat from foods and to provide the desired characteristics. In this study, it is aimed to review the fat substitutes used in cake production.

Keywords: Cake, fat substitute, fat reduction



GİRİŞ

Günümüzde, yaşam şekillerinin değişmesiyle birlikte tüketicilerin sağlıklı beslenmeye yönelik ilgileri artmıştır. Gıda endüstrisi, ürün yelpazelerini genişletmek ve daha sağlıklı ürün üretmek üzere araştırma ve yeni ürün geliştirme çalışmalarını hızlandırmıştır (Pareyt ve ark., 2009). Tüketicilerin beslenme yönündeki bilinçlerinin artmasıyla birlikte, fazla yağ tüketiminin çeşitli sağlık sorunlarının nedeni olduğu saptanmıştır. Dünya Sağlık Örgütü (WHO) tarafından sağlıklı beslenmede günlük enerji tüketiminde yağdan gelen enerjinin %30'u aşmaması gerektiği bildirilmiştir. Yüksek oranda yağ tüketimi obezite, kanser, yüksek kan kolesterolü ve koroner kalp hastalığı gibi birçok hastalığı artırmıştır (WHO, 2015). Bu nedenlerle gıdalardaki yağın azaltılması yönündeki araştırmalar, giderek artmakta ve yağ ikameleri üzerine çalışmalar yoğunlaşmaktadır.

Unlu mamuller endüstrisinin en önemli ürünlerinden biri olan kek pek çok ülkede üretimi yapılan besleyici değeri yüksek, tüketimi kolay, göz ve damak zevkine hitap edebilen çeşitlilikte, farklı formülasyonlarda ve şekillerde üretilen hazır bir gıda ürünüdür. Kek ürünleri çok çeşitli formlarda bulunabilen ve unlu mamuller endüstrisinin en önemli ürünlerindedir. TSE 13375 kek standardında “Buğday unu veya tahıl unları ve/veya karışımları, beyaz şeker, yemeklik bitkisel yağ, yumurta, tuz, kabarmayı sağlayan maddeler, çeşni maddeleri, dolgu maddeleri ve diğer katkı maddelerinin, su eklenerek karıştırıldıktan sonra, tekniğine uygun biçimde işlenerek şekil verilmesi ve pişirilmesi suretiyle hazırlanan, ambalajlı olarak tüketime sunulan mamül” şeklinde tanımlanmıştır (TSE, 2008).

Kek üretiminde kullanılan başlıca bileşenler; yağ, un, şeker, yumurta, su, süt, kabartma tozu, yüzey aktif madde, vanilya ve tuzdur. Kek hamurunda, un ve yumurta yapı düzenleyici, şeker tatlandırıcı ve gevrekleştirici, su ve/ya da süt nemlendirici, kabartma tozu gaz üretici ve yüzey aktif maddeler ise kek hamur bileşenlerinin birbirleriyle homojen bir biçimde karışmasını sağlayıcı olarak kullanılmaktadır. Belirtilen maddelerin emülsiyonu son üründe istenilen tadın, dokunun ve hacmin oluşmasını sağlamaktadır (Lawson, 1995).

Yağ kek üretiminde önemli fonksiyonları olan temel bileşenlerden biridir. Yağ kek yapımında kek lezzetinin oluşmasında etkili olan lezzet bileşiklerinin taşınmasında, kek kalitesinin geliştirilmesinde ve hava kabarcıklarının etrafını sararak hava kabarcıklarının hamurda daha stabil hale gelmesinde etkilidir. Aynı zamanda yağ kek hacmini artırmakta, kabuk ve iç yapının oluşmasını etkilemekte, kek içini yumuşatmakta, ürünün nem kaybını önleyerek tazeliğinin korunmasını sağlamakta ve ürünün raf ömrünü uzatmaktadır (Bath ve ark., 1992). Bu çalışmada kek üretiminde kullanılan yağ ikamelerinin ve yağ ikame maddelerinin kek özellikleri üzerine etkisinin derlenmesi amaçlanmıştır.

KEK ÜRETİMİNDE KULLANILAN YAĞ İKAMELERİ

Kek üretiminde kullanılan yağ miktarını azaltmak, daha sağlıklı kek üretmek aynı zamanda kek kalitesini korumak amacıyla çeşitli yağ ikameleri kekte kullanılmıştır. Kekte yağ ikamesi olarak yer alan ürünler ve kullanım oranları Çizelge 1’de yer almaktadır.



Çizelge 1. Kek üretiminde kullanılan yağ ikameleri

Yağ İkamesi	İkame Oranı	Referans
Yulaf kepeği, keten tohumu	%20, 40	Lee ve ark. (2004)
Maltodekstrin	%20, 30, 40, 50	Lakshminarayan ve ark. (2006)
Polidekstroz	%20, 40, 60	Kocer ve ark. (2007)
β -glukan	%20, 30, 40	Kalinga ve Mishra (2008)
Chia jeli	%25, 50, 75	Borneo ve ark. (2010)
Kakao lifi	%25, 50, 75	Martínez-Cervera ve ark. (2011)
Peynir altı suyu konsantresi ve portakal kabuğu	%30, 40, 50, 70	Shehata ve ark. (2011)
İnülin	%50	Rodríguez-García ve ark. 2014
Pektin	%10-20-30	Lim ve ark. (2014)
Kanola yağı ve karnauba mumu oleojelleri	%25, 50, 75	Kim ve ark. (2017)
Fesleğen tohumu müsilajı	%25, 50, 75	Song ve ark. (2017)
Chia jeli	%25, 50, 75, 100	Fernandes ve Mellado (2017)
Manyok nişastası	%8, 12, 16	Rodríguez-Sandoval ve ark. (2017)
Kakao çekirdeği kabuğu	%30, 40, 50	Öztürk ve Ova (2018)
Çözünür ve çözünmez lif	%30	Diez-Sánchez ve ark., 2018
Kahve çekirdeği zarı	%20, 25, 30	Ateş ve Elmacı (2018)
İnülin	%10, 20, 30, 40, 50	Rashid ve ark.(2018)
Yeşil muz püresi	%25, 50, 75, 100	de Souza ve ark. (2018)
Oleojel	%25, 50, 75, 100	Oh ve Lee (2018)
Oleojel	%50	Pehlivanoğlu ve ark. (2018)
Siyah Frenk Üzümü ve Aronya Posası	%30	Quiles ve ark. (2018)
β -glukan	%20, 30, 40, 50	Artunduaga ve Gutiérrez, 2019
Maş fasulyesi nişastası	%10, 20, 30, 40	Punia ve ark. (2019)
Karnıyarık otu	%25, 50, 75, 100	Belorio ve ark.(2019)
β -glukan	%20, 40, 60, 80	Zbikowska ve ark.(2020)

Kek üretiminde yağ ikamesi olarak yulaf kepeği ve keten tohumu tozu kullanılan çalışmada yağ ikame oranı %40 olan keklerin katı yağ ile üretilen kontrol kekinin hacmine benzer hacme sahip olduğu belirlenmiştir. Yulaf kepeği ve keten tohumu ikamesiyle kek içi koyulaşırken kek kabuğu daha açık hale gelmektedir. Artan yağ ikamesiyle birlikte keklerin sertlik, iç yapışkanlık ve esneklik değerleri kademeli olarak artmaktadır. Ayrıca yulaf kepeği ve keten tohumu tozu içeren yağı azaltılmış keklerin hacim indekslerinin kontrol kekinden fazla olduğu saptanmıştır (Lee ve ark., 2004).

Maltodekstrin kekta yağ ikamesi olarak kullanıldığında kek hamurunun viskozitesinin azalmasına neden olmuştur. Düşük viskoziteli kek hamuru, düşük hacimli ve sert kek üretimiyle sonuçlanmıştır. Maltodekstrinle beraber gliserol monostearat kullanıldığında ise kek hamuru ve kek hacminde iyileşme sağlanmıştır. Ancak sodyum stearoil laktilat kullanıldığında kek hamurunda iyileşme sağlanırken kek hacminde ya da dokusunda iyileşme sağlanmamıştır (Lakshminarayan ve ark., 2006).

Kekta polidekstroz yağ ikamesi olarak kullanıldığında stabilitesi düşük bir kek hamuru elde



edilmiştir. Polidekstroz kullanımı ortalama emülsiyon drenaj süresini, kabarcık boyutunu azaltmış ve homojenliği artırmıştır. Kekte polidekstroz %25 yağ ve %22 şeker ikamesi olarak kullanılmasında kalori değerinde %22 azalma sağlanmıştır (Kocer ve ark., 2007).

Arpa ve yulaftan elde edilen β -glukan konsantresinin yağ ikamesi olarak keklerde kullanıldığı çalışmada β -glukan konsantresi kullanım oranının artışıyla kıvam, akış davranış indeksi, kayıp modülüsü ve depolama modülüsü artmıştır. β -glukan konsantresinin ilavesiyle kek hacmi azalırken sertlik artmış, kekin kabuk rengi açılırken iç renginde koyulaşma gözlenmiştir. Keklerde bayatlama, depolama süresi ve β -glukan konsantresinin fonksiyonu olarak artmıştır. Arpadan elde edilen β -glukan konsantresini %20 oranında içeren kekin yağı azaltılmamış kek ile benzer kalitede olduğu gözlenmiştir (Kalinga ve Mishra, 2008).

Borneo ve ark. (2010), Yağ yerine %25 chia jeli içeren keklerinin renk, tat, doku ve genel kabul edilebilirliği kontrol örneğiyle aynı olduğunu, %50 yağ ikamesi içeren kekin kontrole kıyasla 100 g porsiyon başına 36 kkal daha az kalori ve 4 g daha az yağ içerdiğini saptamıştır. Kek simetrisi ve kek ağırlığının formülasyondaki chia jelinden etkilenmediği, ikame yüzdesi arttıkça kek hacmi azaldığı belirlenmiştir.

Kakao lifinin çikolatalı keklerde yağ ikamesi olarak yer aldığı çalışmada kakao lifi içeren keklerin kontrol kekinden daha düşük sertlik ve çiğnenebilirliğe sahip olduğu ancak nem içeriklerinin yüksek olduğu belirlenmiştir. Yağı azaltılmış keklerin renk özelliklerinin kontrol kekine benzer olduğu ancak kek yüksekliği, acı tat ve yüzey yapışkanlığının geliştirilmesi gerektiği vurgulanmıştır (Martínez-Cervera ve ark., 2011).

Shehata ve ark. (2011), kekin duyusal özelliklerini koruyarak %75'e kadar yağ ikamesi olarak peynir altı suyu konsantresi ve portakal kabuğunun kullanılabilirliğini tespit etmiştir. Keklerin nem içeriği ve spesifik hacmi yağ ikame maddesinin kullanımıyla beraber artmıştır. Deneysel olarak sığanlar kullanılarak yapılan biyolojik değerlendirmede yağ ikamesi kullanılan keklerle beslenen sığanlarda toplam kolesterol, trigliserit, düşük yoğunluklu lipoprotein ve karaciğer enzimlerinde önemli bir düşüş ve yüksek yoğunluklu lipoproteinde artış gözlenmiştir.

Rodríguez-García ve ark. (2014), inülini %50 oranında yağ ikamesi olarak keklerde kullandıkları çalışmada, yağ ikamesi olan keklerde düşük hamur stabilitesi, kabarcık hareketini artırarak, daha büyük hücrelere ve kontrolden daha az yüksekliğe sahip kek elde etmişlerdir. Duyusal değerlendirmede %50 yağ ikamesinin keklerin genel kabul edilebilirliğini önemli ölçüde değiştirmediği belirlenmiştir.

Yuja posasından elde edilen pektinin yağ ikame maddesi olarak pişirme performansını değerlendirmek için kek formülasyonlarına dahil edildiği çalışmada, keklerde katı yağ ikamesi olarak pektin jeli kullanıldığında, kek hamurunun daha yüksek viskozite ve daha az pseudoplastik davranış sergilediği belirlenmiştir. Kek hamurunun özgül ağırlığı, artan pektin jel seviyeleri ile önemli ölçüde artmış ve pişirme sonrası kek hacmi ile yüksek oranda korelasyon göstermiştir. Pektin içeren kekler yüksek sertliğe sahip olmasına rağmen, hacim kaybı olmaksızın kontrol keki kadar yumuşak keklerin üretiminde ağırlıkça %10'a kadar pektin ile ikame edilmesi etkili olmuştur (Lim ve ark., 2014).

Keklerde yağ ikamesi olarak kanola yağı-karnauba mumu oleojellerinin kullanıldığı çalışmada %50'ye kadar oleojellerin yağ ikamesi olarak kullanımı hava hücrelerini kek hamurlarında tutma kabiliyetini korumada etkili olmuştur. Ancak oleojellerin yağ ikamesi olarak kullanım oranı arttıkça kek hacminde azalma eğilimi görülmüş ve bu durum kek sertliğinin artmasına yol açmıştır. Oleojel içeren keklerdeki doymuş yağ asitleri seviyesi (%13,3) katı yağlı kontrol (%74,2) ile karşılaştırıldığında önemli ölçüde düşmüştür. Kontrol ve yağ yerine %25 oleojel ikamesi içeren kekler arasında belirgin farklılıklar gözlenmemiş olup bu durum kek formülasyonundaki yağın, kek kalitesinde kayıp olmaksızın %25'e kadar oleojeller ile ikame edilebileceğini göstermiştir (Kim ve ark., 2017).



Song ve ark.(2017) yağ içeriği %75'e kadar azaltılmış kek formülasyonunda fesleğen tohumu müsilağı kullanmıştır. Yağ içeriği %25 azaltılmış fesleğen tohumu müsilağı içeren örneklerin özgül ağırlık, hamur verimi, pişirme kaybı, hacim indeksi ve simetri indeksi iyileştirilmiştir. Ayrıca retrogradasyonu inhibe ettiğini doğrulanmıştır.

Çikolatalı keklerde chia jeli yağ ikamesi olarak kullanılmış, %50 oranında yağ ikamesi içeren formülasyon ürünün teknolojik özelliklerini geliştirmiştir. %75 yağ ikamesi içeren formülasyonda, spesifik hacim haricinde bütün teknolojik parametrelerde düşüş tespit edilmiştir (Fernandes ve Mellado ark., 2017).

Rodriguez-Sandoval ve ark. (2017) modifiye manyok nişastasını keklerde %16 oranına kadar yağ ikamesi olarak kullanmıştır. Yağı azaltılmış keklerde %8'in üzerinde modifiye manyok nişastasının yağ ikamesi olarak eklenmesi keklerin kalite özelliklerini ve dokusal özelliklerini etkilemiştir. Modifiye manyok nişastası %8'in üzerinde kullanıldığında keklerin yüksekliği azalırken sertlik değeri artmıştır. Modifiye manyok nişastasının eklenmesi, depolama sırasında daha düşük kek içi nem içeriği ve daha yüksek kek içi sertliği ile sonuçlanmıştır. Depolamanın 2. ve 4. günlerinde %8 yağ ikamesi içeren kekler ve kontrol keklerinin genel kabul edilebilirliğinde fark saptanmamıştır.

Ham ve yıkanmış kakao çekirdeği kabuğunun keklerde yağ ikamesi olarak kullanıldığı çalışmada kül, protein, toplam fenolik bileşik ve toplam antioksidan aktivite yıkama işlemiyle azalmıştır. Yağ ikamesi içeren keklerin ham selüloz içeriği kontrol kekine kıyasla daha yüksek saptanmıştır. Keklerde yağın %50'si ham kakao çekirdeği kabuğu ile ikame edildiğinde kekin kimyasal, fiziksel ve duyu özelliklerini önemli ölçüde geliştirdiği ifade edilmiştir (Öztürk ve Ova, 2018).

Kek üretiminde çözünür lif (maltodekstrin) ve çözünmeyen lif (patates lifi) %30 oranında yağ ikamesi olarak kullanıldığı çalışmada, çözünür lif keklerin yapısını ve kalitesini çözünmeyen liften daha az etkilemiştir. Çözünür lifle hazırlanan kekin sertliği çözünmeyen lifle hazırlanan kekten daha az saptanmıştır. Ayrıca tüketici tarafından kontrol keki ile çözünür lifle hazırlanan kekler arasında farklılık bulunmamış olup çözünmez lifle hazırlanan kekler daha az beğenilmiştir (Diez-Sánchez ve ark., 2018).

Ateş ve Elmacı (2018), kahve çekirdeği zarını %30 oranına kadar keklerde yağ ikamesi olarak kullanmıştır. Kahve çekirdeği zarının yağ ikamesi olarak kullanımı spesifik hacim ve ağırlık kaybını etkilemezken, kek kabuğunun L* ve b* değerlerini azaltmış, a* değerini artırmıştır. Keklerin sertlik ve çignenebilirlik değerleri artmış, esneklik ve iç yapışkanlık değerleri azalmıştır. Keklerde kahve çekirdeği zarı kullanımı nem, kül ve antioksidan aktivite değerlerini de artırmıştır. Kek karakteristiklerine etki etmeden %30'a kadar kahve çekirdeği zarının yağ ikamesi olarak kullanılabilmesi tespit edilmiştir.

Hindiba köklerinden ve yer elması yumrularından elde edilen inülin keklerde %50'ye kadar yağ ikame maddesi olarak kullanmıştır. Artan inülin konsantrasyonu ile kek hamurunun viskozitesinin azaldığı, su kaybı ile artan inülin konsantrasyonu arasında ters ilişki olduğu belirlenmiştir. Panelistler tarafından %30 yağ ikamesi içeren örnekler en çok beğenilmiştir. Yağ ikame maddesi olarak yüksek seviyelerde inülin kullanılarak hazırlanan keklerde acılık tespit edilmiştir (Rashid ve ark., 2018).

Keklerde yeşil muz püresi yağ ikamesi olarak yer aldığı kekin sertlik ve esneklik değerleri artmıştır. Yeşil muz püresi %25 yağ ikamesi olarak kullanıldığında kontrol kekine benzer nitelikte yağı azaltılmış kek elde edilmiştir (de Souza ve ark., 2018).

Hidroksipropil metilselüloz oleojelleri keklerde yağ ikamesi olarak yer aldığı kekin düşük viskoziteli kek hamurları elde edilmiştir. Hamurun özgül ağırlığı, artan yağ ikame oranıyla artma eğilimi göstermiştir. Yağ ikame oranı %50'ye kadar çıktığında pişmiş keklerin özgül hacmi, sertlik ve çignenebilirliği olumsuz etkilenmemiştir. Bu sonuçlar, hidroksipropil



metilselüloz oleojellerinin, keklerin kalite özelliklerinde önemli bir bozulma olmadan %50'ye varan katı yağları değiştirmede etkili olabileceğini göstermiştir (Oh ve Lee, 2018).

Pehlivanoglu ve ark. (2018) kekte oleojel kullanılarak keklerin yağ içeriğinin azaltılması ve katı yağ yerine doymamış yağ asidi bileşimi bakımından zengin oleojeller kullanılarak keklerdeki doymuş yağ asidi içeriğini azaltmıştır. Oleojel içeren keklerin renk özelliklerinin kontrol numunesine çok benzer olduğu saptanmıştır. Formülasyonunda yağ ikamesi olarak oleojel içeren kekin dokusal özellikleri önemli ölçüde etkilenmiştir. Duyusal analiz sonuçları göre oleojel içeren keklerin tüketilebilir olduğunu göstermiş ve en çok kabul gören örnek, yüksek oleik asitli ayçiçek yağı ve eşit miktarda (50/50) pamuk çekirdeği yağından üretilen oleojeli içeren örnek olarak tespit edilmiştir.

Quiles ve ark. (2018) kekteki yağın %30'unu ikame etmek için siyah frenk üzümü veya aronya posası kullanmışlardır. İki tür posayı yağ ikamesi olarak içeren kekler, düşük yükseklik, sertlik ve daha az sayıda gözenek sergilemiştir. Yağın ikame edildiği keklerde, pişirme sırasında daha az ağırlık kaybı olmuştur.

Kekte yağ yerine farklı oranlarda (20, 30, 40 ve 50%) reishi mantarından elde edilen β -glukan kullanılmıştır. Yağ ikamesi olarak β -glukan kullanımıyla hamurun içinde daha az hava kabarcığı bulunduğu için keklerin hacminde azalma gözlenmiştir. Kekte kullanılan β -glukan konsantrasyonu arttıkça saklama sırasında keklerin sertliğinin de önemli ölçüde arttığı belirlenmiştir. Yağı azaltılmış kekler kontrol örneğiyle benzer renk, nem içeriği ve su aktivitesi sergilemiştir. Yağın %50 seviyesinde β -glukan ile ikame edilmesi fiziksel olarak kekte önemli değişikliklere neden olmaktadır. Yağ yerine %40 oranında β -glukan kullanımının kek üzerinde olumsuz etki olmaksızın kek formülasyonunda yer alabileceği belirlenmiştir (Artunduaga ve Gutiérrez, 2019).

Punia ve ark. (2019) kekte %40'a kadar yağ ikamesi olarak maş fasulyesi kullanmıştır. Maş fasulyesi nişastası içeren keklerin daha yüksek özgül hacme sahip olduğu görülmüştür. Çalışmada %30 maş fasulyesi nişastasını yağ ikamesi olarak içeren keklerin en iyi dokuya, beğenilen renge ve ağız hissine sahip olduğu belirlenmiştir. Genel olarak %30 oranında maş fasulyesi nişastası içeren keklerin kabul edilebilir olduğu sonucuna varılmıştır.

Karnıyarık otu (psyllium) kekte yağ ikamesi olarak kullanıldığında, yüksek oranda yapılan yağ ikamesi kabarcık boyutunu arttırmış, ancak sulu hamur yoğunluğunda önemli bir fark gözlenmemiştir. Yağ ikame oranının artırılması keklerin spesifik hacmini düşürmüştür. 7 günlük depolamadan sonra kontrol kekine kıyasla sertlikte önemli bir fark saptanmamıştır. Yağ ikame oranının artışıyla kabuk rengi daha açık hale gelmiş olup, a^* değeri azalmış ve b^* değeri artmıştır. Genel olarak, %25 yağ ikamesi içeren kekler kontrol kekiyle kıyaslandığında genel kabul edilebilirliğinde fark belirlenmemiştir (Belorio ve ark., 2019).

Mikrobiyal β -glukan yağ ikamesi olarak kek formülasyonunda yer aldığı β -glukan içeren kek hamurunun ve keklerin kontrol numunesine göre daha sert olduğu tespit edilmiştir. % 40'ın üzerinde β -glukan ile zenginleştirirken keklerin kalitesinde bir azalma belirlenmiştir. 14 günlük depolama süresinde de %30 ve %40 yağı azaltılmış keklerde sertlik artışı tespit edilmiştir. Yağın β -glukan ile % 40'a kadar ikame edilmesi duyusal olarak kabul edilebilir kek üretimi sağlanabildiği ancak daha yüksek ikame oranlarında kabul edilebilirliğin azaldığı saptanmıştır (Żbikowska ve ark., 2020).

SONUÇ

Değişen beslenme alışkanlıklarıyla birlikte daha az kalorili veya sağlıklı beslenme arayışına girilmiştir. Bu çalışmada kek üretiminde yağın yerini tutabilecek ikame maddeleri incelenmiştir. Kek üretiminde yağ kekin dokusuna, görünüşüne, lezzetine ve hacmine etki eden oldukça önemli temel bileşendir. Yapılan araştırmalardaki verilere göre yağ yerine birçok



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on FOOD, AGRICULTURE and VETERINARY
19-20 June, Izmir-TURKEY**



ikame maddesi kullanabileceği kabul edilmiştir. Yağ ikame maddesinin kullanım oranına bağlı olarak kek yapısının etkilendiği saptanmıştır. Bu derleme sonucunda kekte değişen oranlarda yağ ikamesi olarak yulaf kepeği, keten tohumu, maltodekstrin, polidekstroz, β -glukan, chia jeli, kakao lifi, peynir altı suyu konsantresi ve portakal kabuğu, inülin, pektin, oleojel, fesleğen tohumu müsilajı, manyok nişastası, kakao çekirdeği kabuğu, çözünür ve çözünmez lif, kahve çekirdeği zarı, yeşil muz püresi, siyah frenk üzümü ve aronya posası, maş fasulyesi nişastası, karniyarik otunun kullanıldığı belirlenmiştir.



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DOCUMENTATION OF PLANT GENETIC RESOURCES IN BULGARIA – CURRENT STATUS AND NEW APPROACHES

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ABSTRACT

Plant genetic resources for food and agriculture are critically important for the sustainable food production in condition of an ever-growing population and climate change. The study aims to present the documentation of germplasm accessions, stored in the Bulgarian seed genebank, and the new approaches, corresponded with the international agreements, which address the conservation, sustainable use and access and benefit-sharing of these resources. The survey is based on the national register of plant genetic resources and the European Searching Catalogue EURISCO. According to EURISCO the National Inventory of Bulgaria includes 69,644 accessions. Among those, 17,978 accessions are characterized with Bulgarian origin. During the period 1982–2021, the fund of the National Genebank in Sadovo has been enriched with 53,474 seed accessions. Through expeditions 10,715 local accessions and wild crop relatives, have been collected from home gardens and natural habitats within the country. There are 36,712 genotypes introduced by international free exchange. Registered are 6,047 breeding materials: lines and advanced varieties. Collections of cereals, grain legumes, oil and industrial crops, forages, vegetables, medical and aromatic plants have been created. All seed accessions are listed, according to the international standards of FAO/Bioversity Multi-Crop Passport Descriptors. The research is supported by the project № KII-06H36/2 BG PLANTNET “Establishment of National Information Network Genebank – Plant Genetic Resources” of the National Scientific Fund of the Ministry of Education and Science in Bulgaria.

Keywords: crops, conservation, documentation, *ex situ* collections, plant diversity



1. INTRODUCTION

The germplasm is a valuable natural resource in plant diversity that is crucial for its potential use. The germplasm preservation seeks to conserve endangered and vulnerable plant species worldwide for future proliferation and development and it is also the bedrock of agricultural production (Priyanka & al., 2021). To ensure our nutrition and economic safety, mankind is reliant on the continuous availability of a diverse pool of plant genetic resources for food and agriculture. We face significant hurdles in mobilizing them for effective and sustainable use. International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA, 2009) was signed, for a sustainable use of plant biodiversity, as well as the fair and equitable sharing of advantages accruing from their usage, in accordance with the Convention on Biological Diversity (FAO, 1992).

Enrichment of genetic resources means collected, systematized and documented components of biodiversity of actual or potential value, stored in controlled conditions outside their natural habitats (*ex situ*) by organizations or their specialized structural units in order to maintain them alive, further study and rational use. All collections of genetic resources of cultivated plants and their wild relatives must have a certain minimum of information about the preserved specimens according to the norms of work with genetic material. The database of collections includes descriptive information about each specimen, stored in the organization - the holder of the collection. Plant genetic resources are a public fund and the profits should be used for society interest. As the societies and economies become more and more driven by data and information, the governance of information is increasingly important. In parallel, as biodiversity continues to decline the status quo is not acceptable and new solutions need to be found. The main goal of all EU programs regarding plant diversity is to improve the coordination of conservation activities in Europe and to facilitate the access to plant genetic resources. Information activities are directed towards guaranteeing a free access to conserved germplasm and interaction between all stakeholders (CBD, 2011).

Bulgaria is an area particularly suitable for the cultivation of different crops. It is one of the richest in plant diversity countries in Europe. Despite being small in size (110,910 km²), the territory of the country includes three biogeographical regions - Alpine, Black Sea and Continental. The various relief and geology, the specific microclimatic conditions and the millennium human activity determine the rich plant diversity and habitats, most of them with conservation status (CBD, 2014). However, it is estimated that over the last decades, the area experienced genetic erosion, resulting in the loss of many traditional plant genetic resources (Krasteva & al., 2009; Knüpffer, 2016).

Local varieties (in terms of crop landraces, old cultivars and neglected crops) have unique climatic and ecological tolerances. Therefore, the main priority for conservation at the national level is focused on the species and variety diversity in home gardens (Knüpffer, 2002; Kehlenbeck & al., 2007; Borrell & al., 2020; Ulian & al., 2020).

The study aims to present the documentation of germplasm accessions, stored in the Bulgarian seed genebank, and the new approaches, corresponded with the international agreements, which address the conservation, sustainable use and access and benefit-sharing of these resources.

2. MATERIAL and METHODS

The Institute of Plant Genetic Resources – Sadovo, Bulgaria is the National Coordinator in the European Program for Plant Genetic Resources (ECPGR). The scientific areas are coordinated in line with the EU's priorities for agriculture and rural development.



The National Genebank in Bulgaria was established in 1984. The research activities are carried out according to the FAO standards for long-term conservation of plant germplasm under controlled conditions. Three collections are maintained: base collection – long-term conservation of accessions in hermetically closed containers at -18°C and at 3–7% moisture (depending upon species); work collection – under $+6^{\circ}\text{C}$; and collection for free exchange with national and international partners (FAO, 2014).

The Information and Documentation Centre is responsible for registration, documentation and information about the seed accessions, conserved in the National Genebank of Bulgaria. All seed accessions are listed in the National Register of plant genetic resources, according to the international standards of FAO/Bioversity (2017). Each genotype has a unique collection number and passport characterization data to be managed in its level of conservation. The information includes taxonomic description, data of registration, country of origin, donor, ecology-geographical characterization of the habitat, biological status, type of conservation – long term, medium or work collection, whether the genotype is available for exchange, whether it is duplicated in other genebanks etc. The taxonomic description of the crops is under the nomenclature of the USDA Genetic Resources Information Network (GRIN, 2015).

The free electronic access to the information about the Bulgarian *ex situ* collection is possible through international databases. The National Genebank is nominated by ECPGR as a focal point for Bulgaria in EURISCO – European Searching Catalogue, providing information about *ex situ* plant collections, maintained in Europe (Weise & al. 2017).

The free exchange of seeds for scientific purposes in the country and abroad is based on signing a Standard Material Transfer Agreement (SMTA), according to the international genebank standards (FAO, 2014).

3. RESULTS and DISCUSSION

During the activities of the National Plant Genetic Resources Program, the Genebank of Bulgaria has collected over 69,644 accessions belonging to 532 genera and 1,927 plant species. According to the EURISCO (<http://eurisco.ecpgr.org>; data check June, 2021) the Bulgarian collection is the 7th biggest in Europe and has a share of 3,4%, after Great Britain, Russia, Germany, Ukraine, Poland and Spain. The collection consists of genotypes of diverse geographical origin from three institutes (Table 1).

Table 1. Status of the Bulgarian National Inventory in EURISCO (June, 2021)

FAO INSTCODE	No of accessions	BGR origin
BGR001	65,224	16,145
BGR005	563	4
BGR029	3,857	1,829
No of accessions	69,644	17,978

During the period 1982-2021 the fund is enriched with 53,474 accessions. Documentation system optimizes the management of plant genetic resources in relation to their targeted storage, study, reproduction, free exchange and use. Currently, accessions with local Bulgarian origin are 31,4 % of the genebank fund, their conservation and sustainable preservation being a priority in the activities of enrichment of the collections, in accordance with the new national-level accents.

The accessions from collecting missions are 10,715 – local varieties and populations from home gardens and crop wild relatives from their natural habitats. With higher percentage from the



local accessions are grain legumes and vegetable crops followed by cereals. The genetic diversity is present even in a single farm and village. Emerging from unconscious selection within a population and well adapted to environmental factors, the local plant genetic resources are of great importance in the context of limited use of fertilizers and plant protection products in organic farming. Local varieties could be successfully used in crop breeding for the transfer of valuable economic traits as tolerance to abiotic and biotic stress, high biological value, etc. The described geographical characteristics of the collected accessions make it possible for the traditional varieties to restore in the regions of origin through the seed resources stored in the *ex situ* collections in the genebank.

Home gardens are recognized as *in situ* conservation sources of germplasm diversity. Local crop varieties are maintained by farmers or gardeners within traditional farming systems as part of these conservation techniques. Landraces are sown and harvested, and the farmer often saves a portion of the harvested seed for resowing in subsequent seasons. The farmer saves the valuable germplasm, whether deliberately or accidentally.

Traditional vegetables are cultivated varieties arising through a long history of selection and cultivation in places like home gardens. They are defined as indigenous or exotic species which, due to prolonged use, have become part of the culture of a community. Traditional vegetables have considerable commercial value and high market potential to contribute the household income. However, traditional vegetables as a valuable source for food and nutritional security are underutilized and under-represented in the global conservation system for plant genetic resources.

In the database 6,047 breeding materials are registered – lines and improved new varieties from the institutes of the Agricultural Academy, Bulgarian Academy of Science, Agricultural University and others. The access to them is regulated in accordance with the principles for the protection of breeders' intellectual property rights.

Plant breeding has profound impact on food production and will continue to play a vital role in world food security. Genetic diversity plays critical role in crop improvement because crossing between genetic materials of diverse origin which shows superiority over the closely related species. Plant breeding is primarily depends on presence of substantial genetic variation to address the maximum genetic yield potential of the crops and exploitation of this variation through effective selection for improvement. Hence, plant breeding was launched earlier with plant domestication to develop the superior genotypes in terms of yield, resistance to diseases and insects and other many different traits. Plant breeding has decreased the variation of genetic materials due to the limited preferences of crop plants for further improvements for different desirable traits.

There are 36,712 genotypes, introduced from abroad by international germplasm free exchange. The National Genebank conducts professional contacts with about 197 genebanks, centers for plant genetic resources and botanical gardens worldwide. The main partners of the Bulgarian Genebank in the exchange are established research centers such as GRIN (USDA), ICARDA (Syria), VIR (Russia), NordGen (Sweden), IPK (Germany), INRA (France), John Innes Center (UK). The requested foreign germplasm is investigated in the country environmental conditions and used as a donor of valuable traits in breeding programs.

Ex situ collections from cereals, grain legumes, technical, fodder, vegetable, medical and aromatic crops are maintained. The highest share of accessions is from the genera *Triticum*, *Hordeum*, *Zea*, *Phaseolus*, *Avena*, *Capsicum*, *Pisum*, *Arachis* (Fig 1).

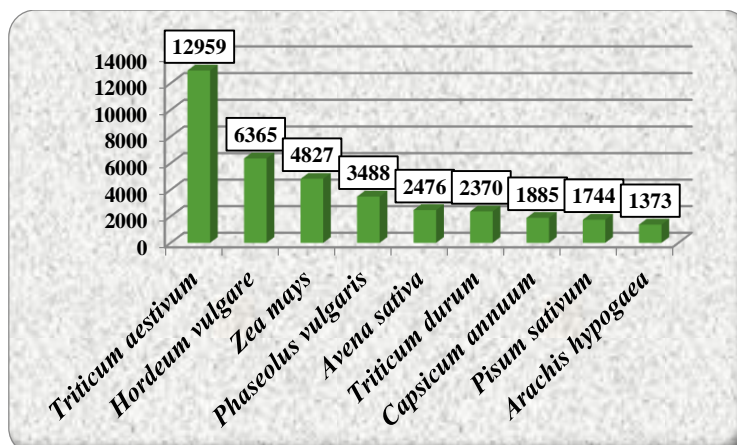


Fig. 1. Species with the highest number of accessions in the Bulgarian National Inventory

A total of 450 plant species from 60 families are maintained in the Botanical Garden of the Institute of Plant Genetic Resources – Sadovo. Rare and endemic and endangered plants are maintained in the botanical garden. Of these, eight species are Balkan endemics: *Achillea clypeolata*, *Allisoides bulgarica*, *Knautia macedonica*, *Chamaecitissus janke*, *Iris reichenbachii*, *Iris suaveolens*, *Aegilops cylindrica*, *Haberlea rhodopensis*, which also has the status of a rare species; five species of Bulgarian endemics: *Allium rhodopaeum*, *Sedum album*, *Vicia incisa*, *Aegilops neglecta*, *Soldanella rhodopaea*; four species of endangered plants: *Leucyrum aestivum*, *Artemisia pedemontana*, *Anemone sylvestris*, *Pyraacantha coccinea*; and 11 rare species: *Meum athamanticum*, *Artemisia lerchiana*, *Artemisia pontica*, *Leontopodium alpinum*, *Leucanthemum vilgare*, *Andrachne telephioides*, *Aegilops triuncialis*, *Koeleria brevis*, *Secale cereale var. perene*, *Clematis alpina*, *Paeonia tenuifolia*. Thematic distribution of species is: essential oily, cereal grasses, fodder, decorative, protected and rare species, wild crop relatives. The Bulgarian germplasm collection consists of accessions of different biological status, and they are divided into different categories – crop wild relatives, traditional and advanced varieties, with a high share of the breeding materials, presented in their various subcategories (lines, synthetic populations, hybrids, etc.). Within EURISCO, in addition to the electronic catalogue, there are also other databases - AEGIS (A European Genebank Integrated System) and ECPGR Central Crop Databases (ECCDB). A new EVA (European Evaluation Network) electronic system is currently under construction to improve access to and use of stored *ex situ* collections, including evaluation and characterization information. All of these databases use the EURISCO format.

The status of the Bulgarian National Inventory in the AEGIS database (<https://www.ecpgr.cgiar.org/aegis>, data check June, 2021) includes information about 391 local accessions with Bulgarian origin (Table 2).



Table 2. Bulgarian accessions in AEGIS database (data check February 2021)

Crops	Country of origin	Sample status	No of accessions
<i>Triticum aestivum</i>	BGR	local	135
<i>Triticum dicoccon</i>	BGR	local	26
<i>Triticum durum</i>	BGR	local	126
<i>Triticum monococcum</i>	BGR	local	32
<i>Triticum spelta</i>	BGR	local	7
<i>Secale cereal</i>	BGR	local	15
<i>Lathyrus sativus</i>	BGR	local	9
Medical and aromatic plants	BGR	local/wild	41
No of accessions			391

The National Genebank of Bulgaria implemented free germplasm exchange by providing accessions to national and foreign users. The exchange collection contents 2,989 accessions of 42 genera and 89 plant species. According to the annual reports in the period 2017-2020, 258 seed samples from cereals, oil crops, legumes and vegetables were provided to researchers in Bulgaria for research and breeding activities. By seed requests totally 709 accessions from 27 plant species were sent to scientific organizations as genebanks, research institutes, etc. within EU countries (549 accessions), Japan (61 accessions), China (50 accessions), India (20 accessions), Israel (11 accessions), Mexico (11 accessions), and New Zealand (7 accessions). The scientific interest of the partners abroad is focused mainly on the local germplasm from genus *Triticum*, *Hordeum*, *Avena*, *Zea*, *Pisum*, diverse forage grasses, vegetables, as well as the new varieties of *Arachis hypogaea* and *Sesamum indicum*, related to the climate change. The germplasm is distributed internationally complying with the quarantine requirements of the recipient country.

From 2019 an integral National network for plant genetic resources with specialized software for the purposes of the genebank, the information center and all institutes keeping *ex situ* collections according to the international standards it starts to be established. The intelligent system ensures the full public access to the information about the fund of Bulgarian Genebank for all stakeholders and it is expected to increase the sustainable use of germplasm in breeding programs and agricultural production.

By reviewing and highlighting the National state of conserved plant germplasm, we attempt to unlock food resources from some neglected and underutilized species, which along with the wealth of traditional knowledge about their uses and practices, could help support sustainable agriculture while ensuring better protection of the environment and the continued delivery of its ecosystem services. This work informs a wide range of user communities, including scientists, conservation and development organizations, policymakers, and the public of the importance of biodiversity beyond mainstream crops.

4. CONCLUSIONS

Agriculture is under great pressure to produce greater quantities of food on limited land resources. Such circumstances are being exacerbated with the threat of climate change. In this regard, plant genetic resources could be undertaken as a proper solution in encountering the global challenges.

The Bulgarian National Genebank in Sadovo maintains one of the largest *ex situ* collections in Europe and the richest conserved plant diversity in Southeast European region.

Documentation, according to the international standards of FAO/Bioversity, optimizes the management of *ex situ* collections in relation to their sustainable conservation, access and target use.

European Information Networks provide free access of potential users to conserved genotypes according to the principles of the International Treaty on Plant Genetic Resources for Food and



Agriculture and the implementation of the Nagoya Protocol on equitable distribution of their benefits.

The germplasm serves as the raw material for breeders to improve various crops. The National Network for plant genetic resources will gradually build a "knowledge bank" and also will be a great platform for scientists looking to enhance biodiversity as a source of agricultural development.

5. ACKNOWLEDGEMENTS

The research is supported by the project № KII-06H36/2 BG PLANTNET “Establishment of National Information Network Genebank – Plant Genetic Resources” of the National Scientific Fund of the Ministry of Education and Science in Bulgaria.



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ÇOKLU DOĞRUSAL REGRESYON MODELLERİ İLE İZMİR İÇİN REFERANS BİTKİ SU TÜKETİMİNİN (ET₀) TAHMİNLENMESİ

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ÖZET

İklim değişikliği, “iklimin ortalama durumunda ya da onun değişkenliğinde onlarca ya da daha uzun yıllar boyunca süren istatistiksel olarak anlamlı değişimler” olarak ifade edilmektedir. İklim değişikliğinin getireceği çok sayıda olumsuz etki vardır. İklim değişikliğinin etkilerinden biri olan kuraklık riskinin artması tüm dünyada olduğu gibi ülkemizde de su kullanımı konusunda dikkatli olunması gerekliliğini ortaya koymaktadır. En çok su kullanımının tarım sektöründe olduğu gerçeği, tarım sektöründe doğru bir sulama programlaması yapmayı zorunlu hale getirmektedir. Sulama programlarında kullanılan temel veri ise bitki su tüketimidir. Bu verinin iklim şartlarına göre değerlendirilip hesaplanması ve buna göre sulama programlarının oluşturulması, mevcut su kaynaklarının korunması bakımından önem arz etmektedir. Bu çalışmada, İzmir bölgesinde Mayıs ayı için iklim verilerinden yararlanılarak Penman - Monteith eşitliği ile referans bitki su tüketimleri (ET₀) hesaplanmıştır. Çoklu doğrusal regresyon modelleri (ÇDRM) kullanılarak Penman - Monteith eşitliğinden elde edilen verilere en yakın referans bitki su tüketimi değerleri elde edilmeye çalışılmıştır. Bu şekilde değişen iklim şartlarına bağlı olarak modele girilen verilerle referans bitki su tüketimi değerlerinin ÇDRM₁ ve ÇDRM₂'de (R²=0.98) %98 oranında doğru sonuca ulaşıldığı hesaplanmıştır. ÇDRM₁ ve ÇDRM₂'de korelasyon katsayıları 0.87 olarak tespit edilmiştir. Her iki modelin standart hatası ise 0.04 olarak bulunmuştur. ÇDRM₃'de ise (R²=0.58) %58 oranında istatistiksel olarak doğru sonuca ulaşılmıştır. ÇDRM₃'ün korelasyon katsayısı 0.68 olarak elde edilmiştir. Standart hatası ise 0.17 olarak hesaplanmıştır. Karekök ortalama karesel hata (KOKH) değerleri ÇDRM₁, ÇDRM₂ ve ÇDRM₃ için sırasıyla 0.04, 0.04 ve 0.16 olarak bulunmuştur. Ortalama mutlak göreceli hata değerleri (OMGH) ise ÇDRM₁, ÇDRM₂ ve ÇDRM₃ için sırasıyla %6.63, %6.67 ve %26.5 olarak tespit edilmiştir.

Anahtar Kelimeler: Referans bitki su tüketimi, regresyon, modelleme



ESTIMATION OF REFERENCE PLANT WATER CONSUMPTION (ET_0) FOR IZMIR WITH MULTIPLE LINEAR REGRESSION MODELS

ABSTRACT

Climate change is expressed as "statistically significant changes in the average state of the climate or its variability over tens or more years". There are many negative effects of climate change. Increasing the risk of drought, which is one of the effects of climate change, reveals the need to be careful about water use in our country as in the whole world. The fact that the most water use is in the agricultural sector makes it necessary to make an accurate irrigation programming in the agricultural sector. The main data used in irrigation programs is evapotranspiration. Evaluating and calculating this data according to climatic conditions and creating irrigation programs accordingly are important in terms of protecting existing water resources. In this study, using the climate data for May in the Izmir region, reference evapotranspiration (ET_0) was calculated with Penman - Monteith equation. The closest ET_0 values to the data obtained from Penman - Monteith equation was tried to be obtained by using multiple linear regression models ($\mathcal{C}DRM$). In this way, it has been calculated that 98% of the ET_0 values were reached in $\mathcal{C}DRM_1$ and $\mathcal{C}DRM_2$ ($R^2 = 0.98$) with the data entered into the model depending on the changing climatic conditions. Correlation coefficients in $\mathcal{C}DRM_1$ and $\mathcal{C}DRM_2$ were determined as 0.87. The standard error of both models was found to be 0.04. In the $\mathcal{C}DRM_3$ ($R^2 = 0.58$), a statistically correct result was reached at a rate of 58%. Correlation coefficient of $\mathcal{C}DRM_3$ was obtained as 0.68. Its standard error was calculated as 0.17. Root mean square error (KOKH) values were found as 0.04, 0.04 and 0.16 for $\mathcal{C}DRM_1$, $\mathcal{C}DRM_2$ and $\mathcal{C}DRM_3$, respectively. Mean absolute relative error values (OMGH) were determined as 6.63%, 6.67% and 26.5% for $\mathcal{C}DRM_1$, $\mathcal{C}DRM_2$ and $\mathcal{C}DRM_3$, respectively.

Keywords: Climate change, sustainable agriculture, drought, flood



GİRİŞ

İklim değişikliğine bağlı olarak kuraklık riskinin artması ile su kaynaklarının etkin kullanımı konusu dünyada olduğu gibi Türkiye’de de artarak önem kazanmaktadır. Bu nedenle bitki yetiştiriciliğinde kullanılacak sulama suyunun, olanaklar ölçüsünde en az kayıpla sulama alanlarına iletilmesi, alan içinde dağıtılması ve bitki-su gereksinimini istenen düzeyde karşılayacak biçimde bitki kök bölgesine verilmesi bir bakıma zorunlu hale gelmiştir (Bayramoğlu, 2013; Atış ve ark., 2015).

Ülkemizdeki kuraklık olaylarının en şiddetli ve geniş alanlara yayılmış bir şekilde etkili olanları 1990, 1996 ve 2001 yıllarında gerçekleşmiştir (Türkeş, 2003; Suzan ve Gürgülü, 2019). Kuraklık etkisi 2007 yılında tekrar kendini göstermiş ve tarımsal üretimde kayıplar yaşanmıştır (Şimşek ve ark., 2007a; Şimşek ve ark. 2008; Suzan ve Gürgülü, 2019). Devamında kurak dönemler 2014 ve 2020 yıllarında barajlardaki su seviyesini düşürerek su stresinin yaşanmasına sebep olmuştur (İSKİ, 2021).

Tarımsal üretimde sulama zamanı ve aralıklarının programlanmasında, bitki sulama suyu ihtiyacının belirlenmesinde, kuraklığın izlenmesi ve hidrolojik modellerin oluşturulmasında, sulama ve drenaj sistemleri ile göletlerin ve barajların projelendirilmesi ve işletilmesinde dikkate alınan temel veri evapotranspirasyon (ET_c) olarak adlandırılan bitki su tüketimidir. Bitki yaprak yüzeylerinden gerçekleşen terleme (Transpirasyon) kayıpları ile topraktan veya su yüzeyinden gerçekleşen buharlaşma (Evaporasyon) kayıplarının toplamı olarak tanımlanan evapotranspirasyon; toprak, bitki, iklim ve işletme biçimi gibi çok sayıda etmenin etkisiyle gerçekleştiğinden doğadaki en karmaşık olaylardan birisi olarak kabul edilmektedir (Kanber, 2006; Usta ve Gençoğlu, 2019). Bununla birlikte, evapotranspirasyonu doğrudan etkileyen iklim parametrelerinin yağış, sıcaklık, rüzgar hızı ve oransal nem olduğu bilinmektedir (Uçak ve ark., 2013; Usta ve Gençoğlu, 2019).

Kuraklıklara bağlı olarak suyun önemi artmıştır. Sudan ve suyun getirdiği faydalardan en yüksek düzeyde yararlanılması için bölge koşullarının iklim ve topoğrafya yapısına uygun bitki su tüketim miktarları belirlenip sulama programları hazırlanmalıdır (Aydınşakir ve ark., 2003). Bu açıdan evapotranspirasyon bir bölgede sulama programının belirlenmesinde oldukça önemli bir görev üstlenmektedir (Jensen ve ark., 1990).

Sulamada önemli bir parametre olan evapotranspirasyonun sağlıklı olarak belirlenmesi gerekmektedir. Evapotranspirasyon doğrudan tarla denemeleri veya lizimetre koşullarında denemeler yapılarak ölçülmektedir. Gerçek evapotranspirasyonun elde edilmesi, arazide kontrollü ve ölçülü sulamalarla en az 3 yıl süreyle yapılan denemelerle olmaktadır. Bu ise uzun zaman, büyük emek ve masraf gerektiren bir yöntemdir. Bu güçlüklerden dolayı, tüm dünyada araştırmacılar, değişik iklim bölgeleri için amprik eşitlikler ve paket programlar geliştirerek bitki su tüketimini tahmin etmeye çalışmışlardır (Morton, 1976; Kodal ve Benli, 1984; Samani, 2000; Balçın ve ark., 2004).

Evapotranspirasyon yöntemleri birçok farklı koşula bağlı olarak değiştiğinden ve bölgeden bölgeye farklılık gösterdiğinden yöreye özgü eşitlikler geliştirilse bile sağlıklı sonuçlar vermemiştir. Bu amaçla evapotranspirasyon miktarını belirlemeye yönelik birçok çalışma yapılmıştır (Doorenbos ve Pruitt, 1977; Jensen ve ark., 1990). Bu çalışmalar içerisinde çok sayıda araştırmada, iklim verilerine bağlı olarak evapotranspirasyonu belirleme yöntemlerinde en başarılı yöntemin Penman-Monteith olduğu belirtilmiştir (Monteith, 1965).

Trabzon ilinde, Penman-Monteith eşitliğinden yararlanılarak 2009-2012 yılları arasında referans bitki su tüketimi (ET₀) hesaplanmış ve bu değerlere bağlı olarak yıllık ve aylık elde edilen ET₀ miktarlarında meydana gelen değişim saptanmaya çalışılmıştır. Çalışmada yıllar



arasında artan sıcaklık ve değişen verilere göre ET_0 miktarlarında artış olduğu belirtilmiştir (Bayramoğlu, 2013).

Bu çalışmanın amacı, İzmir bölgesinde yazlık olarak yetiştiriciliğin yapılmaya başlandığı Mayıs ayında uzun yıllar için (1990-2020 yılları), iklim değişikliğinin referans bitki su tüketimine etkisini ve bu etkiyi en doğru şekilde verebilecek doğru ÇDRM'ni bulmaktır.

MATERYAL ve YÖNTEM

İzmir, Türkiye'nin üçüncü büyük kentidir. İzmir, Ege kıyı bölgesinin tipik bir örneği gibidir. Kuzeyde Madra Dağları, güneyde Kuşadası Körfezi, batıda Çeşme Yarımadası'nın Tekne Burnu, doğuda ise Aydın, Manisa il sınırları ile çevrilmiş İzmir, batıda kendi adıyla anılan körfezle kucaklaşır. İzmir ili içinde Ege Bölgesi'nin önemli akarsularından olan Gediz Nehri'nin aşağı kolu ile Küçük Menderes Nehri bulunur. Akdeniz iklim kuşağında kalan İzmir'de yazları sıcak ve kurak, kışları ılık ve yağışlı geçmektedir. İzmir tarımsal anlamda zeytin, çekirdeksiz üzüm, incir, kiraz, kestane, pamuk, tütün, patates, soğan, domates ve çeşitli sebzelerin üretiminin yanında süs bitkileri, silajlık mısır, sertifikalı fidan ve tohum üretiminde ön sıralardadır (Anonim, 2021).

Referans bitki su tüketiminin (ET_0) tahmin edilmesi amacıyla birçok yazılım geliştirilmiştir (Karaca ve ark., 2017). Bunlardan biri FAO tarafından geliştirilmiş olan CROPWAT yazılımıdır. Maksimum ve minimum hava sıcaklıkları, oransal nem, rüzgar hızı ve günlük güneşlenme süresi gibi iklim parametrelerinin giriş değişkenleri olarak dikkate alındığı CROPWAT yazılımı referans bitki su tüketiminin tahmin edilmesi amacıyla araştırmacılar tarafından sıkça kullanılmaktadır. Penman Monteith eşitliğini kullanarak aylık ortalama günlük toplam ET_0 değerlerini hesaplayabilen CROPWAT yazılımında iklim parametreleri dışında rakım, enlem ve boylam değerleri de giriş değişkeni olarak dikkate alınmaktadır (Usta ve Gençoğlu, 2019).

Çalışmada kullanılacak olan CROPWAT yazılımında ihtiyaç duyulan iklim verileri, Meteoroloji Genel Müdürlüğü'nden (MGM) talep edilmiş ve 1990-2020 yılları arasındaki değerler kullanılmıştır. Hesaplamalar bitkisel üretim başlangıcının yoğun olarak yapıldığı "Mayıs" ayını kapsamaktadır. Bu veriler yıllar bazında "Mayıs" ayı için tek tek düzenlenip iklim verilerinin aylık ortalamaları EXCEL yazılımından elde edilmiştir.

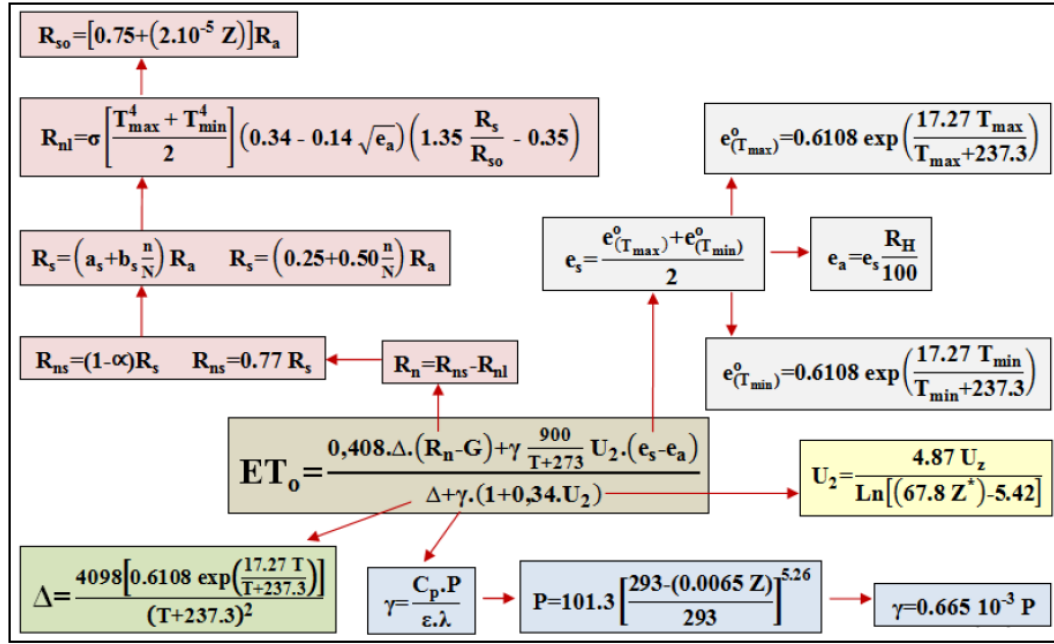
FAO 56 Penman Monteith eşitliğinin bileşenleri Şekil 1'de gösterilmiştir. Bitki su tüketimi (ET_0) hesaplamalarında ise Eşitlik 1 kullanılmıştır (Pereira ve ark., 2015).

$$ET_0 = \frac{0.408 \cdot \Delta \cdot (R_n - G) + \gamma \frac{900}{T + 273} U_2 \cdot (e_s - e_a)}{\Delta + \gamma \cdot (1 + 0,34 \cdot U_2)} \quad (1)$$

Eşitlik 1 ve Şekil 1'de; ET_0 : Referans evapotranspirasyon (mm gün^{-1}), Δ : Doymun buhar basıncı eğrisinin eğimi ($\text{kPa } ^\circ\text{C}^{-1}$), R_n : Bitki yüzeyindeki net radyasyon ($\text{MJ m}^{-2} \text{gün}^{-1}$), G : Topraktaki ısı akısı ($\text{MJ m}^{-2} \text{gün}^{-1}$), γ : Psikometrik sabite ($\text{kPa } ^\circ\text{C}^{-1}$), T : Ortalama hava sıcaklığı ($^\circ\text{C}$), T_{\max} , T_{\min} : Ortalama en yüksek ve en düşük hava sıcaklıkları ($^\circ\text{C}$), U_2 : 2 m yükseklikte ölçülen rüzgar hızı (m s^{-1}), U_Z : Toprak yüzeyinden Z yükseklikte ölçülen rüzgar hızı (m s^{-1}), Z^* : Rüzgar hızının ölçüldüğü yükseklik (m), e_s : Doymun buhar basıncı (kPa), e_a : Gerçek buhar basıncı (kPa), RH: Oransal nem (%), R_{ns} : Güneşten gelen net kısa dalga radyasyon ($\text{MJ m}^{-2} \text{gün}^{-1}$), R_{nl} : Dünyadan giden net uzun dalga radyasyon ($\text{MJ m}^{-2} \text{gün}^{-1}$), α : Yansıtma katsayısı (Albedo), R_s : Yeryüzüne ulaşan kısa dalga radyasyon ($\text{MJ m}^{-2} \text{gün}^{-1}$), R_a : Atmosferin dış yüzüne ulaşan radyasyon ($\text{MJ m}^{-2} \text{gün}^{-1}$), a_s , b_s : Regresyon katsayıları, n : Gerçek güneşlenme



süresi (saat), N: Olası maksimum güneşlenme süresi (saat), σ : Stefan Boltzmann katsayısı ($4.903 \cdot 10^{-9} \text{ MJ K}^{-4} \text{ m}^{-2} \text{ gün}^{-1}$), R_{so} : Açık gökyüzü radyasyonu ($\text{MJ m}^{-2} \text{ gün}^{-1}$), Z: Rakım (m), P: Atmosferik basınç (kPa), C_p : Sabit basınç altındaki özgül ısı ($\text{MJ kg}^{-1} \text{ }^\circ\text{C}^{-1}$), λ : Buharlaştırma gizli ısı (MJ kg^{-1}), ε : Su buharı moleküler ağırlığının kuru hava ağırlığına oranı ve $e^o(T_{max})$ ile $e^o(T_{min})$: En yüksek ve en düşük hava sıcaklıklarındaki doymuş buhar basıncını (kPa) ifade etmektedir (Pereira ve ark., 2015).



Şekil 1. FAO 56 Penman Monteith eşitliği ve bileşenleri (Usta ve Gençođlan, 2019)

Figure 1. FAO 56 Penman Monteith equation and its components (Usta ve Gençođlan, 2019)

ET_0 ile T_{max} , T_{min} , U_2 , n ve R_H iklim parametreleri arasındaki anlamlı istatistiksel ilişkilerin ortaya koyulmasında doğrusal regresyon analizi yöntemi kullanılmıştır (Eşitlik 2). Buna göre bağımsız değişkenler olarak T_{max} , T_{min} , U_2 , n ve R_H , bağımlı değişken olarak da ET_0 değerleri dikkate alınmıştır. T_{max} , T_{min} , U_2 , n ve R_H bağımsız değişkenlerinin çeşitli kombinasyonları kullanılarak üç adet çoklu doğrusal regresyon modeli (ÇDRM) geliştirilmiştir. İstatistiksel hesaplamalar için EXCEL programından yararlanılmıştır. Çizelge 1’de geliştirilen çoklu doğrusal regresyon modelleri ve bu modellerin oluşturulmasında dikkate alınan bağımsız değişkenler verilmiştir. Geliştirilen her bir model için, ET_0 tahmininde kullanılabilecek eşitliklerin oluşturulması amaçlanmıştır (Büyüköztürk, 2003; Usta ve Gençođlan, 2019).

$$\hat{Y} = a + (b_1 \cdot X_1) + (b_2 \cdot X_2) + (b_3 \cdot X_3) + (b_4 \cdot X_4) + \dots + (b_n \cdot X_n) \quad (2)$$

Eşitlik 2’de a: Tahmin eşitliğinin sabit değeridir. b_1 , b_2 , b_3 , b_4 ..., b_n : Doğrusal regresyon analizinde eğimler sabit tutulduğunda ilgili bağımsız değişkendeki birim artışa karşılık, bağımlı değişkende meydana gelen değişim miktarı olarak ifade edilmektedir. Kısmi eğim veya kısmi regresyon katsayısı olarak da isimlendirilebilmektedir. X_1 , X_2 , X_3 , X_4 ..., X_n : Doğrusal regresyon analizindeki bağımsız değişkenleri ifade etmektedir. Bağımlı değişkenin tahmin edilen değerini ($E\hat{T}_0$) ifade etmektedir.



Çizelge 1. Çoklu doğrusal regresyon analizi modelleri
Table 1. Multiple linear regression analysis models

Model	Bağımsız değişkenler	Tahmin eşitliği
<i>Model</i>	<i>Independent variables</i>	<i>Prediction equality</i>
ÇDRM ₁	X ₁ : T _{max} , X ₂ : T _{min} , X ₃ : U ₂ , X ₄ : n,	E \check{T} ₀ = a + (b ₁ . T _{max})+(b ₂ . T _{min})+(b ₃ . U ₂)+(b ₄ . n)+(b ₅ . R _H)
DDRM ₁	X ₅ : R _H	
ÇDRM ₂	X ₁ : T _{max} , X ₂ : T _{min} , U ₂ , X ₃ : n, X ₄ :	E \check{T} ₀ = a + (b ₁ . T _{max})+(b ₂ . T _{min})+(b ₃ . n)+(b ₄ . R _H)
DDRM ₂	R _H	
ÇDRM ₃	X ₁ : T _{max} , X ₂ : T _{min}	E \check{T} ₀ = a + (b ₁ . T _{max})+(b ₂ . T _{min})
DDRM ₃		

Bağımlı değişken olan ET₀'daki değişimin ne kadarının bağımsız değişkenler (T_{max}, T_{min}, U₂, n ve R_H) tarafından açıklandığını ifade etmek amacıyla Eşitlik 3 kullanılarak her bir modelin regresyon katsayısı belirlenmiştir. Bununla birlikte bağımlı değişken ile bağımsız değişkenler arasındaki ilişki düzeyini belirlemek amacıyla, Eşitlik 4 kullanılarak her bir modelin korelasyon katsayısı tespit edilmiştir (Akgül ve Çevik, 2003; Usta ve Gençoğlan, 2019). CROPWAT yazılımı kullanılarak hesaplanan referans evapotranspirasyon (ET₀) değerleri ile ÇDRM modelleri ile hesaplanan referans evapotranspirasyon (E \check{T} ₀) değerleri arasındaki farkın bir ifadesi olarak Eşitlik 5 ile standart hata miktarları belirlenmiştir (Köksal, 1985; Usta ve Gençoğlan, 2019).

$$R^2 = \frac{\sum_{i=1}^n (\hat{Y}_i - \bar{Y}_i)^2}{\sum_{i=1}^n (Y_i - \bar{Y}_i)^2} \quad (3)$$

$$r = \sqrt{\frac{\sum_{i=1}^n (\hat{Y}_i - \bar{Y}_i)^2}{\sum_{i=1}^n (Y_i - \bar{Y}_i)^2}} \quad (4)$$

$$S = \sqrt{\frac{\sum_{i=1}^n (Y_i - \hat{Y}_i)^2}{n - k}} \quad (5)$$

Eşitliklerde; R²: Regresyon katsayısını, r: Korelasyon katsayısını, \hat{Y}_i : Bağımlı değişkenin modellerle tahmin edilen değerini (E \check{T} ₀), Y_i: Bağımlı değişkenin gerçek değerini (ET₀), \bar{Y}_i : Bağımlı değişkenin gerçek değerlerinin aritmetik ortalamasını, n: Gözlem sayısını (31 yıllık veri seti için n=31 alınmıştır), S: Standart hatayı, k: Bağımlı ve bağımsız değişkenlerin toplam sayısını ifade etmektedir. ÇDRM₁ için k=6, ÇDRM₂ için k=5 ve ÇDRM₃ için k=3 değerleri dikkate alınmıştır.

Eşitlik 6 kullanılarak %95 güven aralığında ve %5 ($\alpha=0.05$) anlamlılık düzeyinde f testi yapılmıştır (Ünver ve Gamgam, 1999). Elde edilen f değerlerini anlamlılık F değerleri ile karşılaştırmak için Excel'den yararlanılmıştır. Burada anlamlılık F değerlerini EXCEL anovaya göre kendisi üretmiştir (İltir, 2019).

$$f = \frac{\sum_{i=1}^n (\hat{Y}_i - \bar{Y}_i)^2 \cdot (n - 2)}{\sum_{i=1}^n (Y_i - \hat{Y}_i)^2} \quad (6)$$

Regresyon analizleri için EXCEL programından yararlanılmış (Şekil 2) ve elde edilen F değerleri ile anlamlılık F değerleri formülden gelen f değerleri ile sağlanması yapılacak şekilde



kontrol edilmiştir. Aynı zamanda kat sayılar, standart hata ve olasılık (P) değerleri de iklim verilerine bağlı olarak EXCEL tarafından üretilmiştir. Burada üretilen P değerlerinin 0.05'ten küçük olması, bağımsız değişkenlerinin model üzerindeki etkisinin daha fazla olduğunu göstermektedir (İltir, 2019).

Şekil 2. Regresyon analizinin yapıldığı EXCEL penceresi
Figure 2. EXCEL window for regression analysis

ÇDRM modellerinde referans evapotranspirasyonun gerçek değerleri (ET_0) kullanılarak hesaplanan tahmini değerlerini (\hat{ET}_0) karşılaştırma kriteri olarak, ortalama mutlak göreceli hata oranı (OMGH) ve karekök ortalama karesel hata (KOKH) değerleri dikkate alınmıştır. Her iki hata miktarının da sifıra yaklaşması, ele alınan modelin tahmin yeteneğinin artması anlamına gelmektedir. KOKH ve OMGH değerlerinin belirlenmesinde sırasıyla Eşitlik 7 ve Eşitlik 8 kullanılmıştır (Usta ve Gençoğlan, 2019).

$$KOKH = \sqrt{\frac{1}{n} \sum_{i=1}^n (Y_i - \hat{Y}_i)^2} \quad (7)$$

$$OMGH = \frac{1}{n} \sum_{i=1}^n \left(\frac{|Y_i - \hat{Y}_i|}{Y_i} 100 \right) \quad (8)$$

ARAŞTIRMA BULGULARI ve TARTIŞMA

İzmir ili 1990 - 2020 yılları arasında Mayıs ayına ait ortalama iklim verileri ve CROPWAT yazılımı kullanılarak referans evapotranspirasyon (ET_0) miktarları belirlenmiştir (Şekil 3). Maksimum ve minimum hava sıcaklıkları (T_{max} , T_{min}), oransal nem (R_H), 2 m yükseklikten ölçülen rüzgar hızı (U_2) ve günlük güneşlenme süresi (n) verileri yazılıma girilerek solar radyasyon (RS) ve referans evapotranspirasyon (ET_0) değerleri hesaplanmıştır. Ayrıca rakım, enlem ve boylam bilgileri MGM tarafından gönderilen istasyon bilgilerine göre yazılıma işlenmiştir. CROPWAT yazılımına işlenen meteorolojik verilere örnek olarak 2005 yılı için

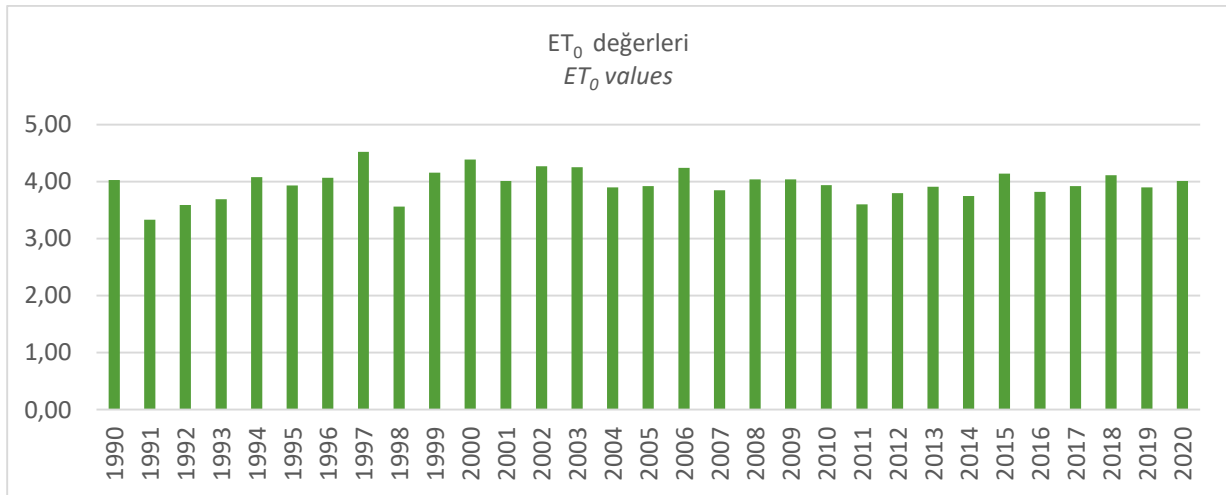


işlem ekranı Şekil 3'te verilmiştir. Tüm bu işlemler daha önce de belirtilen yıllar aralığında tüm yıllar için teker teker yazılıma işlenerek Mayıs ayı ortalama ET_0 değerleri hesaplatılmıştır.

Month	Min Temp	Max Temp	Humidity	Wind	Sun	Rad	ETo
	°C	°C	%	km/day	hours	MJ/m ² /day	mm/day
January	6.9	11.9	71	3	4.5	7.9	0.62
February	6.0	13.9	69	4	4.8	10.1	0.96
March	8.2	17.9	68	3	6.0	14.2	1.69
April	11.6	21.8	68	4	8.5	20.2	2.81
May	16.4	25.3	61	3	9.2	22.9	3.67
June	19.4	31.8	54	3	11.3	27.4	4.75
July	23.0	33.8	57	3	11.8	26.8	5.08
August	23.4	32.6	58	3	11.4	24.7	4.65
September	18.9	29.6	61	3	9.8	19.8	3.34
October	13.7	26.8	61	3	7.8	14.0	1.98
November	9.6	19.1	68	3	5.1	8.8	0.96
December	8.8	14.7	67	3	3.8	6.7	0.59
Average	13.8	23.2	63	3	7.9	17.0	2.59

Şekil 3. 2005 yılında Mayıs ayına ait ortalama iklim verileri ve günlük ET_0 değeri
Figure 3. Average climate data for May 2005 and daily ET_0 value

Yıllara göre Mayıs ayındaki ET_0 değerleri Şekil 4'te verilmiştir. Buna göre ET_0 değerleri Mayıs ayı günlük ortalama olarak 3.3 ile 4.5 mm arasında değişiklik göstermiştir. İklim verilerine göre değişkenlik gösteren ET_0 değerleri sıcaklığın yüksek olduğu kurak yıllarda artış göstermiştir.



Şekil 4. Yıllara göre "Mayıs" ayı günlük ortalama ET_0 değerleri
Figure 4. Daily average ET_0 values for "May" by years

Maksimum hava sıcaklığı (T_{max}), minimum hava sıcaklığı (T_{min}), 2 m yükseklikte ölçülen rüzgar hızı (U_2), güneşlenme süresi (n), oransal nem (R_H) parametrelerinin çeşitli



kombinasyonlarını kullanarak geliştirilen ÇDRM₁, ÇDRM₂ ve ÇDRM₃ çoklu doğrusal regresyon modellerinde ET₀ tahmininde kullanılabilecek tahmin eşitlikleri Çizelge 2’de verilmiştir. ÇDRM₁ ve ÇDRM₂ modellerinin her ikisinin de ET₀ ile ilişki düzeyini ifade eden korelasyon katsayıları r=0.87 olup, referans evapotranspirasyondaki değişimin %98’inin (R²=0.98) bu iki model tarafından açıklanabildiği ortaya koyulmuştur. T_{max}, T_{min}, U₂, n ve R_H parametrelerinin bağımsız değişkenler olarak dikkate alındığı ÇDRM₁’de standart hata 0.04 iken, T_{max}, T_{min}, n ve R_H parametrelerinin bağımsız değişkenler olarak dikkate alındığı ÇDRM₂’de ise standart hata yine 0.04 olarak belirlenmiştir. T_{max} ve T_{min} parametrelerinin bağımsız değişkenler olarak dikkate alındığı ÇDRM₃’de ise standart hata 0.17 olarak belirlenmiş ve en yüksek standart hata olarak hesaplanmıştır. Bu hata miktarları göz önünde bulundurulduğunda, ET₀ ile ilişki düzeyi en yüksek ÇDRM₁ ve ÇDRM₂ çoklu doğrusal regresyon modelleridir. Ayrıca standart hata miktarı daha az olan bu iki modelin ÇDRM₃’e göre istatistiksel olarak daha güvenilir çıktığı açıkça görülmektedir. Yani ÇDRM₃’ün ET₀ ile ilişki düzeyi ÇDRM₁ ve ÇDRM₂ modellerine göre daha düşük seviyededir. ÇDRM₃’ün korelasyon katsayısı r=0.68 olup, ET₀’daki değişimin %58’i (R²=0.58) bu model tarafından açıklanabilmektedir.

Çizelge 2. Çoklu doğrusal regresyon modelleri ve tahmin eşitliği
Table 2. Multiple linear regression models and estimation equation

Model	Tahmin Eşitliği	R ²	S	r
<i>Model</i>	<i>Prediction equality</i>			
ÇDRM ₁	ET ₀ = -0.59653+(0.031521 x T _{max})+(0.047291 x	0.98	0.04	0.87
DDRM ₁	T _{min})+(0.016286 x U ₂) + (0.223775 x n) + (0.012885 x R _H)			
ÇDRM ₂	ET ₀ = -0.566767 + (0.02795 x T _{max})+(0.051233 x	0.98	0.04	0.87
DDRM ₂	T _{min})+(0.227418 x n) + (0.013105 x R _H)			
ÇDRM ₃	ET ₀ = 0.19324 + (0.23481 x T _{max}) - (0.15133 x T _{min})	0.58	0.17	0.68
DDRM ₃				

ÇDRM₁, ÇDRM₂ ve ÇDRM₃ modellerinde bağımsız değişkenler (T_{max}, T_{min}, U₂, n ve R_H) ile bağımlı değişken (ET₀) arasında doğrusal bir ilişki olup olmadığını kontrol etmek amacıyla %95 güven aralığında ve %5 (α=0.05) anlamlılık düzeyinde f testi yapılmış ve elde edilen sonuçlar Çizelge 3’de verilmiştir. Buna göre; tüm modeller için F değerleri anlamlılık F değerlerinden büyük olduğu için bağımsız değişkenler değiştiğinde sonucun değişiminin de anlamlı olduğunu göstermektedir. Buradaki F değerleri modeldeki tüm iklim verilerini kapsamaktadır.

Çizelge 3. Tüm modellerin F değeri ve anlamlılık F değerleri
Table 3. F value and significance F values of all models

Model	F	Anlamlılık F
<i>Model</i>		<i>Significance F</i>
ÇDRM ₁	246.0386953	2.05059E-20
DDRM ₁		
ÇDRM ₂	310.3908	1.56252E-21
DDRM ₂		
ÇDRM ₃	19.30812	5.37E-06
DDRM ₃		

İklim verileri ÇDRM₁ için tek tek değerlendirildiklerinde modelde kullanılan kat sayılar, standart hata değerleri ve olasılık (P) değerleri Çizelge 4’te verilmiştir. Buna göre P değeri



0.05'ten küçük olan değerler, bağımsız değişkenlerinin model üzerindeki etkisi daha fazla olanlardır. Bu değişkenler minimum sıcaklık, güneşleme süresi ve nem olarak belirlenmiştir.

Çizelge 4. ÇDRM₁'in iklim verilerinin istatistiksel olarak hesaplanması
Table 4. Statistical calculation of the climate data of ÇDRM₁

	Katsayılar <i>Coefficients</i>	Standart Hata <i>Standard error</i>	P değeri <i>P value</i>
Kesişim <i>Intersection</i>	-0.59653	0.214942	0.010288298
Maksimum sıcaklık <i>Maximum temperature</i>	0.031521	0.015506	0.052811935
Minimum sıcaklık <i>Minimum temperature</i>	0.047291	0.016476	0.008227798
Rüzgar <i>Wind</i>	0.016286	0.018853	0.395871625
Güneşlenme süresi <i>Sunbathing time</i>	0.223775	0.011795	2.33801E-16
Nem <i>Moisture</i>	0.012885	0.001458	3.63908E-09

İklim verileri ÇDRM₂ için tek tek değerlendirildiklerinde modelde kullanılan kat sayılar, standart hata değerleri ve olasılık (P) değerleri Çizelge 5'te verilmiştir. Buna göre P'nin 0.05'ten küçük olduğu durumda bağımsız değişkenlerin model üzerindeki etkisi daha fazladır. Bu bağımsız değişkenler ÇDRM₁'deki gibi ÇDRM₂'de de minimum sıcaklık, güneşlenme süresi ve nem olarak belirlenmiştir. İki modelden elde edilen değerler karşılaştırıldığında, bağımsız değişkenlerden olan rüzgarın bağımlı değişken olan ET₀ üzerindeki etkisi Mayıs ayı için ihmal edilebilir düzeydedir denilebilir.

Çizelge 5. ÇDRM₂'in iklim verilerinin istatistiksel olarak hesaplanması
Table 5. Statistical calculation of the climate data of ÇDRM₂

	Katsayılar <i>Coefficients</i>	Standart Hata <i>Standard error</i>	P değeri <i>P value</i>
Kesişim <i>Intersection</i>	-0.566767	0.211125	0.012474
Maksimum sıcaklık <i>Maximum temperature</i>	0.02795	0.014871	0.071434
Minimum sıcaklık <i>Minimum temperature</i>	0.051233	0.015754	0.003165
Güneşlenme süresi <i>Sunbathing time</i>	0.227418	0.010961	1.06E-17
Nem <i>Moisture</i>	0.013105	0.001428	1.23E-09

İklim verilerinin tek tek değerlendirildiği ÇDRM₃ için kullanılan kat sayılar, standart hata değerleri ve olasılık (P) değerleri Çizelge 6'da verilmiştir. Buna göre P değeri 0.05'ten küçük olanlarda bağımsız değişkenlerin model üzerindeki etkisi daha fazladır. Bu değişken istatistiksel hesaplamalar sonucunda maksimum sıcaklık olarak belirlenmiştir.



Çizelge 6. ÇDRM₃'ün iklim verilerinin istatistiksel olarak hesaplanması

Table 6. Statistical calculation of ÇDRM₃'s climate data

	Katsayılar <i>Coefficients</i>	Standart Hata <i>Standard error</i>	P değeri <i>P value</i>
Kesişim <i>Intersection</i>	0.19324	0.655135	0.770199
Maksimum sıcaklık <i>Maximum temperature</i>	0.23481	0.042891	7.59E-06
Minimum sıcaklık <i>Minimum temperature</i>	-0.15133	0.054334	0.009486

Modellerle hesaplanan ET₀ değerlerinin, CROPWAT'tan elde edilen ET₀ değerlerinden olan sapma miktarlarını belirlemek amacıyla, karekök ortalama karesel hata (KOKH) ve ortalama mutlak göreceli hata (OMGH) değerleri belirlenmiştir. KOKH değerleri ÇDRM₁ için 0.04, ÇDRM₂ için 0.04 ve ÇDRM₃ için 0.16 olarak elde edilmiştir. OMGH değerleri ise ÇDRM₁ modeli için %6.63, ÇDRM₂ modeli için %6.67 ve ÇDRM₃ modeli için %26.5 olarak belirlenmiştir. Elde edilen bu sonuçlar, modellerin oluşturulmasında dikkate alınan iklim parametresi sayısı arttıkça hata oranlarının azaldığını göstermektedir.

SONUÇLAR

Özellikle son yıllarda iklim değişikliği etkisi ile ciddi bir tehdit olarak karşımıza çıkan kuraklık, ülkemizdeki kısıtlı su kaynağı koşullarının daha da hissedilir sorunlar ile karşımıza çıkmasına yol açmaktadır. Su tüketiminin en yoğun olduğu tarım sektöründe, sulama projelerinin gerçekçi ve zamanın koşullarına uygun planlanması gerekmektedir. Bunun için iklim verilerine bağlı olarak uzun ya da kısa dönemlere ilişkin, bitkilerin kullanacakları su miktarlarının belirlenmesi önem arz etmektedir. Bu çalışmada, CROPWAT yazılımı içinde Penman - Monteith eşitliği kullanılarak Mayıs ayı için günlük ortalama referans bitki su tüketim değerleri bulunmuştur. Bu eşitlikte elde edilen bitki su tüketimi değerlerine göre regresyon modelleri (ÇDRM₁, ÇDRM₂ ve ÇDRM₃) oluşturularak Mayıs ayı için çeşitli denklemler üretilmiştir. Elde edilen sonuçlara göre, sırasıyla 5 ve 4 bağımsız değişkenin kullanıldığı ÇDRM₁ ve ÇDRM₂ modelleri istatistiksel anlamda tutarlı sonuçlar vermiştir. Bu modellere göre, iklim değişikliği riskinin arttığı günümüz koşullarında İzmir bölgesi için modellere girilen iklim verileri Mayıs ayındaki geleceğe yönelik referans bitki su tüketim değerleri hakkında fikir vermesi açısından önemlidir. Bağımsız değişkenler ÇDRM₁'deki gibi ÇDRM₂'de de minimum sıcaklık, güneşlenme süresi ve nem olarak belirlenmiştir. İki modelden elde edilen değerler karşılaştırıldığında, bağımsız değişkenlerden olan rüzgarın bağımlı değişken olan ET₀ üzerindeki etkisi Mayıs ayı için ihmal edilebilir düzeydedir denilebilir. Yazlık bitki yetiştiriciliğinin yoğun olarak yapıldığı İzmir bölgesinde Haziran, Temmuz, Ağustos ve Eylül ayları için de gelecek çalışmalarda çoklu regresyon modellerinin oluşturulması planlanmaktadır. Böylece gelecek çalışmalardan elde edilecek modeller ile hesaplanacak referans bitki tüketimleri bitkisel üretimin yapıldığı tüm sulama sezonu boyunca daha net sonuçlar elde edilmesini sağlayacaktır. Ayrıca, sonraki çalışmalarda oluşturulması planlanan modellerde kullanılacak iklim parametrelerinin, modellere ve elde edilecek eşitliklere olan etkileri ele alınacaktır. Bununla birlikte, kullanılacak olan bağımsız değişkenlere bağlı olarak bitki su tüketimi değerlerinde meydana gelecek farklar ve iklim parametrelerinin bitki su tüketimleri üzerindeki etkilerinin daha iyi gözlemlenebileceği düşünülmektedir.



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SÜT VE SÜT ÜRÜNLERİNDE *CAMPYLOBACTER* SPP. İLE TOKSİNLERİNİN YOL AÇTIĞI GIDA KAYNAKLI ENFEKSİYONLAR

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ÖZET

Günümüzde gıda enfeksiyonlarına neden olan patojen mikroorganizmaların birçoğu konusunda yeterli kaynak ve çalışmalara ulaşılabilmektedir. Ancak, gıda zehirlenmelerine neden olan patojenler arasında çoğunlukla ilk sıralarda literatür çalışmalarında yer edinen *Salmonella* spp. ve/veya *Listeria monocytogenes* gelmekte olup gıda güvenliği ve dolayısı ile halk sağlığı bakımından risk teşkil eden *Campylobacter* spp. ile özellikle toksinlerinin tespiti konusunda yapılan çalışmaların ya gıda ürünü bakımından belirli gıdalarla sınırlı olduğu ya da toksinleri üzerine çalışmalar konusunun kısıtlı kaldığı görülmektedir. İnsanlarda gastroenteritis başta olmak üzere Guillain Barre Sendromu (GBS), Miller Fisher Sendromu (MFS), Hemolitik Üremik Sendrom (HUS), Reiter Sendromu, reaktif artrit gibi karşılaşılan birçok komplikasyon nedenlerinden biri olarak son zamanlarda yapılan çalışmalar ile keşfedilen ve gıda kaynaklı enfeksiyon etkenleri olarak daha çok sorumlu olan *Campylobacter jejuni*, *C. coli*, *C. lari* sıklıkla, *C. upsaliensis*, *C. concisus* ve *C. hyointestinalis* ise daha nadir olarak hayvansal gıdaların kontaminasyonları sonucunda insanlarda hastalık oluşumuna neden olan bazı *Campylobacter* türleridir. *Campylobacter* spp. sadece suş düzeyinde değil daha da önemlisi suşlarının oluşturduğu HeLa hücrelerini aktive etmesine rağmen Vera hücrelerini aktive edemeyen 70kDa büyüklüğündeki toksin, HeLa ve Vero hücrelerini aktive eden sitotoksin (CLT), hemolitik etki gösteren sitotoksinler (CT), Shiga benzeri toksin (SLT), cytolethal distending toksin (CDT A- CDT B- CDT C) ve hepatotoksinler (HT) gibi bir dizi toksin üretebilmektedirler. *Campylobacter* spp.'nin memeliler ile kanatlı hayvanların gastrointesinal sistemlerinde bulunması gıda enfeksiyonlarının başlıca nedenini oluşturmaktadır. Çoğunlukla tavuk ve hindi eti gibi kanatlı et ve ürünleri ile kırmızı et üzerine çalışmaların bulunduğu *Campylobacter* spp.ve suşlarının aslında bir mastitis etkeni olarak ya da dışkı vasıtasıyla çiğ süt ve süt ürünleri ile yeterince pastörizasyon işlemi uygulanmamış süt ve ürünlerinde, kontamine sularda, bazı çalışmalara göre ise sebzelerde bile kontaminasyonun şekillenmesiyle gıda enfeksiyonlarında rol aldıkları görülmektedir. Bu derlemede, küçüğünden büyüğüne her dönemde çeşitli şekilleri ile sıklıkla tüketilmekte olan süt ve süt ürünlerinin *Campylobacter* spp. ve toksinleri bakımından önemi vurgulanacak olup, tespit metotları hakkında bilgi verilmesi amaçlanmıştır.

Anahtar Kelimeler: *Campylobacter* spp., toksin, süt ve süt ürünleri, halk sağlığı



FOODBORNE INFECTIONS IN MILK AND DAIRY PRODUCTS CAUSED BY *CAMPYLOBACTER* SPP. AND TOXINS

ABSTRACT

Today sufficient resources and studies on most of the pathogenic microorganisms causing foodborne infections could be accessed. However, among pathogens that cause foodborne poisoning, usually *Salmonella* spp. and/or *Listeria monocytogenes* come forward in studies in the literature while studies on *Campylobacter* spp. and especially detection of its toxins that cause risk in terms of food safety, thus public health remain limited to certain food types or studies on toxins remain limited. Discovered in recent studies to be one of the causes of many complications in humans such as gastroenteritis primarily together with Guillain Barre Syndrome (GBS), Miller Fisher Syndrome (MFS), Hemolytic Uremic Syndrome (HUS), Reiter Syndrome, and reactive arthritis *Campylobacter jejuni*, *C. coli*, *C. lari* are some *Campylobacter* types that frequently cause diseases in humans while *C. upsaliensis*, *C. concisus*, and *C. hyointestinalis* cause diseases to a lesser extent as foodborne infection factors, as a result of contamination of food from animal origin. *Campylobacter* spp. can create a series of toxins such as toxin at 70kDa size that activates not just at the level of strains but more importantly HeLa cells created by strains while it cannot activate Vera cells, cytotoxin that activates HeLa and Vero cells ((CLT), cytotoxins that made hemolytic effect (CT), Shiga-like toxin (SLT), cytolethal distending toxin (CDT A- CDT B- CDT C), and hepatotoxins (HT). Existence of *Campylobacter* spp. in gastrointestinal systems of mammals and poultry animals is the main cause of foodborne infections. Studies on *Campylobacter* spp. and strains are mostly conducted on meat and products of poultry animals such as chicken and turkey together with red meat. However, *Campylobacter* spp. and strains most frequently play role as a mastitis factor or through feces in raw milk and milk products and milk and milk products that are not subjected to sufficient pasteurization process, contaminated waters and according to some studies even in vegetables with embodiment of contamination. Purpose of this compilation is emphasizing significance of milk and milk products that are frequently consumed large and small in every period and in various types in terms of *Campylobacter* spp. and toxins and providing information on detection methods.

Keywords: *Campylobacter* spp., toxin, milk and milk product, public health



1. INTRODUCTION

Campylobacter infections (*Campylobacteriosis*) are reported to cause various complications in humans such as gastroenteritis primarily together with Guillain Barre Syndrome (GBS), Miller Fisher Syndrome (MFS), Hemolytic Uremic Syndrome (HUS), Reiter Syndrome, and reactive arthritis due to their zoonotic character. Discovered in recent studies as foodborne infection factors, *Campylobacter jejuni*, *C. coli*, *C. lari* are some Campylobacter types that frequently cause diseases in humans while *C. upsaliensis*, *C. concisus*, and *C. hyointestinalis* are other types that cause diseases in humans to a lesser extent and due to contamination of food of animal origin.

Campylobacter types are commonly found in nature while they also make up of normal intestinal flora of most animals, especially poultry (Çakmak & Erol, 2010). It is stated that the types that cause contamination of animals and various food are mostly Thermophilic Campylobacter types. They could be found in mostly poultry, beef, pork meat and products, milk and milk products, fish and fish products, vegetables, and even unchlorinated water (Jacops-Reistma, 2000; Uçar et al., 2007). The underlying cause of existence of Campylobacter types more frequently in poultry compared to other animal types is body temperature of poultry being close to 42°C that is the optimal temperature for reproduction of Campylobacter types (Çakmak & Erol, 2010).

Existence of *Campylobacter* spp. in gastrointestinal systems of mammals and poultry is the main cause of foodborne infections. It is considered that *Campylobacter* spp. and strains on which studies mostly center on poultry such as chicken and turkey meat and products together with red meat and pork meat, mostly take part in foodborne infections with embodiment of contamination as mastitis factor or through feces in raw milk and raw milk products and milk and milk products that are not sufficiently pasteurized, contaminated waters, fish and fish products, shellfish, and even in vegetables according to some studies (Uçar et al., 2007; Çakmak & Erol, 2010).

2. MORPHOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF CAMPYLOBACTER TYPES

Campylobacter spp. that is in Campylobacteraceae family of Proteobacteria group Epsilon subgroup, in Epsilon proteobacteria is a gram negative, microaerophilic-capnophilic, catalase and oxidase positive, mobile (*C. gracilis* immobile), unencapsulated, hair-like, long, spiral-shaped, asporogenous and nonpigmented, 0.2-0.5µm wide and 0.5-5.0µm tall microorganism. While in microscope they look “S” shaped, in spindle or coccoid form. They have flagella on one or two ends with no fimbria. Authors suggested that flagella (having in-built lipopolysaccharide) is an adhesion factor and is effective in antibiotic resistance of plasmids with its carrying plasmids (Bang et al., 2003; Çakmak & Erol, 2010; İbrahim, 2016; Gökçe, 2017). For development of Campylobacter strains, a microaerophilic environment with 5% O₂, 8% CO₂, 87% N₂. Campylobacter types develop in 37°C although some thermophilic strains such as *C. jejuni*, *C. coli*, and *C. lari* reproduce at optimum development temperature 42°C (32-45°C) with pH 6.5-7.5 in 48-72 hours. Although it is not a competitive microorganism, authors informed that it cannot keep its resistance against many processes such as heating, pasteurization, drying, etc. (Nachamin, 2007; Ray & Bhunia, 2016; Yörük, 2021).

3. CAMPYLOBACTERIOSIS

Changes in nutrition habits and increase in tourism activities in recent years triggered the increase in Campylobacteriosis cases. European Union Food Safety Authority (EFSA) noted

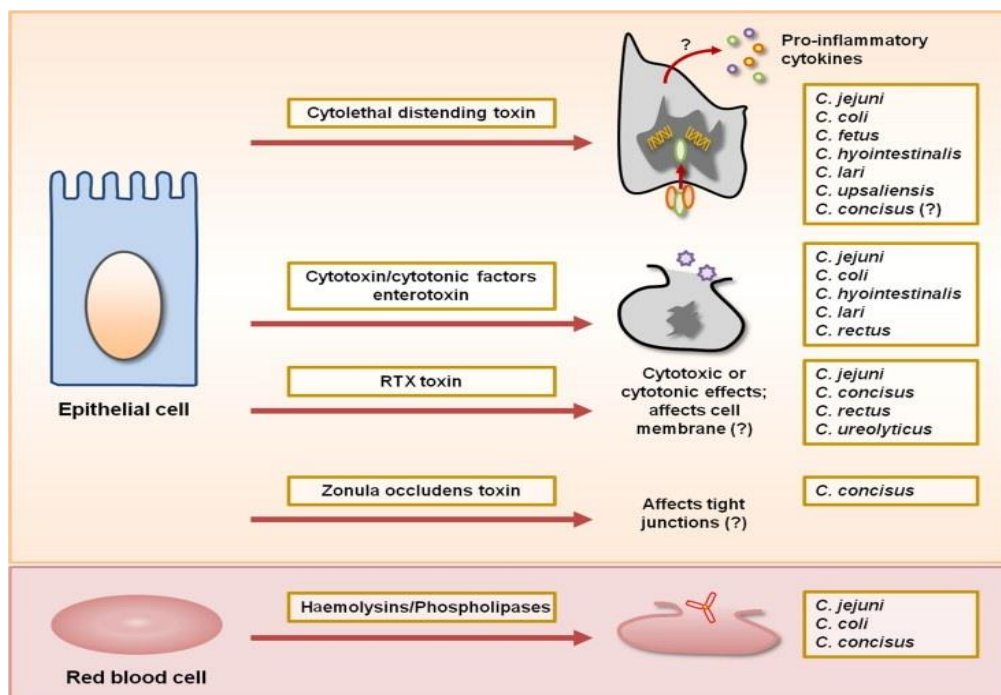


that *Campylobacter* infections make up the first among animal-borne zoonotic diseases with 214,779 number of cases (Sarkar et al., 2014). According to Regulation on Surveillance and Control Procedures of Infectious Diseases in Turkey, *C. jejuni* and *C. coli* are in “D Group Infectious Diseases with Obligation to Report” with reporting obligation (Kestir & Özpinar, 2018).

Campylobacter types that use poultry intestines as host can create infection usually based on insufficient heat treatment of meats or cross-contamination of convenience foods (Grant et al., 2016; Skarp et al., 2016). The minimal infective dose in *Campylobacter* infections is noted as 5×10^2 kob/mL (Koluman, 2006). Bacteria virulence for *Campylobacteriosis* is determined with some characteristics such as activity of *Campylobacter* types, their adhesion to cells, ability to create enterotoxins-cytotoxin, diffusion to cells, ability to survive in cell post-phagocytosis (Altın, 2017) (Güner et al., 2012).

Cytotoxins are proteins that have cellular and intercellular effect, destroying the target cell. Cytotoxins effective in cells bind on cells and reach cytoplasm following which they display their effect and destroy the cell. Cytotoxins effective among cells cause structural defects in pores of target cells. Thus, cytotoxins and granular content in cells are released (Gökçe, 2017). Sepsis and shock might be seen due to endotoxins formed in *Campylobacter* infections. *C. coli* and *C. jejuni* secrete cytotoxins causing cell damage. Some cytotoxins created by *Campylobacter* spp. can create a series of toxins such as;

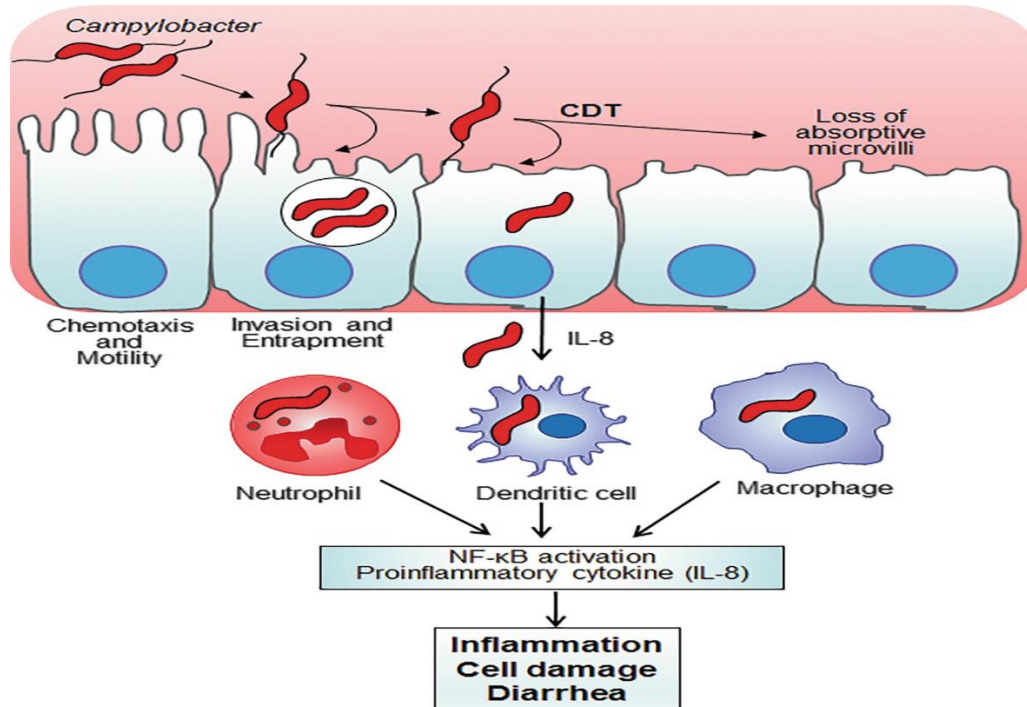
1. Toxin in 70kDa size that activate HeLa cells and cannot activate Vero cells,
2. Cytotoxin that activates HeLa and Vero cells (CLT),
3. Cytotoxins that have hemolytic effect (CT),
4. Shiga-like toxin (SLT),
5. Cytolethal distending toxin (CDT A- CDT B- CDT C), and
6. Hepatotoxins (HT) (Elmalı et al., 2004; Çakmak & Erol, 2010; Ray & Bhunia, 2016).



Enterotoxins can bind on target cell receptors and destroy adenylate cyclase enzyme systems of cells, causing destruction of cellular cyclic adenosine monophosphate (cAMP) layout.



Diarrhea would be formed due to destruction of cellular and intercellular iodine balance (Gökçe, 2017).



Campylobacteriosis-based infections in humans usually develop in 1 to 5 days and cause symptoms such as watery or bloody diarrhea, stomachache and vomiting that last for an average of 5-7 days. Campylobacteriosis display itself in 2 different ways as enteric and extra-enteric symptoms (Crushell et al., 2004; Koluman, 2006; Güner et al., 2012).

a. Enteric Symptoms: Enteric symptoms differ according to nutrition habits together with immune system of host, intestinal microflora and bacteria virulence. Accordingly, they are displayed with various levels of severity from mild enteritis symptoms to normal diarrhea and severe conditions such as mucous diarrhea and even blood ulcerative diarrhea, sickness, vomiting, etc. (Koluman, 2006).

b. Extra-Enteric Symptoms: Cause symptoms such as primarily gastroenteritis, reactive arthritis, miscarriages, premature births, endocarditis, pneumonia, Hemolytic Uremic Syndrome (HUS), Reiter Syndrome and myelin loss through damaging antibodies and ganglioside receptors on myelin layer of nerve cells created against antigenic determinants of microorganism followed by many syndromes such as “Debilitating General Stroke” Guillain-Barre Syndrome (GBS) and Miller Fisher Syndrome (MFS) that can be shaped with various neurological complications (Crushell et al., 2004; Koluman, 2006; Ray B & Bhunia A, 2016).

4. CAMPYLOBACTER SPP. AND TOXINS IN MILK AND MILK PRODUCTS

Campylobacter spp. types make up of normal flora of gastrointestinal systems of endothermic animals and contaminate carcass and internal organs of bovine and sheep at poultry and slaughterhouses during slaughtering or removal of internal organs. Raw or insufficiently cooked poultry meat and poultry liver, chopped meat, processed turkey meat, mussels, crab, shrimp, raw or insufficiently cooked red meat, pork meat, milk and milk products together with vegetables growing at places where animal feces are used as fertilizer are the main type of food that cause *Campylobacter* infections (Erol, 2007; Ray & Arun, 2016; Skarp, 2016).



Campylobacter infections are seen mostly in poultry meat due to poultry enteric flora being richer in terms of Campylobacter types, cross contamination that can take place during plucking and removal of interior organs, and the fact that active matters can survive at skin nodes and hair follicles (Koluman, 2006; Çakmak & Erol, 2010; Uçar et al., 2010).

Milk and milk products come into contact with Campylobacter infections due to reasons such as contamination of milk with feces during milking, creation of reproduction-prone environment in milk following milking from mastitis (some *Campylobacter* spp. strains being responsible for cases as mastitis active matter) udders, contamination of water with fecal sources, consumption of raw or insufficiently pasteurized milk or milk products (Erol, 2007). (LeJeune & Rajala-Schultz, 2009; Rapp et al., 2012; Muş et al., 2015; Whiley et al., 2013; Ray & Arun, 2016). Facciola et al., 2017) together with droppings of wild birds, unhygienic milking equipment and their exposure to contamination during repair (Davis et al., 2016).

Studies demonstrated that *C. jejuni* and *C. coli* are the *Campylobacter* types that are the most seen due to lack of hygiene, mastitis, and cross contamination sourced from raw milk, low pH of yoghurts could be a barrier to active matters but could still be seen with hygiene reasons while *Campylobacter* spp. active matters could be seen in cheese (El- Zamkan & Abdel Haamed, 2016). Similarly, Modi et al., (2016) reported in their study that they found *C. jejuni* together with 3 virulence gene of the microorganism, *cadF*, *cdtB* and *flgR* in raw milk but they could not find Campylobacter types in milk products that were subjected to high heat treatment such as ice cream, cheese sticks, etc.

In their studies to determine animal-borne Campylobacter prevalence in the globe, Zbrun et al. (2020) conducted comparative studies of various food of animal origin such as beef, pork, chicken, goat, and sheep types to make multilevel random effective meta-analysis. They identified average prevalence of *Campylobacter* spp. as 19.3% and 9.7% for *C. jejuni* and *C. coli* respectively. The authors observed *Campylobacter* spp. at chicken meat products the most as *C. jejuni* (33.7%) followed by *C. coli* (14.1%) and they determined that prevalence of *Campylobacter* spp. is 11% in beef. The authors announced that the lowest prevalence of *Campylobacter* spp. is in milk and milk products (3.5%) together with eggs (4%) and sausages (9.4%). However, they emphasized that following poultry meat and poultry products, *Campylobacteriosis* infections surfaced upon consumption of raw milk and raw milk products as a result of fecal contamination and considering seasonal temperature (Zbrun et al., 2019).

Also, in a study conducted by the authors on milk-borne infectious diseases, they announced that 3621 of the 83 milk-borne infection reported in total resulted in disease. The authors also announced that Campylobacter types are responsible for 66.7% of all milk-borne infections with 10.8% for *Escherichia coli* and 9.6% for *Salmonella* (Newkirk et al., 2011).

5. DETERMINATION METHODS

5.1. Conventional Methods

ISO 10272-1 standards are used as one of the classical methods in determination of *Campylobacter* spp. and ISO 10272-2 standards for colony count or FDA/BAM methods. A, B, C procedures must be applied in line with this ISO 10272 methods. Preston broth must be used for raw and frozen foods in terms of pre-enrichment while Bolton broth must be used for all product types. In order to create microaerophilic condition, horse blood or ready commercial microaerophilic condition creators must be used to incubate in 37-42°C temperature, in order to reproduce Thermophilic *Campylobacter* spp. types incubation must be made for 48 hours in 41.5°C (24 hours with Preston broth). At the end of this period, if agars suggested by Modified Charcoal Cefoperazone Deoxycholate Agar (mCCD agar) or Karmali agar, etc. standards would be determined, a loopful of streak was made and if count would be taken 0.1 mL would be



cultured in mCCD, following 48 hours of incubation in 41.5°C in microaerophilic condition gray and platy colonies would be determined or counted, colonies are applied on Columbia blood agar and morphology and activity test must be conducted with Brucella broth. Biochemically, oxidase, catalase, and sodium hippurate hydrolysis tests together with antibiotic sensitivity test (Nalidixic acid and Cephalothin) could be applied or ready commercial biochemical verification sets could be used. At the same time Gram staining is made and Gram negative, concave, comma, spiral shaped microorganisms are assessed as *Campylobacter* spp. types (ISO 10272-1/2).

5.2. Rapid Tests

Polymerase Chain Reaction (PCR) (Real Time, Multiple, primary use PCR, etc.) set methods are used in detection of *Campylobacter* spp. types, toxins and virulence genes. At the same time, Immunomagnetic Separation, Pulsed-Field Gel Electrophoresis (PFGE), Agarose Gel Electrophoresis together with quick test pathogen determination devices for type determination (Vidas-Elfa, Vidas PC, Box System, etc.) and various Mass Spectroscopy (MS) devices could be used to verify suspect colonies.

6. RESULTS and SUGGESTIONS

Global efforts to control infection of enteric pathogens are effective in reducing incidence of a number of major foodborne pathogens, while human *Campylobacter* infections are increasing in many developed countries in recent years with an increasing infection prevalence. When *Campylobacteriosis* epidemiology is assessed in terms of public health, it is noted that *Campylobacter* infections play an increasing role. Thus, considering the fact that the main reason of *Campylobacter* infections is animals and that these infections have zoonotic characters, primarily national authorities must make risk management for every required point considering public health, ensure all hygiene conditions from the farm to table and take precautions at critical control points. The main element that must be realized primarily is ensuring general health conditions of animals that would serve the purpose together with welfare of their farm conditions. In case of infected animals, their contact with healthy animals must be prevented. Required controls must be established in primarily poultry sector that is the main channel of infection of humans with *Campylobacter* together with raw milk and production of milk products (unseasoned cheese, etc.) and general processing according to HACCP rules, production in hygienic conditions, preventing with various precautions positive effect of warm and high temperatures on development of microorganisms, emphasizing udder and milking hygiene for milk and milk products, ensuring continuous hygiene of milking equipment and planning against contaminating factors during maintenance of equipment to oust risks, using chlorinated or suitably hygienized water, employee hygiene, consumption of sufficiently or heat treated meat and meat products together with pasteurized or UHT milk and seasoned cheese in addition to processed milk products while also controller and employees follow standardized biocontrol methodologies.

Connected to all these, tests applied better and more efficiently are necessary to understand the epidemiology of *Campylobacter* types and develop vaccines and control strategies must be applied correctly, timely, and effectively in their use due to increasing antimicrobial resistance.



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TRA1 VE TRC3 BÖLGE İLLERİNDE BALIKETİ TÜKETİM DURUMUNUN DEĞERLENDİRİLMESİ

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ÖZET

Bu çalışma TRA1 ve TRC3 bölgelerinde TRA12 ve TRC34 alt bölgelerinde yer alan Erzincan ve Siirt illeri kent merkezinde balık eti tüketim durumunun belirlenmesi amacıyla yapılmıştır. Çalışmanın materyalini, Erzincan ve Siirt kent merkezinde ikamet eden her il için 271 olmak üzere toplam 542 kişi ile yapılan anketlerden sağlanan veriler oluşturmaktadır. Veriler tanımlayıcı istatistikler, X^2 testi ve T testi kullanılarak analiz edilmiştir. Araştırma sonuçlarına göre; balık tüketim oranı Erzincan ilinde %10.9, Siirt ilinde ise %22.5 olarak belirlenmiştir. Her iki ilde de bireyler tarafından en çok tüketilen balık türünün hamsi olduğu sonucu ortaya çıkmıştır. Siirt ilinde balık tüketimi bireyler tarafından ortalama 4.5 kg ve ayda 1 defa sıklıkla tüketilirken, Erzincan'da ise ortalama 2 kg ve on beş günde bir tüketilmektedir. "Besin değeri" faktörü bireyler tarafından balık tüketim tercihinde her iki il içinde ilk sırada yer almıştır. Hem Erzincan hem de Siirt ilindeki bireyler uygun fiyattan tüketmek istedikleri balık çeşidine ulaşamadıkları için balık tüketemediklerini beyan etmişlerdir. Sonuç olarak; balığın uygun fiyat, istenilen çeşit ve taze olarak satış olanaklarının geliştirilmesi, Erzincan ve Siirt illerinde balık tüketiminin artması için önem arz etmektedir.

Anahtar kelimeler: Erzincan, Siirt, balık tüketim oranı, besin değeri



EVALUATION OF FISH MEAT CONSUMPTION IN TRA1 AND TRC3 REGIONAL PROVINCES

ABSTRACT

This study was conducted in TRA1 and TRC3 regions in order to determine fish consumption in the city center of Erzincan and Siirt provinces located in TRA12 and TRC34 sub-regions. The material of the study consists of the data obtained from the surveys conducted with a total of 542 people, 271 for each province residing in Erzincan and Siirt city center. Data were analyzed using descriptive statistics, X^2 test and T tests. According to the results of the research; The rate of fish consumption has been determined as 10.9% in Erzincan and 22.5% in Siirt. It has been concluded that the most consumed fish species by individuals in both provinces is anchovy. While fish consumption in Siirt province is consumed by individuals on average 4.5 kg and once a month, it is consumed on average 2 kg and every fifteen days in Erzincan. The “nutritional value” factor has ranked first among both provinces in fish consumption preference by individuals. Individuals in both Erzincan and Siirt provinces stated that they could not consume fish because they could not reach the type of fish they wanted to consume at affordable prices. As a result; It is important to improve the sales opportunities of the fish at affordable prices, the desired variety and fresh, and to increase fish consumption in Erzincan and Siirt provinces.

Keywords: Erzincan, Siirt, the rate of fish consumption, nutritional value



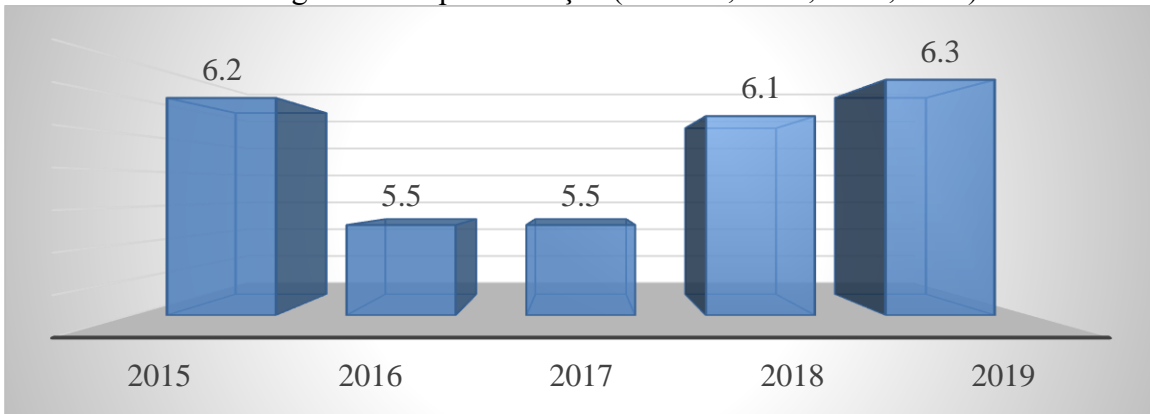
GİRİŞ

Pek çok su ürünü, insan beslenmesi açısından mükemmel bir vitamin ve mineral deposudur. Türkiye’de en fazla tüketilen su ürünü balıktır. Deniz ve tatlı sulardan sağlanan balıklar, beslenmemizde önemli ve besleyici bir role sahiptir. Balıketi, beslenme değeri ve özellikle protein kalitesi bakımından mükemmel bir gıdadır. Et, süt, yumurta yanında balık, en önemli yüksek değerli protein kaynağıdır. Balıketi %18-20 oranında protein içermektedir. Balıketi vitamin açısından da oldukça zengindir. Balıkelerde en fazla bulunan vitaminler; yağda çözünebilir A, D, E ve K vitaminleri ile suda çözünebilir B grubu (B1, B2, B6, B12) vitaminleridir. Ayrıca, iyot, selenyum, fosfor, magnezyum ve çinko mineralleri bakımından da iyi bir kaynaktır. Balık yağları en zengin omega-3 yağ asidi kaynağıdır (Turan ve ark., 2006). Toplam su ürünleri üretimi (avcılık ve yetiştiricilik) miktarı 2018 yılında Dünya’da yaklaşık olarak 176 milyon ton, Türkiye’de ise yaklaşık olarak 629 bin ton olarak gerçekleşmiştir (Tablo 1). Dünya su ürünleri üretiminde hem avcılık hem de yetiştiricilik sektöründe Çin 62.2 milyon ton ile lider konumda olup bu ülkeyi Endonezya, Hindistan, Vietnam ve Peru takip etmektedir (Anonim, 2020). Türkiye su ürünleri üretimi 2019 yılında bir önceki yıla göre %33 oranında artarak 836 bin 524 ton olarak gerçekleşmiştir. Üretimin %44,6’sını yetiştiricilik ürünleri oluşturmuştur. Yetiştiricilik üretiminin %69’u denizlerde (Muğla %42) %31’i iç sularda (Elazığ %18), gerçekleşmiştir. Su ürünleri avcılığı 2019 verilerine göre bir önceki yıla oranla %47.5 artış göstererek, avcılıkla yapılan üretim 463 bin 168 ton olarak gerçekleşmiştir. Deniz ürünleri avcılığı bir önceki yıla göre %52, iç su ürünleri avcılığı %4.8 artmıştır.

Tablo 1. Dünya ve Türkiye toplam su ürünleri üretimi

Yıllar	Dünya toplam (Ton)	Türkiye toplam (Ton)
2014	167.290.000	537.345
2015	170.344.000	672.241
2016	170.994.000	588.715
2017	172.657.000	630.820
2018	175.874.000	628.631

Kişi başına ortalama su ürünleri tüketimi, 2019 yılında bir önceki yıla oranla %3.3 artarak 6.26 kg olarak gerçekleşmiştir (Anonim, 2020). Gelişmiş ülkelerde 2017 yılı verilerine göre kişi başına balık tüketimi 24,4 kg iken gelişmekte olan ülkelerde kişi başına 19.4 kg, gelişmemiş ülkeler kişi başına 12.6 kg’a ulaşmıştır. Düşük gelirli, gıda açığı bulunan ülkelerde balık tüketimi 2017’de 9.3 kg olarak tespit edilmiştir (Anonim, 2020; FAO, 2020).



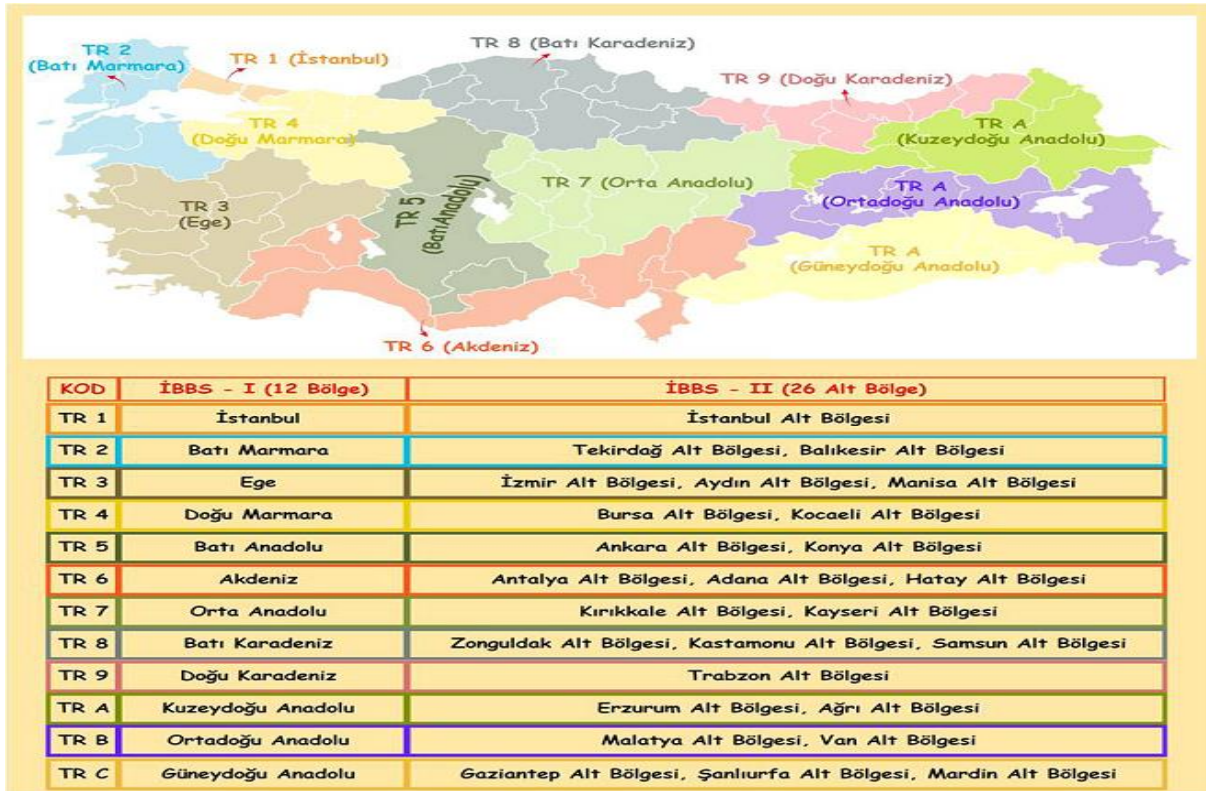
Şekil 1. Türkiye kişi başına su ürünleri tüketimi (kg)



Bu çalışma TRA1 ve TRC3 bölgelerinde TRA12 ve TRC34 alt bölgelerinde yer alan Erzinca ve Siirt illeri kent merkezinde balık tüketim durumunun belirlenmesi amacıyla yapılmıştır.

MATERYAL ve YÖNTEM

Erzinca ili Doğu Anadolu bölgesinde yer alır. Erzinca nüfusu 2020 yılında bir önceki yıla göre 316 azalarak 234.431 kişi olarak belirlenmiştir. Siirt ili güneydoğu Anadolu bölgesinde yer alan bir il olmakla beraber ilin nüfusu 331.070'dir. Bu nüfusun %72.4'ü kent merkezinde yaşamaktadır. İstatistiki Bölge Birimleri Sınıflandırması (İBBS)'na göre Erzinca ili; TRA Kuzeydoğu Anadolu, TRA1 Erzurum alt bölgesi ve TRA12 olarak Siirt ili ise TRC Güneydoğu Anadolu, TRC3 Mardin alt bölgesi ve TRC34 olarak sınıflandırılmıştır (Şekil 2).



Şekil 2. İstatistiki Bölge Birimleri Sınıflandırması kaynak: (<https://depo.sosyal-bilgiler.com>)

MATERYAL ve YÖNTEM

Çalışmanın birincil verileri Erzinca ve Siirt illeri kent merkezlerinde yaşayan bireylerden sosyodemografik ve ekonomik ölçütlere dikkat edilerek her ilden de tesadüfi olarak seçilen 271 kişi ile toplamda 542 kişi ile 2019 yılı şubat, mart ve nisan aylarında yüz yüze yapılan anketlerden oluşmaktadır. Örnek hacmini belirlemek için her il içinde aşağıdaki formül kullanılmıştır (Baş, 2008).

$$\frac{N * t^2 * p * q}{d^2 * (N - 1) + t^2 * p * q}$$

Formüle;

n: Örneğe alınacak birey sayısı,

N: Hedef kitledeki birey sayısı (Erzinca ili için: 157 452; Siirt ili için: 161423),

p: İncelenen olayın gerçekleşme olasılığı (0,50),

q: İncelenen olayın gerçekleşmeme olasılığı (0,50),



t: Standart normal dağılım değeri (1,65),

d : Örnekleme hatası (0,05)'dir.

Formülde %90 güven aralığı, %5 hata payı ve maksimum örnek hacmine ulaşabilmek için $p=q=0,5$ olarak alınmış ve örnek hacmi her iki il içinde 271 olarak hesaplanmıştır.

Araştırma sonucunda elde edilen verilerin analiz edilmesinde SPSS 17.0 (Statistical Package For Social Sciences) paket programı kullanılmıştır. Analiz kapsamında frekans tabloları ve yüzde oranlara ait tablo ve grafikler, tanımlayıcı istatistikler Ki Kare testi (X^2), bağımsız örneklem T testinden faydalanılmıştır.

BULGULAR ve TARTIŞMA

Anket Yapılan Bireylere Ait Sosyo Demografik ve Ekonomik Özellikler

Erzincan ve Siirt illeri kent merkezinde anket yapılan bireylere ait sosyo demografik ve ekonomik özelliklere ait oransal dağılım Tablo 2'de verilmiştir. Her iki il içinde anket yapılan bireylerin büyük kısmının erkeklerden oluştuğu belirlenmiştir. Siirt ilinde anket yapılan bireylerin Erzincan ilindeki bireylere göre 34 yaşından küçük olma oranları daha yüksek olarak belirlenmiştir. Erzincan'daki bireylerin yüksek oranda (%51.3) ilköğretim mezunu, Siirt ilindeki bireylerin ise ön lisans mezunu oldukları belirlenmiştir (%37.3). Erzincan'da aile birey sayısının yüksek oranda (%43.7) 4 kişiden az olduğu, Siirt ilinde ise yüksek oranda (%61) 4 kişiden fazla olduğu belirlenmiştir. Her iki il içinde bireylerin medeni durumu yüksek oranda evli olarak belirlenmiştir. Erzincan ve Siirt illerindeki bireylerin aylık gelirlerinin büyük oranda 1000-3000₺ arasında olduğu belirlenmiştir. 2018 yılında Türkiye genelinde gerçekleştirilmiş olan "Tüketici Profili ve Bilinç Düzeyi Araştırması" verilerine göre; anket yapılan bireylerin %63.7 oranında 34 yaşın altında olduğu, %46.4'ünün evli, %52.6'sının erkek, %42.6'sının lise mezunu, %30'unun ise üniversite ve üzeri öğrenim durumuna sahip olduğu, hane büyüklüğü ortalama 2.79 kişi olarak belirlenmiştir. Çalışma sonuçlarının gerek Erzincan ili gerek Siirt ili özelinde düşünüldüğünde Türkiye genelinde yapılan çalışma sonuçları ile kısmen benzer olduğu söylenebilir.

İller itibariyle aile birey sayısı ve gelir durumu ortalamaları Tablo 3'te verilmiştir. Erzincan ilinde anket yapılan bireylerin aile birey sayısı ortalama 3.80 kişi, Siirt ilinde ise 4.65 kişi olarak belirlenmiştir. Aile birey sayısı ortalamaları arasında yapılan t testi sonucunda istatistiki olarak önemli bir fark olduğu Siirt ilinin birey sayısı ortalamasının Erzincan iline göre daha yüksek olduğu sonucu ortaya çıkmıştır. Bireylerin aylık gelir ortalamaları iller itibariyle değişmekle birlikte genel ortalama 3046.50₺ olarak hesaplanırken Erzincan ilinde aylık gelir ortalama 2879.53₺, Siirt ilinde ise 3213.47₺ olarak hesaplanmıştır. Siirt ilindeki bireylerin aylık gelir ortalamasının Erzincan ilindeki bireylerden daha yüksek olduğu sonucu saptanmıştır.



Tablo 2. Erzincan ve Siirt illeri kent merkezinde anket yapılan bireylere ait sosyo demografik ve ekonomik özelliklerin dağılımı

Sosyo demografik ve ekonomik özellikler/İller	Erzincan (%)	Siirt (%)
Cinsiyet		
Kadın	41.6	45.8
Erkek	58.4	54.2
Toplam	100	100
Yaş		
18-33	35	57.5
34-49	39.4	25.5
50+	25.6	17
Toplam	100	100
Eğitim durumu		
Okuryazar değil	-	7
Okuryazar	9.2	3.4
İlköğretim mezunu	51.3	15.1
Ortaöğretim mezunu (ortaokul ve lise)	9.5	19.2
Ön lisans mezunu	24.2	37.3
Lisans mezunu	5.9	14
Lisansüstü mezunu	-	4
Toplam	100	100
Ailedeki birey sayısı		
4 kişiden az	43.7	22.8
4 kişi	21.9	16.2
4 kişiden fazla	34.4	61
Toplam	100	100
Meslek		
Serbest meslek	9.9	18.5
Emekli	7.7	5.2
İşçi	8.8	12.9
Memur	16.1	15.1
Çiftçi	3.7	3.7
Esnaf	18.7	6.3
Ev hanımı	20.1	16.6
Diğer	14.7	21.8
Toplam	100	100
Medeni durum		
Evli	63.1	57.9
Bekâr	36.9	42.1
Toplam	100	100
Aylık gelir		
1000₺'den az	17.5	29.9
1000-3000₺ arası	47.5	56.8
3000₺ ve üstü	35	13.3
Toplam	100	100

Tablo 3. İller itibarıyla aile birey sayısı ve gelir durumu ortalamaları

İller/özellikler	Aile birey sayısı***		Gelir durumu**	
	Ortalama	Standart hata	Ortalama	Standart hata
Erzincan	3.80	0.090	2879.53	141.843
Siirt	4.65	0.093	3213.47	73.025
Toplam/Genel ortalama	4.23	0.067	3046.50	80.018

***:p<0.01; **:p<0.05



Erzincan ve Siirt İllerinde Balık Tüketip Tüketmeme Durumu

Erzincan ilindeki anket yapılan bireylerin %11.1'inin balık tükettiği, %88.9'unun ise balık tüketmediği belirlenmiştir. Siirt ilinde balık tüketen bireylerin oranı %22.9, balık tüketmeyen bireylerin oranı ise %77.1 olarak belirlenmiştir. Yapılan anket geneli itibariyle balık tüketim oranı %17, balık tüketmeme oranı ise %83 olarak bulunmuştur (Tablo 4). Ki kare analizi sonucunda iller itibariyle balık tüketim durumu arasında istatistiki olarak önemli bir ilişki olduğu Siirt ilinde balık tüketiminin Erzincan'a göre daha yüksek olduğu sonucuna varılmıştır. Bu durumun nedeni olarak; Erzincan ilinde kırmızı et ve tavuk etinin balık etine göre daha çok tüketilmesi gösterilebilir. Karakaya ve inci (2014) ve Abdikoğlu ve ark. (2015) tarafından Bingöl ve Tekirdağ'da yapılan çalışmalarda da kırmızı et ve tavuk etinin, balık etinden daha yüksek oranda tüketildiği bildirilmiştir. Kayseri'de yapılan bir çalışmada et tüketim tercihinde kırmızı etin ilk sırada tavuk etinin 2. sırada, balık etinin ise 3. sırada geldiği belirlenmiştir (Soylu, 2018). Ankara ve Çanakkale illerinde balık tüketim oranı %28 olarak belirlenmiştir (Bayraktar ve ark., 2019). Doğan (2019) balık tüketim oranını Erzurum'da %19.7, Bayburt'ta %23.3 ve Erzincan'da ise %13 olarak bildirmiştir. Arık Çolakoğlu ve ark (2006) yaptıkları çalışmada Çanakkale için balık tüketim oranını %29.8 olarak bildirmişlerdir. Adıyaman'da Olgunoğlu ve ark (2014) tarafından yapılan çalışmada balık tüketen bireylerin oranı %5 olarak belirlenmiştir. Ağrı ilinde yapılan çalışmada balık tüketim oranı %7.3 olarak tespit edilmiştir (Gürel ve ark., 2017). Yüksel ve ark., (2011) tarafından Tunceli'de yapılan çalışmada, en fazla balık etinin beğenilmesine rağmen en az oranda (%22) balık etinin tüketildiği sonucuna varılmıştır. Trabzon ve Giresun illerinde yapılan çalışmada balık tüketim oranı %41 olarak belirlenmiştir (Aydın ve Karadurmuş, 2013). Kahramanmaraş'ta Beyazbayrak (2014) yaptığı çalışmada balık etinin tüketim oranını %6 olarak belirlemiştir. Balık tüketim oranı Elazığ ilinde Çiçek ve ark (2014) tarafından %3 olarak, mersinde Şen ve Şahin (2017) tarafından %38 olarak bildirilmiştir. Daha önce yapılan çalışmalar ve çalışma sonucunda Türkiye'de et tüketim tercihinde kırmızı et ve tavuk etinin balık etine göre daha ön planda olduğu balık etinin bölgelere ve illere göre, bireylerin sosyo demografik ve ekonomik özelliklerine göre farklı oranlarda tüketildiği sonucuna varılmıştır.

Tablo 4. İller itibariyle balık tüketip tüketmeme durumu

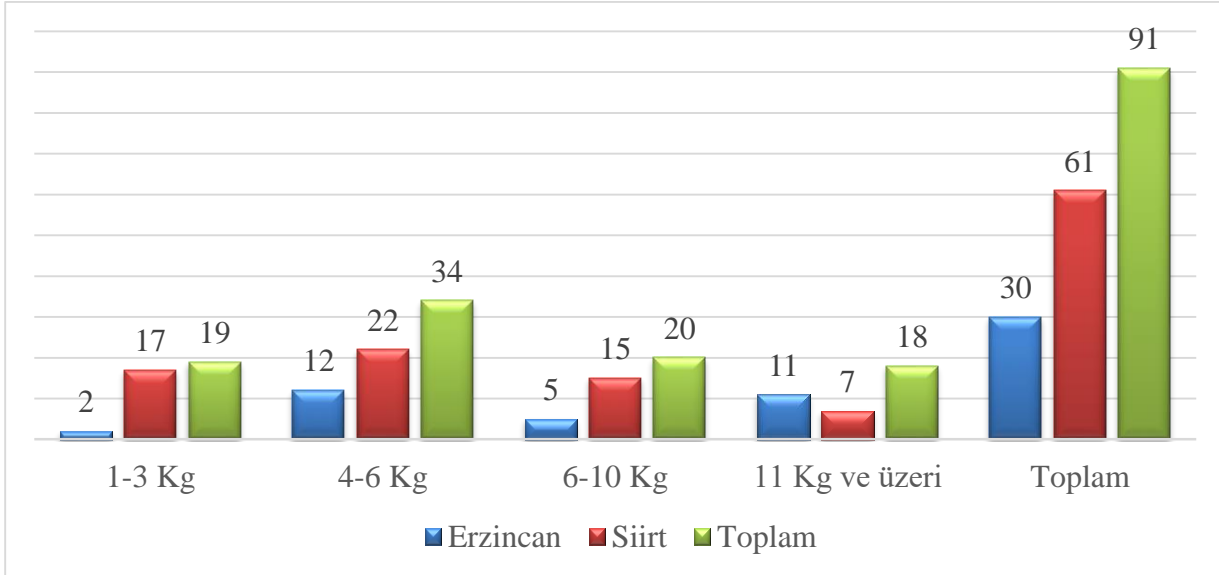
İller	Balık tüketen	Balık tüketmeyen	Toplam
Erzincan	30 (%11.1)	241 (%88.9)	271
Siirt	62 (%22.9)	209 (%77.1)	271
Toplam/Genel ortalama	92 (%17)	450 (%83)	542
Ki Kare ve p değeri	13.406; 0.000		

Erzincan ve Siirt İllerinde Aylık Balık Tüketim Miktarı

Her iki ilde anket yapılan bireylerin 91'inin balık tükettiği belirlenirken, Siirt ilinde bu sayı 61 Erzincan ilinde ise 30 kişi olarak belirlenmiştir. Balık tüketen bireylerin %67'si Siirt ilinde %33'ü ise Erzincan ilinde yer almaktadır. Aylık balık tüketim miktarlarının iller itibariyle dağılımına bakıldığında, 19 kişinin (%20.8) 1-3 kg, 34 kişinin (%37.6) 4-6 kg, 20 kişinin (%21.9) 6-10 kg ve 18 kişinin (%19.7) 11 kg ve üzerinde balık tükettiği belirlenmiştir. Aylık 1-3 kg balık tüketim oranı Erzincan ilinde %6.7 (2 kişi), Siirt ilinde ise %27.8 (17 kişi), 4-6 kg balık tüketim oranı Erzincan'da %40 (12 kişi), Siirt'te ise %36.2 (22 kişi), 6-10 kg balık tüketim oranı Erzincan'da %16.7 (5 kişi), Siirt'te %24.5 (15 kişi), 11 kg ve üzeri balık tüketim oranı Erzincan'da %36.6 (11 kişi), Siirt ilinde ise %11.5 (11 kişi) olarak hesaplanmıştır (Şekil 2). 4-6 kg arasında balık tüketim miktarının her iki il içinde genel olarak



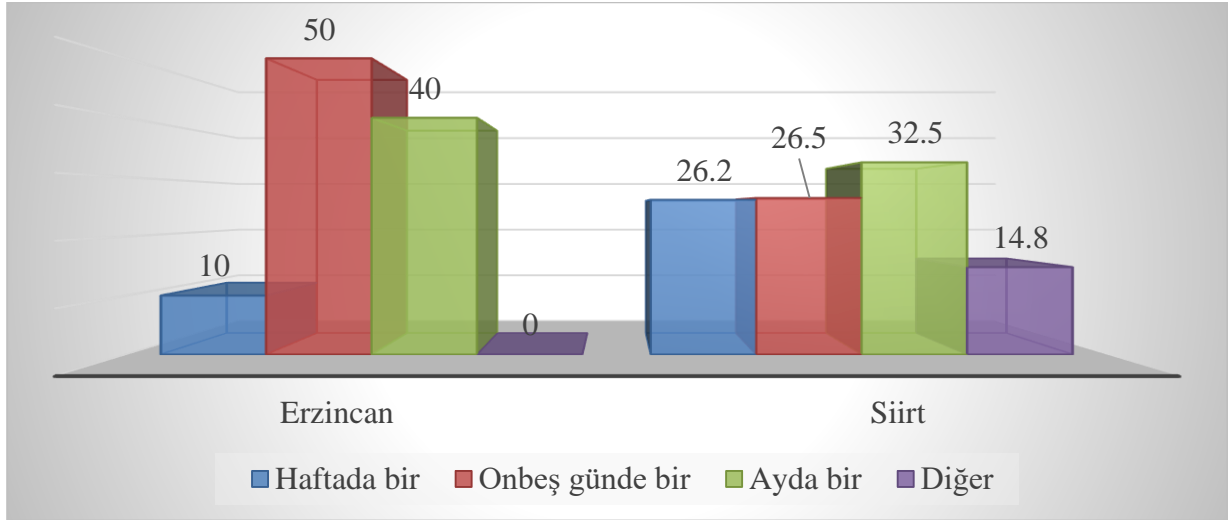
daha fazla tercih edildiği sonucuna varılmıştır. Aylık balık tüketim miktarı; Özer ve ark. (2016) tarafından Ankara'da 3.4 kg, Karakaya ve Kırıcı (2016) tarafından Bingöl'de 4.88 kg, Bayraktar ve ark. (2019) tarafından Ankara ve Çanakkale'de 1 kg'dan az balık tüketilme oranı %52 olarak belirlenmiştir. Dünyada kişi başı balık tüketimi 16 kg, Avrupa Birliğinde (AB) ise 22 kg, Türkiye'de ise 6.26 kg olarak gerçekleşmiştir (TÜİK, 2020). Çalışma sonucunda her iki ilde de aylık balık tüketim miktarının yetersiz olduğu kanısına varılmıştır.



Şekil 3. Erzurum ve Siirt İllerinde Aylık Balık Tüketim Miktarı (Kişi)

Erzurum ve Siirt İllerinde Balık Tüketim Sıklığı

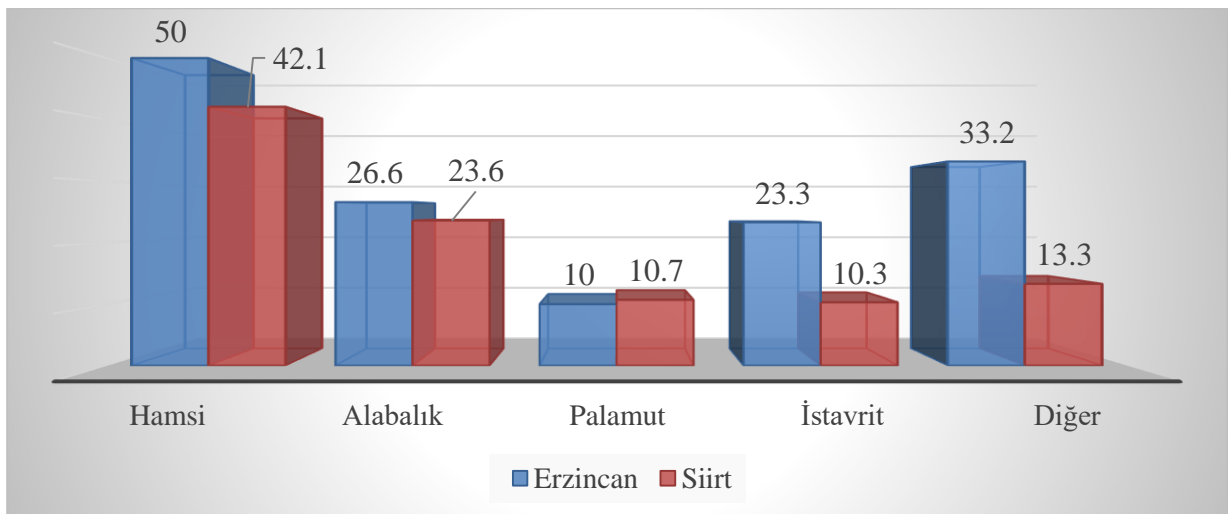
Haftada bir balık tüketim oranı Erzurum'da %10, Siirt'te %26.2, onbeş günde bir balık tüketilme oranı Erzurum'da %50, Siirt'te %26.5, ayda bir balık tüketilme oranı Erzurum'da %40, Siirt'te %32.5 olarak belirlenmiştir. Diğer (özel günler vb.) günlerde Erzurum ilinde kimsenin balık tüketmediği belirlenirken, Siirt'te bireylerin %14.8'inin balık tükettiği belirlenmiştir (Şekil 4). Balık tüketim sıklığı; Bingöl'de Karakaya ve Kırıcı (2016) tarafından %35 oran ile onbeş günde bir, Gül Yavuz ve ark. (2015) tarafından Ankara'da %30 ile haftada bir, Kahramanmaraş'ta Ercan ve şahin (2016) tarafından %54 oranla ayda birkaç defa, Tekirdağ'da Abdikoğlu ve ark. (2015) tarafından %60 oranla onbeş günde bir, Bayraktar ve ark. (2019) tarafından Ankara ve Çanakkale'de %81 oranla haftada bir veya ayda bir, Terin ve ark. (2016) tarafından Van'da %30.6 oranla onbeş günde bir, Şen ve şahin (2017) tarafından Mersin'de %43 oranla haftada bir olarak belirlenmiştir. Sonuç olarak hem Erzurum hem de Siirt ilindeki bireylerin balık tüketim sıklığında onbeş günde bir ve/veya ayda bir defa tüketim eğilimi içinde oldukları sonucu diğer çalışma bulgularıyla kısmen benzerlik göstermektedir. Balığa taze olarak ulaşımın sağlandığı bölgelerde gelir seviyesinin artmasıyla birlikte balık tüketim sıklığının da haftada bir olarak tercih edildiği kanısına varılmıştır.



Şekil 4. Erzincan ve Siirt İllerinde Balık Tüketim Sıklığı (%)

Erzincan ve Siirt İllerinde En Çok Tüketilen Balık Çeşidi

Hem Erzincan hem Siirt illinde bireyler tarafından en çok tüketilen balık çeşidi hamsi olarak belirlenmiştir. Alabalık, istavrit ve palamut tüketilen diğer balık çeşitleri olarak sıralanmıştır. Diğer balık çeşitleri (Çupra, çinekop, somon vd.) Erzincan ilinde Siirt iline nazaran daha fazla tercih edilmektedir (Şekil 5). Aydın ve Karadurmuş (2013), Olgunoğlu ve ark. (2014), Abdikoğlu ve ark. (2015), Bayraktar ve ark. (2019) tarafından yürütülmüş çalışmalarda da en çok tüketilen balık çeşidinin hamsi olduğu bildirilmiştir. Türkiye genelinde yapılan birçok araştırmada hamsinin bireyler tarafından ilk sırada tüketildiği ve çalışma sonuçlarının da bu paralellikte olduğu sonucuna varılmıştır.



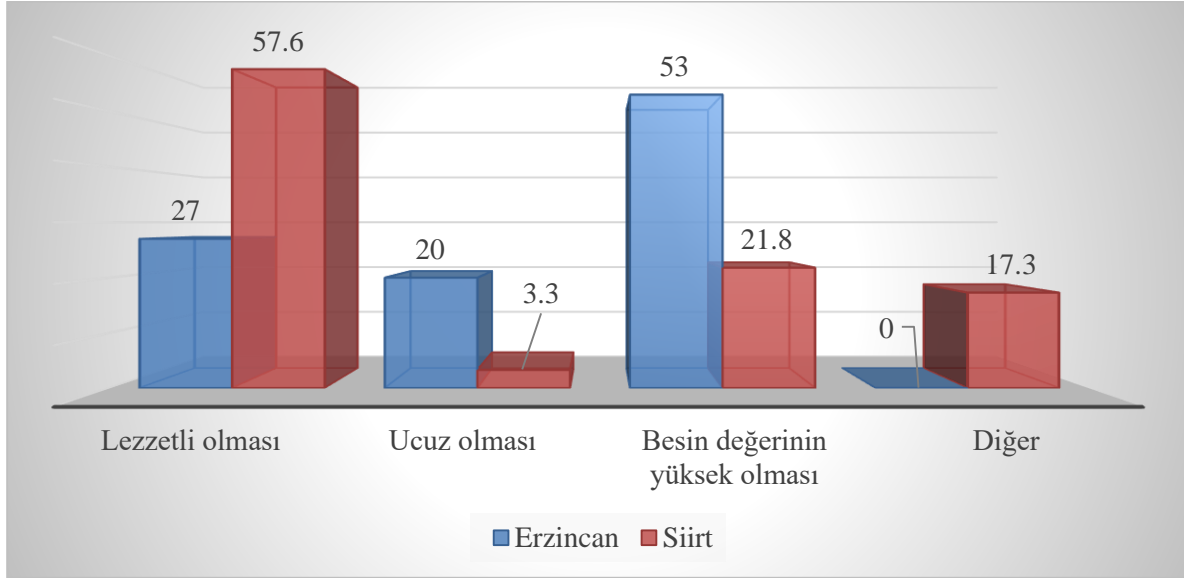
Birden fazla cevap verilmiştir.

Şekil 5. Erzincan ve Siirt İllerinde En Çok Tüketilen Balık Çeşidi (%)

Erzincan Ve Siirt İllerinde Balık Tüketim Tercihinde Öncelikli Faktör



Erzincan ilinde bireyler, balık tüketim tercihinde %53 oranla besin değerinin yüksek olması, %27 oranla lezzetli olması ve %20 oranla ucuz olması faktörlerini ön planda tutarken, Siirt ilindeki bireylerin ise %57.6 oranla lezzetli olması, %21.8 oranla besin değerinin yüksek olması ve %17.3 oranla diğer (düşük kolesterolü olması, kolay bulunması, kalite ve güven, alışkanlık) faktörlerini ön planda tuttukları belirlenmiştir. Daha önce yapılan birçok çalışmada da balık tüketim tercihinde lezzet ve sağlık (besin değerinin yüksek olması) faktörleri bireyler tarafından ilk sırada yer almıştır (Aydın ve Karadurmuş, 2013; Çadır ve Duman, 2013; Abdikoğlu ve ark., 2015; Karakaya ve Kırıcı, 2016; Bayraktar ve ark., 2019; Doğan, 2019).



Şekil 6. Erzincan ve Siirt illerinde balık tüketim tercihinde öncelikli faktör (%)

SONUÇ ve ÖNERİLER

Hem Erzincan hem de Siirt ilinde bireylerin yüksek oranda evli ve erkek olduğu aylık gelirlerinin 3000₺'den az olduğu belirlenmiştir. Siirt ilinde aile birey sayısı ortalaması ve aylık gelir ortalaması Erzincan iline göre yüksek bulunmuştur. Erzincan ve Siirt ilinde ortalama balık tüketim oranı %17 olarak belirlenmiştir. Siirt ilinde balık tüketim oranı Erzincan'a göre daha yüksek bulunmuştur. Erzincan ve Siirt ilinde balık tüketim miktarı ortalama 4-6 kg, balık tüketim sıklığı ise onbeş günde bir veya ayda bir olarak belirlenmiştir. Her iki il içinde en çok tüketilen balık çeşidinin hamsi olduğu balık tüketim tercihinde ise Siirt ilinde "lezzet" Erzincan ilinde ise "besin değeri" faktörünün ilk sırada olduğu belirlenmiştir. Çalışma sonucunda her iki ilde de aylık balık tüketim miktarının yetersiz olduğu kanısına varılmıştır.

Çalışma sonuçları ışığında;

- ✓ Balık tüketim miktarının artırılması için balıkçılığın sağlığa faydalı olduğu konusunda eğitim ve bilinçlendirme çalışmaları yapılmalıdır.
- ✓ Uygun fiyattan istenilen çeşitten ve taze olarak balık satın alınma olanaklarının hem Erzincan hem de Siirt ilinde geliştirilmesi bireylerin balık tüketimine olumlu katkı sağlayacaktır.
- ✓ Deniz ürünleri üretimi ve kültür balıkçılığının desteklenerek, üretim ve tüketim dengesinin korunması için soğuk zincirin kurulması ve sürdürülebilir olması sağlanmalıdır.



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VARIATION OF MORPHOLOGICAL AND AGRONOMIC TRAITS OF HULLESS BARLEY ACCESSIONS

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ABSTRACT

In recent years, there has been a renewed interest in the cultivation of hulless barley related mainly to its qualities as a healthy whole grain food. Assessment of available genetic variation for the economically important traits is at the base of any breeding program. Hereof, the aim of the present study was to evaluate the variation in the morphological and agronomic traits of hulless barley accessions and to select accessions for inclusion in hulless barley breeding program of the Institute of Agriculture – Karnobat. In this study, 24 accessions of hulless spring barley, provided by ICARDA (International Centre for Agricultural Research in the Dry Area) along with local hulled spring standard cultivar Venera were studied. Genotypes were evaluated in randomized block design with three replications at the Institute of Agriculture – Karnobat, Southeastern Bulgaria in three growing seasons (2017 - 2019). The studied traits included number of spikes per plant, days to heading, plant height (cm), peduncle length (cm), spike length (cm), awn length (cm), spikelet number per spike, grain number per a spike, grain weight per a spike (g), 1000 grains weight (g) and grain yield (kg/ha). All studied traits exhibited considerable variation. Mean grain yield of hulless accessions ranged from 1.002 to 4.763 t/ha. Lines INBYT-HI-15-1, INBYT-HI-15-4, INBYT-HI-15-21, and INBYT-HI-15-22 had grain yield that not differ significantly from those of hulled standard. Therefore, those lines can be used in the breeding program for the development of new hulless varieties with improved grain yield.

Keywords: Hulless barley, grain yield, agronomic traits



INTRODUCTION

The renewed interest in the cultivation of hulless barley is based mainly on health benefits connected with a high content of β -glucans, vitamins, minerals, and proteins in its grain (Wood, 2004; Ragaee et al., 2006). Minimal processing of hulless barley preserved all advantages of the whole grain (Liu, 2007). Using hulless barley for food is associated with reduced risk of coronary heart disease and certain cancers and improves prevention and management of type 2 diabetes (Shaveta and Kaur, 2019). Moreover, hulless barley has a number of advantages when it used as feed like higher digestibility, protein and energy, and lower fiber than covered barley (Bleidere and Gaile, 2012). Therefore, increasing attention has been paid to breeding modern hulless varieties with high yield and quality. However, the narrow genetic variation obstructed further improvement of yield and quality in this crop. A possible solution to this problem includes exploring, preserving, and utilizing diversity within germplasm resources (Singh, 2006).

Evaluation of germplasm collections for economically important agronomic traits is an effective tool to analyze genetic diversity and also allows plant breeders to select valuable genetic resources for utilization in breeding programs (DeLacy et al., 2000). The selection of genetically diverse parents for hybridization will contribute to broadening the genetic basis of crops.

The genetic diversity can be estimated using univariate analysis or multivariate analysis. In recent years, multivariate analysis has gained popularity and has been employed to workout similarities and differences between different genotypes (Jian et al., 2006). Among all other methods, principal component analysis has the edge to assign only one group to each genotype, at the same time it also depicts the importance of major contributors toward total diversity at each axis of differentiation (Sharma, 2006). Therefore, breeders have widely used principal component analysis for the assessment of genetic diversity and exploration of promising genotypes for breeding programs.

The aim of the present study was to evaluate variation in morphological and agronomic traits of hulless barley accessions and to select accessions for inclusion in hulless barley breeding program of the Institute of Agriculture – Karnobat.

MATERIAL and METHODS

The plant materials used in this study included 24 genotypes of hulless barley, all of which had been provided by ICARDA (International Centre for Agricultural Research in the Dry Area) along with local hulled spring standard cultivar Venera.

The field study was conducted in three growing seasons from 2017 -2019 on the experimental field of the Institute of Agriculture - Karnobat, Southeastern Bulgaria (42°39' N, 26°59' E).

The experiment was set up on leached chernozem soil under rainfed conditions. The design was a randomized complete block design with 3 replications on plots of 4.8 m². Field management followed local practices.

The studied traits included: plant height (cm), days to heading, spike length (cm), awn length (cm), peduncle length (cm), spikelet number per spike, grain number per spike, grain weight per spike (g), 1000 grain weight (g) and grain yield (t/ha).

The mean values were compared by the least significant difference (LSD) at 0.05 probability level. Principal Component Analysis was performed and the resulting PC scores were plotted. All *statistical* analyses were performed using *statistical* SPSS19.0 software.



RESULTS and DISCUSSION

Mean values for studied agronomic and morphological traits of hulless barley accessions along with check variety Venera are presented in Table 1. Significant genotypic differences were observed for all traits indicating the existence of genotypic variation and diversity among the tested genotypes. Plant height varied from 58.68 cm in INBYT-HI-15-21 to 96.25 cm in INBYT-HI-15-3. The minimum number of days to heading was found in INBYT-HI-15-3 (74.00) and the maximum value was observed in INBYT-HI-15-23 (83.67). The spike length ranged from 6.36 cm (INBYT-HI-15-5) to 10.10 cm (INBYT-HI-15-19). The six-rowed accession INBYT-HI-15-22 had the highest number of spikelets and grains in spike and the highest grain weight per spike. A significantly higher 1000 grain weight compared to hulled check Venera was found in INBYT-HI-15-3. High 1000 grain weight is a desirable characteristic of grain when it is used as food or feed. Bleidere et al. (2013) and Sayd et al. (2018) reported that grains of hulless genotypes were characterized by higher 1000-grain weight than that of hulled barley.

Mean grain yield of hulless accessions ranged from 1.002 to 4.763 t/ha. Check variety had average 4.553 t/ha grain yield for the period of the study. A considerably lower yield of hulless than hulled genotypes was pointed out in previous studies (Choo et al., 2001; Newman and Newman, 2005; Dickin et al., 2012). This difference in yield potential is the main reason for the limited cultivation of naked varieties. In present study, lines INBYT-HI-15-1, INBYT-HI-15-4, INBYT-HI-15-21, and INBYT-HI-15-22 had grain yields that not differ significantly from those of hulled check. Therefore, those lines can be used in the breeding program for the development of new hulless varieties with improved grain yield.



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Table 1. Mean values for studied agronomic and morphological traits of hulless barley accessions and check variety Venera (2017 - 2019)

Genotypes	Row-type	PH	DH	SL	AL	PL
INBYT-HI-15-1	2	87.21	74.64	9.20	12.50	20.05
INBYT-HI-15-2	6	78.37	77.00	7.85	14.55	23.15
INBYT-HI-15-3	2	96.25	74.00	8.30	12.30	16.35
INBYT-HI-15-4	2	77.29	74.33	8.85	12.95	19.40
INBYT-HI-15-5	6	79.73	77.00	6.36	11.41	24.27
INBYT-HI-15-6	6	82.24	77.00	8.10	12.50	19.70
INBYT-HI-15-7	6	86.47	77.67	8.60	13.10	22.70
INBYT-HI-15-8	2	89.64	82.33	8.95	12.35	18.50
INBYT-HI-15-9	6	90.58	78.00	9.90	12.45	25.25
INBYT-HI-15-10	6	67.28	79.00	7.42	10.96	20.04
INBYT-HI-15-11	2	78.76	82.33	7.75	10.63	19.33
INBYT-HI-15-12	6	89.44	78.33	9.40	15.00	19.95
INBYT-HI-15-13	6	95.14	79.00	8.95	17.55	18.20
INBYT-HI-15-14	6	88.31	81.67	8.00	14.25	16.30
INBYT-HI-15-15	6	92.64	82.33	6.58	11.58	18.25
INBYT-HI-15-16	6	79.49	78.67	8.05	13.60	17.25
INBYT-HI-15-17	2	93.55	79.33	9.25	15.60	22.85
INBYT-HI-15-18	6	82.61	81.00	6.68	12.36	20.23
INBYT-HI-15-19	6	81.74	82.00	10.10	14.40	17.75
INBYT-HI-15-20	6	82.11	79.00	7.80	11.45	18.20
INBYT-HI-15-21	6	58.68	83.00	7.90	13.37	15.17
INBYT-HI-15-22	6	94.35	78.33	8.80	15.30	22.80
INBYT-HI-15-23	6	89.72	83.67	8.85	16.10	23.05
Atahualpa	2	87.38	82.67	9.25	14.20	22.75
Venera	2	91.23	81.00	9.90	12.70	26.20
LSD 0.05		7.10	3.02	1.26	0.94	2.67



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Table 1. Mean values for studied agronomic and morphological traits of hulless barley accessions and check variety Venera (2017 - 2019) (Continuous)

Genotypes	Row-type	SNS	GNS	GWS	TGW	GY
INBYT-HI-15-1	2	26.20	23.30	1.43	41.90	4.763
INBYT-HI-15-2	6	67.80	53.20	2.70	40.80	3.251
INBYT-HI-15-3	2	25.20	23.50	1.38	51.10	3.757
INBYT-HI-15-4	2	26.90	25.20	1.51	49.10	4.276
INBYT-HI-15-5	6	60.00	48.18	2.38	37.30	2.754
INBYT-HI-15-6	6	67.20	52.20	2.44	36.30	4.052
INBYT-HI-15-7	6	67.20	53.10	2.44	34.10	4.101
INBYT-HI-15-8	2	24.60	22.00	1.23	46.80	2.750
INBYT-HI-15-9	6	72.60	60.60	2.37	37.90	3.008
INBYT-HI-15-10	6	46.62	43.23	2.06	43.40	1.755
INBYT-HI-15-11	2	23.00	22.00	1.22	36.20	1.107
INBYT-HI-15-12	6	75.40	57.30	2.60	45.10	1.002
INBYT-HI-15-13	6	76.80	47.20	2.58	41.00	1.207
INBYT-HI-15-14	6	67.20	48.00	2.35	32.60	3.703
INBYT-HI-15-15	6	59.33	47.08	1.79	40.00	3.505
INBYT-HI-15-16	6	67.80	52.10	2.60	34.10	3.251
INBYT-HI-15-17	2	26.20	25.20	1.66	49.10	2.753
INBYT-HI-15-18	6	46.73	39.82	1.81	40.70	2.786
INBYT-HI-15-19	6	73.20	43.60	2.00	33.40	3.751
INBYT-HI-15-20	6	73.20	52.50	2.36	42.30	2.023
INBYT-HI-15-21	6	68.00	52.47	2.69	38.50	4.500
INBYT-HI-15-22	6	79.80	66.80	3.14	47.50	4.252
INBYT-HI-15-23	6	72.00	52.70	2.82	44.60	2.251
Atahualpa	2	25.60	22.00	1.20	41.90	3.202
Venera	2	31.00	29.70	1.70	48.40	4.553
<i>LSD 0.05</i>		2.97	2.16	0.23	1.77	0.457



The variation studied through Principal Component Analysis revealed that three principal components having greater than 1 eigenvalues contributed 66% of the total variation (Table 2). It was found that Principal Component 1 (PC1) contributed 32.39%, whereas PC2, PC3 contributed 21.02% and 13.03% respectively of the total variation. The traits, which contributed positively to PC1 were spikelet number per spike (0.953), grain number per spike (0.933), grain weight per spike (0.922). While 1000 grain weight contributed negatively to the first component. Maximum genetic variance to PC2 was contributed by plant height, spike length, awn length and peduncle length. In the case of PC3, grain yield contributed positively and days to heading had a negative contribution.

Table 2. Principal Component analysis of hulless barley accessions

Characters	PC1	PC2	PC3
Eigenvalues	3.239	2.102	1.303
% of Variance	32.390	21.021	13.032
Cumulative %	32.390	53.411	66.443
Factor loadings			
Plant height	-0.254	0.712	-0.076
Days to heading	0.212	-0.137	-0.702
Spike length	-0.247	0.721	-0.032
Awn length	0.249	0.756	-0.281
Peduncle length	-0.086	0.485	0.209
Spikelet number per spike	0.953	0.214	-0.026
Grain number per spike	0.933	0.187	0.108
Grain weight per spike	0.922	0.112	0.221
1000 grain weight	-0.607	0.393	0.056
Grain yield	-0.047	0.040	0.786

According to factor loadings, it could be concluded that between spikelet number per spike, grain number per spike, and grain weight per spike had a positive association. While the association between those three traits and 1000 grain weight was negative. Plant height, spike length, awn length, and peduncle length were positively related. A negative relationship between days to heading and grain yield was observed in the studied set of hulless accessions. This relationship between yield and heading time is in agreement with our previous study of hulless barley mutants confirming our conclusion that hulless barley varieties with a long period to heading are probably not suitable for the region of Southeastern Bulgaria because grain filling often occurs in the conditions of water deficit and high temperatures (Dyulgerova and Dyulgerov, 2020). Zaefizadeh et al. (2011), Abd El-Mohsen (2013), and Mansour et al. (2018) also reported negative association between grain yield and days to heading in barley.

Figure 1 displays a biplot in the dimension of the first and second PCs. Hulless accessions with positive values for PC1 and PC2 are of breeding interest because those genotypes had long spikes with a high number of grains in spike and high grain weight per spike. Hulless accessions INBYT-HI-15-1, INBYT-HI-15-3, and INBYT-HI-15-4 had negative values for the first PC and positive for the third PC (Figure 2) are also of special interest for breeding purpose because those accessions showed a favorable combination between high yield and high 1000 grain weight.

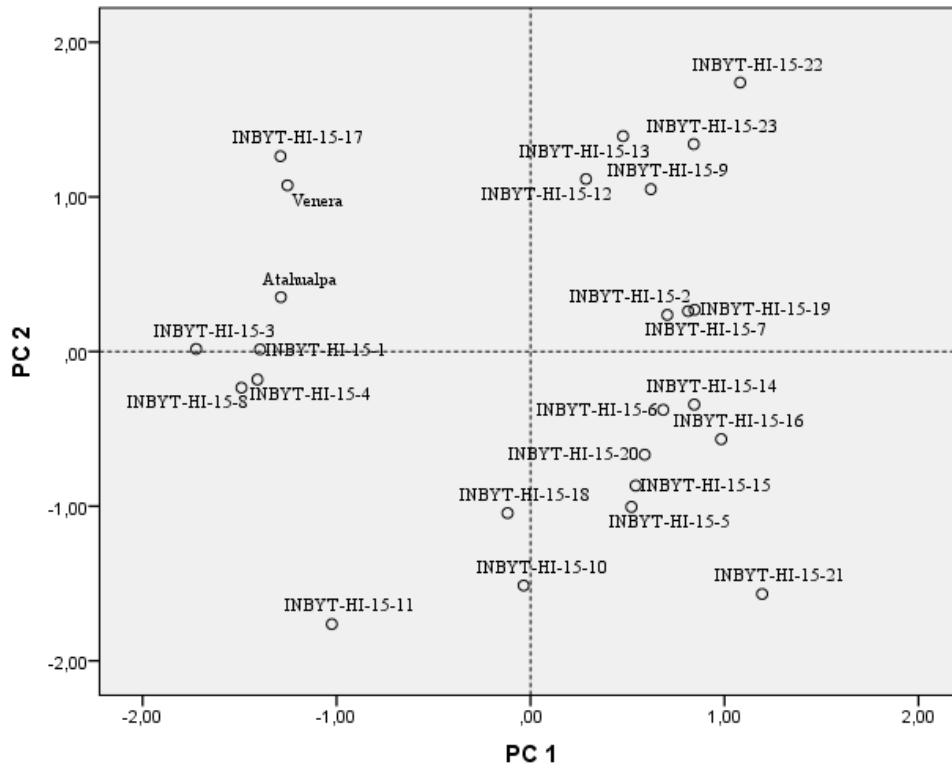


Figure 1. Scatter diagram for PC1 and PC2 of hulless barley accessions

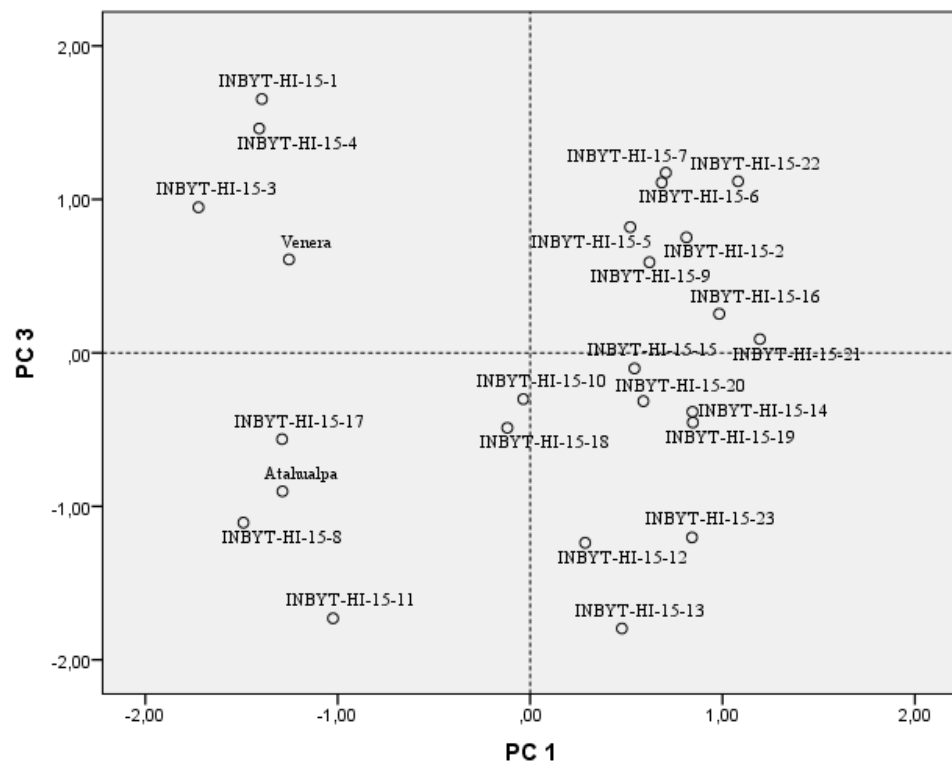


Figure 2. Scatter diagram for PC1 and PC3 of hulless barley accessions



CONCLUSION

In conclusion, a high level of variation was found for all studied morphological and agronomic traits measured in hulless barley accessions. Spikelet number per spike, grain number per spike, and grain weight per spike were the major contributors to the genetic diversity between tested hulless barley accessions.

Mean grain yield of hulless accessions ranged from 1.002 to 4.763 t/ha. Lines INBYT-HI-15-1, INBYT-HI-15-4, INBYT-HI-15-21, and INBYT-HI-15-22 had grain yield that not differ significantly from those of hulled check variety. Therefore, those lines can be used in the breeding program for the development of new hulless varieties with improved grain yield.



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FARKLI TAHIL-BAKLAGİL YEM BİTKİLERİNİN MİNERAL MADDE İÇERİKLERİNE HASAT ZAMANI VE FARKLI ORANLARDA GÜBRE UYGULAMALARININ ETKİSİ

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ÖZET

Bu çalışma, yem karışımına farklı oranlarda üre (0, 10 kg DAP 15 kg/da Üre, 10, 20 kg/da) dozlarının uygulanması ve üç farklı dönemde hasat edilmesi ile bitkilerin mineral madde içeriklerini tespit etmek amacıyla gerçekleştirilmiştir. Çalışma Erzincan İli belde ve köylerinde bulunan 4 tarlada 2019-2020 sezonunda yürütülmüştür. Numunelerin K, P, Ca, Mg, Na, Fe, Mn, Zn ve Cu içerikleri Ağrı İbrahim Çeçen Üniversitesi Merkezi Araştırma ve Uygulama Laboratuvarında bulunan Endüktif Eşleşmiş Plazma-Kütle Spektrometre (ICPMS) cihazı ile belirlenmiştir. Bütün analizler üç tekerrürlü olarak yapılmıştır. Elde edilen verilerin kıyaslanması amacıyla SPSS 24 paket programında varyans analizine tabi tutulmuş, grupların karşılaştırılmasında Duncan karşılaştırma testi uygulanmıştır. Mineral içerikleri hasat zamanı geciktikçe azalma göstermiştir. Tüm gübre uygulamalarında elde edilen değerler kontrol grubundan daha yüksek olmuştur. Mg, P ve K mineralleri en yüksek değerler 10 kg DAP 15 kg/da üre uygulamasında, Na minerali 10 kg/da üre uygulamasında ve Ca minerali de 20 kg/da üre uygulamasında tespit edilmiştir. Ca/P oranı Ca mineralinin yetersizliğinden istenilen düzeyde olmamıştır. K/(Ca+Mg) oranları ise çok yüksek olmasından dolayı hayvanlarda tetani hastalığına neden olma riski taşımaktadır. Sonuçta hasat zamanının ve farklı gübre uygulamalarının mineral içeriklerini etkilediği belirlenmiş ve bu yemleri rasyonda kullanılırken ek Ca maddelere yer verilmesi ya da bu maddece zengin yemlerin rasyonlarda kullanımı, bu riski ortadan kaldıracaktır.

Anahtar Kelimeler: Karışım yem bitkileri, mineral madde, hasat zamanı, üre



HARVEST TIME AND THE EFFECT OF FERTILIZER APPLICATIONS IN DIFFERENT RATIOS ON MINERAL MATERIAL CONTENT OF DIFFERENT GRAIN-LEGUMES FEED PLANTS

ABSTRACT

This study was carried out to determine the mineral content of the plants by applying different doses of urea (0, 10 kg DAP, 15 kg/da Urea, 10, 20 kg/da) to the feed mixture and harvesting in three different periods. The study was carried out in 4 fields in the towns and villages of Erzincan Province in the 2019-2020 season. The K, P, Ca, Mg, Na, Fe, Mn, Zn and Cu contents of the samples were determined by the Inductively Coupled Plasma-Mass Spectrometer (ICPMS) device in Ağrı İbrahim Çeçen University Center Research and Application Laboratory. All analyzes were performed in triplicate. In order to compare the obtained data, variance analysis was applied in SPSS 24 package program and Duncan comparison test was applied to compare the groups. Mineral contents decreased with the harvest time was delayed. The values obtained in all fertilizer applications were higher than the control group. The highest values of Mg, P and K minerals were determined in 10 kg DAP 15 kg/da urea application, Na mineral in 10 kg/da urea application and Ca mineral in 20 kg/da urea application. The Ca/P ratio was not at the desired level due to the insufficiency of the Ca mineral. Since $K / (Ca + Mg)$ ratios are very high, it carries the risk of causing tetany disease in animals. As a result, it has been determined that the time of harvest and different fertilizer applications affect the mineral contents, and the use of additional Ca substances while using these feeds in the ration or the use of feeds rich in this substance in the rations will eliminate this risk.

Keywords: Mixed forage crops, mineral substance, harvest time, urea



GİRİŞ

İnsan beslenmesinde önemli bir yer tutan hayvansal protein, hayvanların verim düşüklüğü ile yeterince sağlanamamaktadır. Verim düşüklüğünün nedeni ise çayır ve meralarımızın kalitelerini kaybetmesi ile kaliteli kaba yem yetersizliğinden kaynaklanmaktadır (Doğan 2013). Bu eksikliğin giderilmesinde tarla tarımı önemli bir yer kaplamaktadır. Tarla tarımında baklagil ve buğdaygil yem bitkileri ayrı ayrı ekilmekle birlikte günümüzde karışık ekimler yapılmakta ve yetiştiriciler tarafından artan oranda benimsenmektedir.

Karışık ekimin yem ihtiyacını karşılaması yanında bazı avantajları bulunmaktadır. Bazı baklagil yem bitkilerinde zayıf gövde nedeni ile yatma meydana gelmekte bu nedenle hasat zor olmakta ve kayıplara neden olmaktadır (Anlarsal vd., 1996; Tan ve Serin, 1996). Bu olumsuzluğun giderilmesinde bu baklagiller tahıllarla birlikte ekilmektedir. Karışık ekimle yalın ekime göre birim alandan daha fazla kuru ot ve daha fazla ham protein elde edilmektedir (Gülümser vd., 2017). Karışımdaki baklagil oranının fazla olması ile topraktan azot kullanımını azaltarak kaynakların daha verimli kullanılmasını sağlar (Erol vd., 2009). Yalın ekime göre alan başına üretimi artırmakla (Ghosh, 2004) beraber, karışık ekimde besin elementi içeriğinin daha fazla olmasını sağlar (Staniak ve ark., 2012). Bir bitkinin hayvan beslemede kaliteli sayılması için o bitkinin besin madde içeriği, sindirilebilirliği yanında mineral madde içeriğinin payı da çok önemlidir. Yemlerin mineral içeriği % 0.21 P, % 0.65 K, % 0.31 Ca ve % 0.1 Mg oranlarında bulunmalıdır (Kidambi ve ark., 1989). Baklagil yem bitkileri buğdaygil yem bitkilerinden daha fazla mineral içeriğe sahiptir. Bu nedenle de yemlerin karışık ekim yapılması önem taşımaktadır (Gülümser vd., 2017).

Ekim yapılacak toprakta hem bitkinin o topraktan istenilen düzeyde besin maddelerini alabilmeleri için hem de toprağın iyileştirilebilmesi için gübre uygulamaları yapılmaktadır. Üre bitkinin azot ihtiyacını karşılamakta iyi bir besin kaynağı olarak bu gübreler içerisinde yer almaktadır. Azot kayıplarının üründe verim ve kalitenin düşmesine neden olduğu bilinmektedir (Anonim, 2020). Ekim öncesi veya ekimden sonra toprağı iyileştirme ve topraktan bitkinin alacağı bitki besin maddelerinin artırılması için çeşitli gübre uygulamaları yapılmaktadır. Çeşitli gübre uygulamaları içerisinde yer alan üre; bitkilerin azot (N) ihtiyaçlarını karşılamak için çok iyi bir besin kaynağıdır. Bitkinin kalitesine uygulanan gübrenin yanı sıra hasat zamanı da etki etmektedir. Erken hasatta kalitenin yükselmesine rağmen verimi azaltmakta, hasat geciktirildikçe o bitkinin sindirilebilirliği azalmaktadır (Gürsoy ve Macit, 2020).

Bu çalışma kışlık ara ürün olarak ekilen beşli yem karışımında makro-mikro element içeriklerine, farklı hasat zamanı ve farklı dozlarda kullanılan gübrenin etkisini belirlemek amacı ile yapılmıştır.

2. MATERYAL ve YÖNTEM

2.1. MATERYAL

Çalışma Erzincan İli sınırları içerisinde bulunan Altınbaşak Beldesi (2 tarla), Uluköy (1 tarla) ve Çatalören (1 tarla) köyünde bulunan 4 tarlada, 2019-2020 sezonunda yürütülmüştür. Her bir tarladan 0-30 cm derinden toprak örnekleri alınarak analiz edilmiştir. Toprak örneklerine ait analiz sonuçları Tablo 1’de verilmiştir.



Tablo 1. Araştırma Yerlerine Ait Toprak Analizi Sonuçları

	Toprak Bünyesi	Ph	Organik Madde	Kireç	Tuz	Potasyum (K ₂ O ha ⁻¹)	Fosfor (P ₂ O ₅ ha ⁻¹)
1. Tarla (Kontrol)	Tınlı	Hafif alkali	Orta	Orta kireç	Tuzsuz	Yüksek	Fakir
2. Tarla (10 DAP+15 Üre kg/da)	Tınlı	Kuvvetli alkali	Little	Orta kireç	Tuzsuz	Yüksek	Fakir
3. Tarla (10 Üre kg/da)	-Tınlı	Kuvvetli alkali	Orta	Fazla kireç	Tuzsuz	Orta	Fakir
4. Tarla (20 Üre kg/da)	Tınlı	Kuvvetli alkali	Orta	Kireçli	Tuzsuz	Az	Fakir

Tarım ve Orman İl Müdürlüğü'nün DAP projesi ile çiftçilere yem bitkilerini destek amacı ile hibe edilen beşli yem karışımı, %35 Macar Fiği (Tarm beyazı), %35 Yem Bezelyesi (Szarvası andrea), %10 Yulaf (Kahraman), %10 Triticale (Karma 2000) ve %10 Buğday (Sönmez 2000) yem bitkilerinden oluşmuştur.

2.1.2. Çalışmadaki Uygulamalar;

Kontrol: 1. Tarlaya kontrol olmak üzere herhangi bir gübre uygulaması yapılmamıştır. Ekim öncesi kazayağı ile işleme yapıp tırmıklanmıştır. 20.09.2019 tarihinde dekara 15 kg tohum mibzerle ekilmiştir. Toplamda 11 da ekimi yapılan tarlaya hasada kadar bir kez salma sulama yapılmıştır.

10 DAP, 15 Üre kg/da: 2. Tarlaya ekimden önce 10 kg DAP (Diamonyumfosfat) verilerek pulluk ve tırmıkla sürülmüştür. Dekara 15 kg tohum ekimi 01.12.2019 tarihinde mibzerle yapılmıştır. Tarlaya 28.03.2020 tarihinde 15 kg/da üre atılmıştır. Toplamda 5 da ekimi yapılan tarlaya hasada kadar bir kez salma sulama yapılmıştır.

10 Üre kg/da: 3. Tarla ekimden önce pullukla sürülerek dişli ile karıştırılmıştır. Dekara 15 kg tohum ekimi 15.11.2019 tarihinde mibzerle yapılmıştır. Tarlaya 07.04.2020 tarihinde 10 kg/da üre atılmıştır. Toplamda 5 da ekimi yapılan tarlaya hasada kadar bir kez salma sulama yapılmıştır.

20 Üre kg/da: 4. Tarla ekimden önce pullukla sürülerek tırmık ile çekilmiştir. Dekara 15 kg tohum ekimi 15.11.2019 tarihinde mibzerle yapılmıştır. Tarlaya 05.04.2020 tarihinde 20 kg/da üre atılmıştır. Toplamda 5 da ekimi yapılan tarlaya hasada kadar bir kez salma sulama yapılmıştır.

Yem karışımı yetiştirilen tarlalara farklı üre dozları ve DAP uygulaması yetiştiricilerin tercihleri doğrultusunda yapılmıştır. Kontrol amaçlı bir tarlada da hiçbir gübre uygulaması yapılmamıştır.

2.1.3. İklim Verileri

Deneme sürecinde Erzincan İli sıcaklık, yağış ve nem bilgileri Meteoroloji Genel Müdürlüğü'nden alınarak Tablo 2'de verilmiştir. Çalışma süresince sıcaklığın en düşük olduğu ay Şubat iken, en yüksek Haziran ayında gerçekleşmiştir. Yağış İlde deneme süresince az olup, nem ise en yüksek Aralık ayında görülmüştür. İlde yağışın yıllara göre daha az olması ekstrem bir durum olup küresel ısınmaya bağlı iklim değişikliğinden kaynaklandığı düşünülmektedir (Kibar et al., 2014).



Tablo 2. Erzincan İli 2019-2020 Yılları Aylara Göre Sıcaklık, Yağış ve Nem Oranları

	Sıcaklık °C	Yağış mm	Nem %
Ekim	15,47	0,25	46,53
Kasım	6,03	0,42	50,90
Aralık	5,20	0,25	65,78
Ocak	0,28	0,50	57,76
Şubat	0,08	1,37	63,35
Mart	8,18	1,78	55,27
Nisan	13,6	0,89	46,12
Mayıs	15,92	1,94	47,25
Haziran	26,66	0,12	40,52
Temmuz	25,67	0,01	34,63

YÖNTEM

Çalışmada 3 biçim zamanı gözetilerek 3 kez hasat yapılmıştır. İlk hasat yem bezelyesinin çiçeklenme öncesinde (1) 4 tarlada da 13.05.2020 tarihinde parsellerin başlarından 50 cm kenar tesiri bırakılarak orak yardımı ile tarlayı temsil edecek şekilde 5m² alandan yapılmıştır. İkinci hasat yem bezelyesi çiçeklenmesinin %50 olduğunda (2) tarlayı temsil edecek şekilde kenar tesiri bırakılarak 5m² alandan 02.06.2020 tarihinde gerçekleştirilmiştir. Üçüncü hasat tam çiçeklenme döneminde (3) kenar tesiri bırakılarak 5m² alandan 16.06.2020 tarihinde olmuştur. Mineral madde analizlerinden önce yem örnekleri Dried Plant Tissue yakma prosedürüne göre yakılmıştır (Miller, 1998). Numunelerin potasyum (K), fosfor (P), kalsiyum (Ca), magnezyum (Mg), sodyum (Na), demir (Fe), mangan (Mn), çinko (Zn) ve bakır (Cu) içerikleri Ağrı İbrahim Çeçen Üniversitesi Merkezi Araştırma ve Uygulama Laboratuvarında bulunan Endüktif Eşleşmiş Plazma-Kütle Spektrometre (ICPMS) cihazı ile belirlenmiştir. Bütün analizler üç tekrürlü olarak yapılmıştır.

Araştırmanın sonucu elde edilen verilerin kıyaslanması amacıyla SPSS 24 (IBM, 2016) paket programında varyans analizine tabi tutulmuş, grupların karşılaştırılmasında Duncan karşılaştırma testi uygulanmıştır.

3. BULGULAR ve TARTIŞMA

Karışık yem bitkilerinin hasat dönemlerine ve farklı üre dozlarına göre Mn, Fe, Cu ve Zn içerikleri incelenmiş (Tablo 3) ve içerikler arasındaki farklılıklar (Zn hasat zamanı ortalamaları hariç (P<0.05)) önemli olarak bulunmuştur (P<0.05).



Tablo 3. Karışımdaki yemlerin farklı hasat zamanı ve uygulanan farklı üre dozlarına göre mikro mineral içerikleri (ppm)

	Hasat Zamanı	0	10 DAP 15 Üre	10 Üre	20 Üre	Ortalama
Mn	1	30,43	63,90	68,42	42,24	51,25A
	2	31,06	33,34	54,52	39,94	39,72B
	3	39,13	46,46	51,86	38,44	44,98AB
	Ort	33,54^c	47,9^b	58,26^a	40,20^{bc}	
Fe	1	113,22	2517	1468	209,44	1077,66A
	2	290,29	195,32	332,10	232,27	262,49B
	3	938,40	724,48	311,36	318,88	573,28AB
	Ort	447,30^b	1145,8^a	703,87^{ab}	253,52^b	
Cu	1	0,83	5,60	4,56	1,73	3,18A
	2	0,77	1,95	3,19	1,41	1,83B
	3	2,06	2,78	0,99	0,48	1,58B
	Ort	1,22^b	3,45^a	2,91^a	1,21^b	
Zn	1	10,78	22,48	8,17	15,94	14,34
	2	8,73	15,34	4,14	17,69	11,48
	3	9,65	9,66	7,12	15,16	10,40
	Ort	9,72^b	15,83^a	6,48^c	16,26^a	

a-c, A-B Aynı satır ve sütunda farklı harfler ile gösterilen ortalamalar arasındaki farklılıklar önemlidir (P<0.05), Mn: Mangenez, Fe: Demir, Cu: Bakır, Zn: Çinko.

Mn elementinin ortalamaları farklı hasat dönemlerinde en düşük %50 çiçeklenme döneminde (39,72 ppm), en yüksek çiçeklenme öncesi dönemde (51,25 ppm) görülmüştür. Gübre uygulamalarına göre Mn elementi ortalamaları 33,54-58,26 ppm arasında değişmiştir. En düşük oran kontrol gurubunda, en yüksek 10 kg/da üre uygulaması yapılan gurupta görülmüştür. Elde edilen değerler bildirilen sınırlardan (0,020-0,025 g/kg) (Milson, 1990) daha yüksek olmuştur. Mn içeriği kullanılan üre miktarı arttıkça azalma göstermiştir. Fe elementi ortalamaları hasat zamanına göre en yüksek 1077,66 ppm çiçeklenme öncesi dönemde, en düşük 262,49 ppm ile %50 çiçeklenme zamanında elde edilmiştir. Gübre uygulamalarına göre 253,52-1145,8 ppm arasında değişmiştir. En düşük 20 kg/da üre uygulamasıyla 253,52 ppm, en yüksek 10 kg DAP 15 kg/da üre uygulamasıyla 1145,8 ppm olmuştur. NRC (2001), sığırların ihtiyacı olan Fe değerini 50 ppm olarak bildirmiştir. Elde edilen Fe değerleri sığırların ihtiyacı olan değerden daha yüksek olmuştur. Gübre uygulamalarında Fe içeriği 20 kg/da üre uygulamasıyla azalma göstermiştir. Cu elementi 3,18 ppm ile çiçeklenme öncesi dönemde en yüksek, 1,58 ppm ile en düşük çiçeklenme sonrası döneminde olmuştur. Gübre uygulamalarında Cu elementi 1,21-3,45 ppm arasında değişmiştir. En yüksek 3,45 ppm ile 10 kg DAP 15 kg/da üre uygulamasında, en düşük 1,21 ppm ile 20 kg/da üre uygulamasında belirlenmiştir. Cu içeriği inekler için bulunması gereken değerden (10 mg/kg) daha düşük değerlere sahip olmuştur (Amin vd., 2016). Cu element içeriği karışık yem bitkisinde 20 kg/da üre uygulamasıyla azalma göstermiştir. Zn elementi ortalamaları hasat zamanına göre 10,40-14,34 ppm arasında değişmiştir. Gübre uygulamalarında Zn ortalamaları 6,48-16,26 ppm arasında değişmiştir. En yüksek 20 kg/da üre uygulamasında, en düşük kontrol gurubunda elde edilmiştir. Sığırlar için Zn gereksiniminin 20-40 ppm arasında olması gerektiği Barnes (1990) tarafından bildirilmiştir. Çalışmada elde edilen Zn içerikleri bildirilen bu değerlerden daha düşük olarak elde edilmiştir. Çalışmada elde edilen mikro minerallerden Mn, Zn ve Cu değerleri karışık yem bitkilerinin mineral içeriğini inceleyen çalışmalarda (Alp vd., 2001; Çimrin vd., 2001; Öztürk, 2009; Doğan, 2013) değerlerden düşük, Mn ve Fe değerleri incelenen çalışmalarda (Alp vd., 2001; Öztürk, 2009) değerler ile benzer olarak tespit edilmiştir. Değerlerin diğer çalışmalardan farklı



olması, iklim, toprak çeşitliliği, bitki çeşitliliği ve uygulanan gübrelerin farklı olmasından kaynaklandığı düşünülmektedir.

Karışık yem bitkilerinin hasat dönemlerine ve farklı üre dozlarına göre Na, Mg, Ca, P ve K içerikleri incelenmiş (Tablo 4) ve içerikler arasındaki farklılıklar (Na hasat zamanı ortalamaları hariç ($P>0.05$)) önemli olarak bulunmuştur ($P<0.05$).

Tablo 4. Karışımındaki yemlerin farklı hasat zamanı ve uygulanan farklı üre dozlarına göre makro mineral içerikleri (%)

	Hasat Zamanı	0	10 DAP 15 Üre	10 Üre	20 Üre	Ortalama
Na	1	0,01	0,03	0,09	0,03	0,04
	2	0,03	0,06	0,06	0,06	0,04
	3	0,02	0,05	0,05	0,03	0,02
	Ort	0,02^b	0,01^b	0,07^a	0,04^{ab}	
Mg	1	0,15	0,50	0,45	0,21	0,33A
	2	0,17	0,21	0,29	0,20	0,22B
	3	0,27	0,37	0,29	0,22	0,29AB
	Ort	0,20^b	0,36^a	0,34^a	0,21^b	
Ca	1	0,07	0,11	0,21	0,13	0,13B
	2	0,05	0,08	0,08	0,22	0,11B
	3	0,11	0,24	0,13	0,33	0,20A
	Ort	0,08^c	0,15^b	0,14^b	0,23^a	
P	1	0,34	0,53	0,30	0,35	0,38A
	2	0,30	0,45	0,35	0,21	0,33AB
	3	0,28	0,33	0,28	0,19	0,27B
	Ort	0,31^b	0,44^a	0,31^b	0,25^b	
K	1	2,92	5,19	0,30	3,21	3,41A
	2	2,64	3,91	0,35	1,84	2,64B
	3	1,54	2,73	0,28	1,76	1,91C
	Ort	2,37^b	3,94^a	2,04^b	2,27^b	

a-c, A-B Aynı satır ve sütunda farklı harfler ile gösterilen ortalamalar arasındaki farklılıklar önemlidir ($P<0.05$), Na: Sodyum, Mg: Magnezyum, Ca: Kalsiyum, P: Fosfor, K: Potasyum

Karışık yem bitkilerinin hasat zamanına göre Na elementi ortalamaları 0,02-0,04 ppm arasında değişmiştir. Gübre uygulamalarına göre Na elementi ortalamaları 0,02-0,07 ppm arasında değişmiş ve en düşük oran kontrol gurubunda, en yüksek oran 10 kg/da üre uygulamasındaki karışık yem bitkilerinde görülmüştür. Elde edilen değerler hem sığırlar (0,06-1) (Barnes et al., 1990) hem de koyular (%0,1-0,08) (NRC, 2001) için bildirilen değerler arasında yer almıştır. Mg elementi ortalamaları hasat zamanına göre en yüksek çiçeklenme öncesi dönemde %0,33 %50 çiçeklenme döneminde %0,22 ile en düşük değeri göstermiştir. Gübre uygulamalarına göre Mg ortalamaları %0,20-0,36 arasında değişmiştir. En düşük kontrol gurubunda, en yüksek 10 kg DAP 15 kg/da üre uygulaması yapılan gurupta gerçekleşmiştir. Mg oranları büyükbaş ruminantların rasyonlarında olması gereken (%0,25) orandan daha fazla olmuştur (NRC, 1996). Ca elementi ortalamaları hasat zamanına göre %0,11-0,20 arasında değişmiştir. En düşük %50 çiçeklenme döneminde, en yüksek çiçeklenme sonrası dönemde elde edilmiştir. Gübre uygulamalarına göre Ca ortalamaları %0,08-0,23 arasında değişmiştir. En düşük kontrol gurubunda, en yüksek 20 kg/da üre uygulaması yapılan gurupta olduğu görülmüştür. Elde edilen Ca içerikleri ruminantlar için rasyonda olması gereken (%0,30) orandan daha az olduğu belirlenmiştir (Tajeda et al., 1985). P elementi ortalaması hasat zamanına göre en yüksek (%0,38) çiçeklenme öncesi dönemde, en düşük (%0,27) çiçeklenme sonrası dönemde gerçekleşmiştir. Gübre uygulamalarına göre P ortalamaları %0,25-0,44 arasında değişmiştir. En yüksek 10 kg DAP 15 kg/da üre uygulamasında, en düşük %20 kg/da üre uygulamasında ve



kontrol gurubu ve %15 üre uygulamasında eşit olduğu belirlenmiştir. Çalışmada elde edilen P oranları sığırlar için gerekli P oranı (%0,23)'nin dan daha yüksek elde edilmiştir (NRC, 2001). K elementi ortalamaları hasat zamanına göre en yüksek %3,41 ile çiçeklenme öncesi dönemde, en düşük %1,91 ile çiçeklenme sonrası dönemde olmuştur. Gübre uygulamalarına göre K ortalamaları %2,04-3,94 arasında değişmiştir. En düşük %10 kg/da üre uygulamasında, en yüksek 10 kg DAP 15 kg/da üre uygulamasında tespit edilmiştir. Rasyonda bulunması gereken K oranının (%) dan çalışmadaki K değerlerinin daha yüksek olduğu belirlenmiştir (Muller, 2009).

Karışık yem bitkilerini mineral içeriğini inceleyen kimi çalışmalardan İncelenen makro mineral içeriklerinden Na, Mg ve Ca oranları düşük, Mg, K ve P oranları yüksek ve Mg, Ca, K ve P oranları benzer (Çimrin vd., 2001; Yolcu vd., 2010; Eğritaş ve Aşçı, 2015; Gülümser vd., 2017) olarak belirlenmiştir.

Karışık yem bitkilerinin hasat dönemlerine ve farklı üre dozlarına göre Ca/P, K/(Mg+Ca), Ca/N ve K/Na ortalamaları incelenmiş (Tablo 5) ve ortalamalar arasındaki farklılıklar önemli olarak bulunmuştur (P<0.05).

Tablo 5. Karışımdaki yemlerin farklı hasat zamanı ve uygulanan farklı üre dozlarına göre Ca/P, K/(Mg+Ca), Ca/N ve K/Na ortalamaları (%)

	Hasat Zamanı	0	10 DAP 15 Üre	10 Üre	20 Üre	Ortalama
Ca/P	1	0,21	0,21	0,69	0,37	0,37B
	2	0,18	0,19	0,24	1,08	0,42B
	3	0,38	0,75	0,46	1,73	0,83A
	Ort	0,26^b	0,38^b	0,47^a	1,06^b	
K(Ca+Mg)	1	13,08	8,54	3,55	9,59	8,69A
	2	12,00	13,45	5,82	4,38	8,91A
	3	4,09	4,43	3,83	3,22	3,89B
	Ort	9,73^a	8,81^{ab}	4,40^c	5,73^{bc}	
Ca/Na	1	7,82	3,81	2,23	3,71	4,39B
	2	1,97	13,11	1,24	3,41	4,93B
	3	4,57	47,72	2,45	10,65	16,35A
	Ort	4,79^b	21,55^a	1,97^b	5,92^b	
K/Na	1	312,22	181,57	24,83	92,86	152,87
	2	88,63	607,40	31,56	28,14	188,93
	3	66,68	533,83	30,87	57,23	172,15
	Ort	155,84^b	440,93^a	29,09^c	59,41^{bc}	

a-c, A-B Aynı satır ve sütunda farklı harfler ile gösterilen ortalamalar arasındaki farklılıklar önemlidir (P<0.05).

Ca/P ortalamaları hasat zamanına göre en yüksek 0,83 ile çiçeklenme sonrası dönemde, en düşük ise 0,37 ile çiçeklenme öncesi dönemde görülmüştür. Gübre uygulamalarına göre Ca/P ortalamaları 0,26-1,06 arasında değişmiştir. En yüksek değer 20 kg/da üre uygulamasında, en düşük değer ise kontrol gurubunda gerçekleşmiştir. Hayvanlarda süt hummasına neden olmaması için Ca/P oranının 2:1 veya 1:2 oranında olması gerektiği bildirilmiştir (Açıkgöz, 2001). Çiçeklenme sonrası hasat ve 20 kg/da üre uygulaması dışında Ca/P oranları bildirilen değerlerden daha düşük olarak elde edilmiştir. K(Ca+Mg) ortalamaları hasat zamanına göre en düşük (3,89) çiçeklenme sonrası dönemde, en yüksek (8,91) %50 çiçeklenme döneminde olduğu belirlenmiştir. Gübre uygulamalarına göre ortalamaları 4,40-9,73 arasında değişmiştir. En düşük %10 üre uygulamasında, en yüksek kontrol gurubunda tespit edilmiştir. K/(Ca+Mg) oranının fazla olmaması (Bakoğlu vd., 1999) ve bu oranın 2,2'nin altında olması gerektiği bildirilmiştir. Çalışmadaki K/(Ca+Mg) oranları olması gereken oranlardan daha fazla olduğu tespit edilmiştir. Gülümser vd. (2017), baklagil ve tahıl karışımlarının Ca/P ve K/(Ca+Mg)



oranlarını çiçeklenme döneminde 2,171-1,942 ve 1,502-1,619 arasında, süt olum döneminde ise aynı sırayla; 2,328-2,235 ve 1,127-1,298 arasında tespit etmişlerdir. Karışım yem bitkileri ile yapılan çalışmalarda elde edilen Ca/P oranları bu çalışmada elde edilen değerlerden yüksek, K/(Ca+Mg) oranları ise düşük olduğu belirlenmiştir (Çimrin vd., 2001; Yolcu, 2008; Eğritaş ve Aşçı, 2015)

Ca/Na ortalamaları hasat zamanına göre 4,39 ile en düşük çiçeklenme öncesi dönemde, 16,35 ile en yüksek çiçeklenme sonrası dönemde görülmüştür. Gübre uygulamalarına göre ortalamalar 1,97-25,55 arasında değişmiştir. En düşük %10 üre uygulamasında, en yüksek 10 kg DAP 15 kg/da üre uygulamasında gerçekleşmiştir. K/Na ortalamaları hasat zamanına göre en düşük çiçeklenme öncesi dönemde 152,87, en yüksek %50 çiçeklenme döneminde 188,93 olarak belirlenmiştir. Gübre uygulamalarına göre ortalamalar 29,09-440,93 arasında değişmiştir. En düşük %10 üre uygulamasında, en yüksek 10 kg DAP 15 kg/da üre uygulamasında belirlenmiştir.

4. SONUÇLAR ve ÖNERİLER

Kaliteli kaba yem açığının kapatılması ve diğer avantajlarından dolayı ekiminin yapılması gittikçe artan karışık yem bitkilerinin makro ve mikro mineral içeriklerini tespit etmek için yapılan bu araştırma, biçim zamanı ve farklı gübre uygulamalarının mineral madde içeriğine etkisinde farklılıkların önemli olduğunu ortaya koymuştur. Mikro mineral içerikleri hasat zamanı geciktikçe azalma göstermiştir. Gübre uygulamalarına göre mikro minerallerin en düşük değerleri kontrol gurubunda ve 20 kg/da üre uygulaması yapılan grupta, en yüksek değerler ise 10 kg DAP 15 kg/da ve 10 kg/da üre uygulaması yapılan grupta olduğu görülmüştür. Makro mineral içeriklerinde genel olarak hasat zamanına göre en yüksek değerler çiçeklenme öncesi dönemde elde edilmiştir. Hasat zamanı geciktikçe makro mineral oranları azalma göstermiştir. Gübre uygulamalarında genel olarak makro mineral içerikleri en düşük değerler kontrol gurubunda görülmüştür. Mg, P ve K mineralleri en yüksek değerler 10 kg DAP 15 kg/da üre uygulamasında, Na minerali 10 kg/da üre uygulamasında ve Ca minerali de 20 kg/da üre uygulamasında tespit edilmiştir. Ca minerali toprak tarafından yeteri kadar alınamamıştır. P içeriğinin ise fazla bulunmasından dolayı Ca/P oranı istenilen sınırlar içinde olmayıp tolere edilebilir olduğu düşünülmektedir. K/(Ca+Mg) oranları ise K içeriğinin fazla ve Ca içeriğinin düşük olması nedeni ile çok yüksek olduğu ve tetani hastalığına neden olma riskinden dolayı yemin rasyonda kullanımında ek Ca verilmesi veya bu maddece zengin yemlerin rasyonlarda kullanımı, bu riski ortadan kaldıracaktır.



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URBANITES' AWARENESS, PERCEPTION AND ATTITUDES TOWARDS URBAN FORESTRY AS A PANACEA FOR ENVIRONMENTAL SUSTAINABILITY IN OGUN STATE, NIGERIA-A SURVEY OF THE COVID-19 ERA

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ABSTRACT

Sustainable environment is becoming less achievable with increase in the rate of urbanization and the threat of forest exploitation in the nearest future. The world in the COVID-19 era must strive towards getting an atmosphere that is friendly and conducive to both humans and non-humans. Urban forestry is perhaps the most effective means of creating a sustainable environment. The urban environment is ecologically complex, being a product of natural and human induced processes. The urban environment in Ogun state is susceptible to myriad of hazards as a result of copious industrial activities and other environmental pollutants. The perception, awareness and attitude of the urbanites were examined towards urban forestry as a panacea for sustainable environment. A simple random technique was employed to gather all the above information for the respondents in the study area. A structured questionnaire was administered on 150 respondents each. The study showed that the urban dwellers in Ogun state were well aware and had the adequate perception on the effectiveness of urban forestry as panacea for a sustainable environment in one way or the other but have a poor attitude towards it, hence were poorly involved in the practice of urban forestry. In view of this, the study recommends the involvement of both government and private institutions in its practice, intensification of campaign on urban forestry to both primary and secondary schools in Ogun state, especially in the metropolis to enhance the practice to its fullest.

Keywords: Urban forestry, perception, awareness, attitude, sustainable environment



INTRODUCTION

Urban forests defined in this study as all the trees and associated vegetation present in a city or planting and maintaining group of trees within a built environment (Ferrini, Konijnendijk, Bosch, Fini, 2017). Urban forestry being a key component of urban social–ecological systems is becoming more important in urban sustainability and planning (Wu, 2014). Trees commonly found in Nigeria include, *Treculia africana* (Moraceae), *Bambusa* spp, *Mangifera indica*, *Khaya ivorensis*, *Acacia* sp, *Gmelina arborea*, *Tectona grandis*, *Citrus* spp, *Asimina triloba*, *Elaeis guineensis*, *Cocos nucifera*, *Psidium guajava*, *Delonix regia* to mention a few. It is generally accepted that trees specifically, can provide a variety of ecosystem services that directly or indirectly impact human well-being and sustain the environment in urban socio-ecological systems (Escobedo, Giannico, Jim, Sanesi, Laforteza, 2019). Forestry have played an important role in social, cultural, economic and environmental development of urban centers in Nigeria, such as landscape enhancement, provision of recreational and cultural facilities, erosion control, provision of shade during meetings, ceremonies, education activities, water-shade protection and supply of fruits and vegetables and fuel-wood (Ajewole, 2015). Massive increase in the rate of urbanization, around the world in the past five decades due to rural urban migration, FAO (2016), and the tendency for a continuous increase in urbanization (Ritchie and Roser, 2018) have placed urban forest under extreme pressure and extinction in Nigeria. Studies have shown that more than half of the world population live in urban areas, this figure is projected to rise to 68% by the year 2050 (Ritchie and Roser, 2018).

The human awareness and perception on what makes the environment sustainable, is very crucial to creating and maintaining a sustainable environment, Moreover, human attitudes are also an important component of urban social–ecological systems and sustainable environment that relates to the actual interactions of people with urban green space, it could as well be an important psychological driver influencing the composition of urban residential yards, making the environment more sustainable. Attitudes are then defined as negative or positive evaluations of a specific object (i.e., preference, liking, or disliking) (Ives and Kendal, 2014) and can be used a measure to evaluate behavior toward objects, such as a tree (Jones, Davis, Bradford, 2013) Studies documenting human attitudes toward trees are more frequently used in the literature to understand the relationships between residents and urban trees (Almas and Conway, 2020).

The purpose of the study is to examine the awareness, perception and attitude of urbanite in Ogun state towards urban forestry as a panacea for sustainable environment. The specific objectives are to assess the level of awareness of urban forestry as a panacea for sustainable environment among urbanites in Ogun state, assess the Ogun state urban dwellers perception of urban forestry as a panacea for sustainable environment, investigate the Ogun state urban dwellers perception of urban forestry as a panacea for sustainable environment, ascertain the practice of urban forestry among dwellers, ascertain the dwellers choice of selecting trees for urban forestry, examine their perceived benefit for urban forestry and ascertain the challenges the dwellers have with urban forestry. The hypothesis of the study is: There is no significant relationship between the demographic features of respondents and of urban forestry on sustainable environment. The world population is becoming increasingly urban as a result of rapid urbanization. The effects of this increasing growth can be seen in forest exploitation, which in turn leads to reduction in oxygen level, wind outbreaks, poor drainage, hot environment, air pollution and poor waste management. These problems all together hinder the sustainable environment. The challenge of achieving sustainable environment, though vital is therefore complex, when the forest is being exploited as a result of urbanization. There is no



better panacea for forest exploitation in the urban areas than urban forestry, which in turn foster sustainable environment. That is why this study seeks to examine the awareness, perception and attitudes of respondents to urban forestry as a panacea for sustainable environment in Ogun state metropolis.

MATERIAL and METHODS

The study was carried out in Abeokuta, the largest urban, centre and capital of Ogun state. The study area is located in the South West Geopolitical zone of Nigeria, built in the centre of Lagos-Ibadan extended urban region and forms part of the larger metropolitan economic area. This strategic location matched with the presence of diverse local resources and rapid population growth. Due to availability of natural resources and rapid rural to urban migration, the population almost doubled from 375,000 in 1981 to 700,000 in 2013. Abeokuta has 2 local government areas, Abeokuta North and Abeokuta South.

This study employed the use of primary data to collect information with the aid of questionnaires. Using cluster sampling technique, all the local governments in Abeokuta were clearly identified and grouped into wards. The 15 wards identified in Abeokuta South Local Government are: Ake 1 (ward 1), Ake 2 (ward 2), Ake 3 (ward 3), Emere (ward 4), Ijemo (ward 5), Itoko (ward 6), Ijaiye/Idi-Aba (ward 7), Erunbe/Ijoko/Ilogbo/Oke-Ejigbo (ward 8), Oke Ijeun (ward 9), Ago Ijesha/Ijeun-Titun/Ago Egun (ward 10), Sodeke/Isale Ijeun 1 (ward 11), Sodeke/Isale Ijeun 2 II (ward 12), Oke-yeke/Imo/Isabo (ward 13), Igbore/Itori/Ago-Oba (ward 14), and Ibara (ward 15). For Abeokuta North Local Government Area, the 16 wards identified are: odo/Ikereku/Ilowo (ward 1), Ikija (ward 2), Ago-oko (ward 3), Elega housing/Imala (ward 4), Iberekodo/Ilugun (ward 5), Ita-ota/ Gbagura (ward 6), Ago iku/Ijaiye kukudi (ward 7), Lafenwa/Afonta (ward 8), Sabo Aiyetoro garage (ward 9), Oke Ago/Owu (ward 10), Totoro/Oke sokori (ward 11), Ita-oshin/Olomore (ward 12), Olorunda/Ijale (ward 13), Imala orile (ward 14), Idi-emi (ward 15) and Ibara orile (ward 16). However, using the wards as the sampling units, 3 wards were randomly selected as the sampling clusters in each local government. In Abeokuta North, odo/Ikereku/Ilowo (ward 1), Lafenwa/Afonta (ward 8) and Ita Oshin/Olomore (ward 12) were randomly selected. Ake 1 (ward 1), Itoko (ward 6) and Sodeke/Isale Ijeun 2 II (ward 12) were randomly selected in Abeokuta South. Systematic sampling was adopted in administering questionnaire on the basis of the 20th building interval in administering the questionnaire in each of the sampling clusters. 25 questionnaires were administered in each of the six representative clusters. Altogether, a total of 150 questionnaires were administered to the respondents in the study area. Data collected were analysed using descriptive statistics, such as frequencies and percentages to describe the variables in the specific objectives of the study. While inferential statistics namely the Spearman rank correlation was used to draw inferences between the variables in the hypothesis.



RESULTS and DISCUSSION

General characteristics of respondents in table 1 show that most of the respondents (29.3%) are between the ages of 31 and 40 years, while 26.7% of them are between the age bracket of 24 and 30. This means most of the respondents are fairly young and well aware about urban forestry. This concurs with the findings of Soewu and Sodeinde (2015), who found that the similar age group to be active. The results also show that 24% of the respondents fell between the age of 41 and 50 years, while 5.3% of them fell between 61 and 70 years and finally 9.3% fell between the age bracket of 51 and 60. The result also shows the gender of the respondents, the females have the highest percentage of 51.3% and only 48.7% of them are males. By implication more of the respondents were females. As per the educational status, findings show that the highest number of respondents attained tertiary education with 50% and this implies that majority of the respondents are relatively educated and this is expected to assist them in their awareness about urban forestry.

Table 1: Socio-demographic profile of the respondents

Variables	(N=150)	Variables	(N=150)
Age (years)		Marital Status	
24-30	40 (26.7)	Single	56 (37.3)
31-40	44 (29.3)	Married	73 (48.7)
41-50	36 (24)	Widow	21 (14)
51-60	14 (9.3)	Occupation	
60 +	16 (10.7)	Civil servant	45 (30)
Gender		Private firm	42 (28)
Male	73 (48.7)	Sole Proprietorship	29 (19.3)
Female	77 (51.3)	Others	34 (22.7)
Level of Education		Occupancy status	
Primary	21 (14)	Personal	54 (36)
Secondary	54 (36.1)	Rented	96 (64)
Tertiary	75 (50)		

Source: Field Survey (2021)

The result also indicated that 36.1% had secondary education and 14% of them had primary education. This means that all the respondents had various forms of formal education. It is evident from the results in the table that most 48.7% of the respondents are married while 37.3% of them are single, while only 14% are widows and widowers. This show most of the respondents are married. On the respondents' occupation status, the results showed that 30% of the respondents are civil servants, 28% are those who work with private establishments and 22.7% of them are non-workers while 19.3% of the respondents are sole proprietors. The study also revealed that majority (64%) of the respondents stay in rented apartments while 36% have their personal apartments. This implies that most of the respondents live in rented house.



Table 2: Degree of Respondents' Awareness about Urban Forestry

Survey question	N (%)
Heard about urban forestry	
Yes	116 (77.3)
No	34 (22.7)
Aware of the benefits of urban forestry	
Yes	102 (68)
No	48 (32)
Aware that urban forestry promote sustainable environment	
Yes	106 (70.7)
No	44 (29.3)
How do you know about these?	
Friends and Family	13 (8.6)
School	16 (10.7)
Tree planting Campaign	18 (12)
Radio	19 (12.7)
Television	14 (9.3)
Newsprint	4 (2.7)
Internet	12 (8)
Social media	20 (13.3)
Do you have trees in your resident?	
Yes	78 (52)
No	72 (48)
Who planted the tree?	
I planted the tree	22 (28.2)
I met the tree there	43 (55.1)
I planted the tree in conjunction with some individuals	13 (16.7)
Who is responsible for the maintenance of the tree?	
Myself	14 (18)
My family members	14 (18)
Myself and family members	15 (19.2)
Gardener hired by house dwellers	26 (33.3)
Nobody	9 (11.5)

Source: Field Survey (2021)

Table 2 shows that majority of the respondents (77.3%) have heard about urban forestry while only 22% of the respondents have not heard about urban forestry. This is an indication that most of the respondents are aware of urban forestry. It also reveals that 68% respondents are aware of the benefits of urban forestry while only 32% are not aware of the benefits of urban forestry. It is well indicated that most of the respondents are aware of the benefits of urban forestry. The table also revealed that 70.7% of the respondents are aware that urban forestry promotes sustainable environment while 29.3% are not aware that urban forestry promotes sustainable environment. This implies that majority of the respondents are aware that urban forestry promotes sustainable environment. In terms of source of information of the respondents, the result showed that 13.3% of the respondents became aware of the benefits of urban forestry through the social media followed by radio 12.7% and tree planting campaign 12% while school, television, friend and family, internet and Newsprints are 10.7%, 9.3%, 8.6%, 8% and 2.7% respectively. This indicates that social media serves as the source of awareness of the benefits of urban forestry to the majority of the respondents.

Findings also show that 52% of the respondents have trees planted in their house premises while 48% did not plant trees in their house premises. This indicates that most of the respondents have trees planted in their house premises because of their awareness of the benefits of urban forestry.



The study also revealed that 55.1% of the respondents met the trees in their house premises, 28.2% planted the trees themselves while 16.7% planted the trees in conjunction with some individuals. According to the result 33.3% of the respondents hired gardener in maintaining the trees. Relatively, this shows that most of the respondents are elites. Result also show that 19.2% of the respondents maintain the trees themselves with the assistance of family members, 18% maintain the trees themselves alone so also 18% of the respondents indicated that it is their family members that maintain the trees while 11.5% do not care in maintaining the trees in their house premises.

Table 3: Perception about Urban Forestry on Sustainable Environment in the Study Area

Survey question	Strongly agree	Agree	Disagree	Strongly disagree	Mean Scores	Rank
Makes the environment cool	80 (53.3)	38 (25.3)	16 (10.7)	16 (10.7)	2.91	1 st
Purifies the air	69 (46)	43 (28.6)	16 (10.7)	22 (14.7)	2.72	2 nd
Beautifies the environment	67 (44.6)	49 (32.7)	18 (12)	16 (10.7)	2.62	4 th
Prevent erosion	60 (40)	51 (34)	15 (10)	24 (16)	2.57	5 th
Serve as a wind break	74 (49.3)	35 (22.3)	18 (12)	23 (15.3)	2.70	3 rd
Source of food and biomedicine	54 (36)	54 (36)	16 (10.7)	26 (17.3)	2.56	6 th
Contribute to environmental conservation	47 (31.3)	57 (38)	16 (10.7)	30 (20)	2.51	7 th

Source: Field Survey (2021); Cut off point = 2.50

In terms of respondents' perception of urban forestry on sustainable environment, those identified by the study are those that centered on making the environment cool 1st, purifying the air, serving as a wind break, beautifying the environment, preventing erosion, serving as source of food as well as biomedicine and contributing to environmental conservation. Which were all ranked 1st, 2nd, 3rd, 4th, 5th, 6th and 7th respectively. According to the result all the variables identified are significant and therefore constitute the major perception towards urban forestry in the study area.



Table 4: Attitude about Urban Forestry on Sustainable Environment in the Study Area

Survey question	Strongly agree	Agree	Disagree	Strongly disagree	Mean Score	Rank
Trees and flowers in a city are important beyond their beauty or pleasing appearance.	54 (36)	40 (26.7)	25 (16.7)	31 (20.7)	2.71	3 rd
One of the most satisfying aspects of tree planting is the tranquility it brings.	33 (22)	37 (24.7)	46 (30.7)	34 (22.7)	2.75	2 nd
The trees in my house, environs and parks are important to my enjoyment of the vicinity.	19 (12.6)	33 (22)	50 (33.3)	48 (32)	2.35	5 th
Well-maintained landscapes and street plantings offset the loss of nearby natural areas to development.	18 (12)	28 (18.7)	50 (33.3)	54 (36)	2.14	6 th
Being around plants makes me feel calmer and more relaxed.	53 (35.3)	33 (22)	27 (18)	37 (24.7)	3.37	1 st
Trees give me a sense of control over my environment.	30 (20)	56 (37.3)	25 (16.7)	39 (26)	2.45	4 th

Source: Field Survey (2021); Cut off point = 2.50

The assessment of the attitudes of the respondent about urban forestry was given in Table 4. During the study it was observed that being around plants makes me feel calmer and more relaxed was ranked 1st, one of the most satisfying aspects of tree planting is the tranquility it brings was ranked 2nd, trees and flowers in a city are important beyond their beauty or pleasing appearance was ranked 3rd, while trees gives me a sense of control over my environment was ranked 4th. However, the trees in my house, environs and parks are important to my enjoyment of the vicinity and the roots of the tree can extend and well-maintained landscapes and street plantings offset the loss of nearby natural areas to development were ranked 5th and 6th respectively. According to this study only being around plants makes me feel calmer and more relaxed, one of the most satisfying aspects of tree planting is the tranquility it brings and trees and flowers in a city are important beyond their beauty or pleasing appearance are the significant variables that constitute the major attitudes towards urban forestry in the study area.

Table 5: Correlation analysis of relationship between demographics characteristics of respondents and their perception of the implication of urban forestry for sustainable environment

Variables	Correlation	Sig	P-value	Remark
Age	0.212	0.014	0.05	Significant
Gender	0.276	0.029	0.05	Significant
Level of education	0.083	0.430	0.05	Not Significant
Marital status	0.266	0.005	0.05	Significant
Occupation	0.232	0.023	0.05	Significant
Residential apartment	0.079	0.241	0.05	Not Significant
Land Space	0.064	0.321	0.05	Not Significant

Source: Field Survey (2021)



This tested for relationship between demographics characteristics and the respondents' perception on the implication of urban forestry for sustainable environment. The dependent variable in the hypothesis i.e. perception of respondents on the implication of urban forestry for sustainable environment was tested against socioeconomic characteristics of the respondents using Spearman rank correlation. Result shown in Table 5 showed that their perception on the implication of urban forestry for sustainable environment is significantly related to age, gender, marital status and occupation. This implied that age, gender, marital status and occupation of respondents are the ones that constituted significant implication on urban forestry for sustainable environment in the study area.

CONCLUSION

The study concluded that respondents in the study area are fully aware of urban forestry, also possess adequate perception of urban forestry in promoting a sustainable environment. However do not have an appropriate attitude in maintaining a sustainable environment, hence the practice of urban forestry among respondents is low. The study further found that urban forestry can improve human health and well-being by providing both physical and psychological benefits, facilitating connections with nature, and by providing services that go beyond their utilitarian value (e.g., emotional, physiological, spiritual).



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BİLECİK'TE TÜKETİME SUNULAN ÇEŞİTLİ KONSERVELERİN BAZI FİZİKSEL VE KİMYASAL ÖZELLİKLERİNİN ARAŞTIRILMASI

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ÖZET

Sanayiinin gelişmesi ile gıda tüketim alışkanlıkları evde üretim yerine hazır ürünleri satın alma olarak değişmiştir. Bunun bir sonucu olarak hazır gıda tüketiminde büyük bir yer kaplayan konserve teknolojisinin önemi gün geçtikçe artmaktadır. Bu sebeple bu çalışma çeşitli konserve türlerinin (biber dolma, yaprak sarma, bamya, türlü, fasulye pilaki, barbunya pilaki) fiziksel ve kimyasal kriterlerinin belirlenerek halk sağlığı açısından muhtemel riskleri saptamak amacıyla uygulanmıştır. Elde edilen sonuçlar Türk Standartları kriterlerine göre değerlendirilmiştir.

Anahtar Kelimeler: Konserve, fiziksel kalite, kimyasal kalite



INVESTIGATION OF VARIOUS PHYSICAL AND CHEMICAL PROPERTIES OF VARIOUS CANNED FOODS CONSUMED IN BILECIK

ABSTRACT

With the development of the industry, food consumption habits have changed from home production to purchasing ready-made products. As a result of this, the importance of canning technology, which takes a large place in ready-to-eat food consumption, is increasing day by day. For this reason, this study was applied to determine the possible risks in terms of public health by determining the physical and chemical criteria of various canned foods (Stuffed green peppers, Stuffed peppers, okra, garnish, bean, red beans).The results obtained were evaluated according to the criteria of Turkish Standards.

Keywords: Canned, physical quality, chemical quality



1. GİRİŞ

Gıda güvenliğinin öneminin artması ile birlikte gıda maddelerinin raf ömrünün arttırılması, mikrobiyolojik kalitesinin yükseltilmesi ve bu değerlerin korunabilmesi ve devamlılığının sağlanabilmesi birçok muhafaza metodu geliştirilmiştir. Bu nedenle gıda maddelerinin korunmasında fiziksel (dondurma, soğutma, ısıtma, ışınlatma vb.), kimyasal yöntemler (katkı maddelerinin), basınç uygulamaları ve kurutma sıklıkla kullanılan yöntemlerdir (Çetin ve Çıbık, 2017; Kaynakçı, 2012). Gıdaların uzun süre muhafazasında sağlıklı ve güvenilirliği yüksek bir yöntem olan ısıtma işlemi uygulaması ile konserve üretimi günümüzde tercih edilmektedir. Konserve teknolojisi ile muhafaza, ısıtma işlemi uygulanarak istenmeyen mikroorganizmaları inaktive ederek gıda maddelerinin dayanıklılığında süreklilik kazandırma işlemidir (Cemeroğlu, 2010). Konserve yöntemi uygulanmasının amacı mevsime ve gıda ürününün hammaddenin üretildiği bölgeye bağlı olmadan her mevsimde, dünyanın her yerinde tüketilebilmesi ve hammaddenin fazla olarak üretildiği yıllarda gıdanın raf ömrünü uzatmak amacıyla muhafazasının sağlanması, bunun yanında hazır tüketimin artması ile tüketimde kolaylık sağlamaktır (Erol, 2007). Konserve üretimi, farklı hammaddelerin işlenmeleri ile birlikte konserve üretimi hammaddenin hazırlanması, konserve kaplarına doldurulması, hermetik kapatma, gıdaya özgü ısıtma işlemi uygulanması ve depolanması gibi genel işlem aşamalarından oluşur (Cemeroğlu ve Acar, 1986; Özdikmenli ve Zorba, 2015). Uygulanması gereken ısıtma işlemi derecesi ve süresini gıdanın çeşidi, içerdiği mikroorganizma türü ve mikrobiyal yük belirler. Özellikle sebzeler düşük asiditeye sahip olduklarından, bu tip gıdalara çok daha etkin bir ısıtma işlemi uygulanmaktadır (Karaman, 2005). Konserve işlemi uygulanmış olan gıda ürünlerinin bozulmasında faktörler fiziksel bozulmalar, kimyasal bozulmalar ve mikrobiyolojik bozulmalardır. Bunların sonucunda üründe istenmeyen koku, tat ve görünüş ile konserve malzemesinde bombaj oluşumu görülmektedir. Fiziksel bozulmaların nedenleri, fazla doluluk yapılması, kapakların tam olarak kapatılmaması, kapak çapıyla kutu çapının uyumsuz olması, konserve kutusu malzemesinin kalitesiz olması ve hava çıkarma işleminin uygun olarak yapılmamasıdır. Bununla birlikte kimyasal bozulmaların nedenleri, kutu materyalinin gıda ürününün özelliğine bağlı olarak gıda ile elektrokimyasal ve fiziksel reaksiyona girerek aşınması, çözünmesi ve bozulması olarak tanımlanan korozyon olayıdır. Oluşan bu korozyon ile ürüne kalay, alüminyum, demir, kurşun gibi istenmeyen madde geçişi, korozyonun ilerleyen safhalarında da oksijen geçirgenliğinin artmasıyla mikrobiyolojik bozulmalar ve H₂ gazı oluşumu sonucunda bombaj görülmektedir (Artık vd., 2019; Ünlütürk ve Turantaş, 2015; Özdikmenli ve Zorba, 2015; Blunden ve Wallace, 2003; Noureddine vd., 2020). Günümüzde gıda güvenliği önem arz etmektedir. Bu nedenle en çok tanınan ve tüketilen konserve ürünlerinin risk profili kontrol edilmelidir. Konserve üretimi yapan işletmelerin farklı hammaddeleri kullanarak konserve üretimi yapmasının yanında aynı işletmede bile hammaddelerin değişik karışım oranlarında kullanılarak standart bir ürün üretiminin sürekli olarak sağlanamaması, konserve üretiminde uygun ambalaj kullanılmaması, ısıtma işlemlerinin yeterli olmaması ve doluluk gibi üretim hataları konservelerin fiziksel ve kimyasal bileşiminde farklılığa neden olmaktadır. Özellikle ufak çaplı bir sanayi dalı olarak çalışan işletmelerde üretilen konservelerde standart ürün üretiminin sürekliliğini sağlamak oldukça zordur. Bunlara ek olarak uygun olmayan şartlarda muhafaza edilen ürünlerdeki üretim hataları konservelerde kusurlara neden olabilir. Bu nedenlerden dolayı her zaman standart ve aynı kalitede konserve üretimi yapılamamaktadır. Bu çalışma, Bilecik ilinde tüketimde önemli yeri olan ve en çok tercih edilen bazı konserve çeşitlerinin (biber dolma, yaprak sarma, bamya, türlü, fasulye pilaki, barbunya pilaki) fiziksel ve kimyasal kalite kriterlerinin belirlenerek, tüketici sağlığını korumak



için alınması gereken önlemlerin tespit edilmesi ve uygulanması, ürünün kalitesini geliştirmeye yönelik çalışmaların yapılması için bir temel oluşturabilmek için gerçekleştirilmiştir.

2. MATERYAL ve YÖNTEM

2.1. MATERYAL

Bilecik ilinde faaliyet gösteren mevcut satış yerlerinde ambalajlarında tüketime sunulan, 3 ay periyodunda numunelerden 10 adet olmak üzere toplam 240 adet konserve örneği, rutin satış prosedürüne ve ambalaj materyaline müdahale edilmeden rastgele örnekleme metoduna göre temin edilerek soğuk zincir kurallarına uyularak laboratuvara getirilmiş ve analizler tamamlanincaya kadar buzdolabı şartları altında (4 °C) muhafaza edilmiştir.

2.2. YÖNTEM

Konserve numunelerinin tuz miktarı analizi için 10 g örnek tartılmış ve 100 mL balonjojeye aktarılarak homojenize edilerek çizgiye tamamlanmıştır. Fitre edilerek 25 mL filtrat alınmış ve behere aktarılarak 0.1 N NaOH ile nötralize edilmiştir. Üzerine % 5'lik potasyum kromat eklenmiş ve 0.1 N AgNO₃ (gümüş nitrat) ile titrasyon yapılarak tuz miktarı % olarak belirlenmiştir (Cemeroğlu, 1992). Asitlik miktarı için 25 g örnek tartılarak 250 mL'lik balonjojede çizgiye tamamlanmış ve homojenize edilmiştir. Süzülen örnekten 25 mL alınarak 0.1 N NaOH ile pH 8.1 değerine kadar titrasyon yapılmış ve sarf miktarı kullanılarak susuz sitrik asit cinsinden g/100g olarak titrasyon asitliği değeri belirlenmiştir (Cemeroğlu, 2010). Yağ analizi için homojenize örnekler 5 g tartılıp 103±2°C'lik etüvde suyu giderildikten sonra Soxhlet yöntemine göre 8 saat petrol eteri ile ekstraksiyona tabi tutulmuştur. (Horwitz, 2019). Konserve numunelerinin bombaj ve sızıntı kontrolü, 37°C'de 10 gün inkübasyona ve 55°C'de 7 gün inkübasyona tabi tutularak inkübasyon sonunda fiziksel olarak tespit edilmiştir (Howard, 1949).

3. BULGULAR ve TARTIŞMA

Yapılan çalışma neticesinde, incelenen konserve numunelerinin (biber dolma, yaprak sarma, banya, türlü, fasulye pilaki, barbunya pilaki) fiziksel ve kimyasal özelliklerinin 3 ay periyodunda ortalama değerleri Tablo 1, Tablo 2, Tablo 3, Tablo 4, Tablo 5 ve Tablo 6'da verilmiştir.

TS 2667 Bitkisel sıvı yağlı biber dolması konservesi standardına göre yemeklik bitkisel sıvı yağ veya zeytinyağı miktarı en düşük % 7, tuz miktarı en fazla % 1.5 olmalıdır. Konserve örnekleri 37°C'de 10 gün, 55°C'de 7 gün inkübasyona bırakılarak sızıntı ve bombaj oluşumu kontrol edilmelidir. Analize tabi tutulan konserve örneklerinin hiçbirinde 37°C'de 10 gün, 55°C'de 7 gün inkübasyonu sonunda bombaj ve sızıntı görülmemiş olup analize tabi tutulan biber dolması konservelerinde tespit edilen yağ ve tuz miktarı standarda uygun bulunmuştur.

TS 2669 Bitkisel sıvı yağlı yaprak sarma konservesi standardına göre yemeklik bitkisel sıvı yağ veya zeytinyağı miktarı en düşük % 6-12, tuz miktarı en fazla % 1.5 olmalıdır. Konserve örnekleri 37°C'de 10 gün, 55°C'de 7 gün inkübasyona bırakılarak sızıntı ve bombaj oluşumu kontrol edilmelidir. Analize tabi tutulan konserve örneklerinin hiçbirinde 37°C'de 10 gün, 55°C'de 7 gün inkübasyonu sonunda bombaj ve sızıntı görülmemiş olup analize tabi tutulan yaprak sarma konservelerinde tespit edilen yağ ve tuz miktarı standarda uygun bulunmuştur.

TS 1467 Taze banya konservesi standardına göre Dolgu Sıvısında Tuz Miktarı, Dolgu Sıvısında Asitlik (Sitrik asit cinsinden) en fazla %0.5, dolgu sıvısındaki tuz oranı en fazla % 2 olmalıdır. Konserve örnekleri 37°C'de 10 gün, 55°C'de 7 gün inkübasyona bırakılarak sızıntı ve bombaj oluşumu kontrol edilmelidir. Analize tabi tutulan konserve örneklerinin hiçbirinde 37°C'de 10 gün, 55°C'de 7 gün inkübasyonu sonunda bombaj ve sızıntı görülmemiş olup



analize tabi tutulan bamyaya konservesi konservelerinde tespit edilen yağ ve tuz miktarı standarda uygun bulunmuştur. TS 12399 Garnitür konservesi standardına göre dolgu sıvısındaki tuz oranı en fazla % 2 olmalıdır. Konserve örnekleri 37°C'de 10 gün, 55°C'de 7 gün inkübasyona bırakılarak sızıntı ve bombaj oluşumu kontrol edilmelidir. Analize tabi tutulan konserve örneklerinin hiçbirinde 37°C'de 10 gün, 55°C'de 7 gün inkübasyonu sonunda bombaj ve sızıntı görülmemiş olup analize tabi tutulan türlü (garnitür konservesi) biber dolması konservelerinde tespit edilen yağ ve tuz miktarı standarda uygun bulunmuştur. TS 2665/T2 Bitkisel sıvı yağlı fasulye pilaki konservesi standardına göre yağ miktarı % 6-12, tuz miktarı en çok % 1.5 olmalıdır. Konserve örnekleri 37°C'de 10 gün, 55°C'de 7 gün inkübasyona bırakılarak sızıntı ve bombaj oluşumu kontrol edilmelidir. Analize tabi tutulan konserve örneklerinin hiçbirinde 37°C'de 10 gün, 55°C'de 7 gün inkübasyonu sonunda bombaj ve sızıntı görülmemiş olup analize tabi tutulan fasulye pilaki konservelerinde tespit edilen tuz miktarı standarda uygun bulunmuştur. Konserve fasulye pilaki örneklerinden 1. ay periyodundaki 2 adedinin, 3. ay periyodundaki 1 adedinin yağ oranı kriterine uygun olmadığı tespit edilmiştir. TS 2664/T2 Bitkisel sıvı yağlı barbunya pilaki konservesi standardına göre yağ miktarı en az %7, tuz miktarı en çok % 1.5 olmalıdır. Konserve örnekleri 37°C'de 10 gün, 55°C'de 7 gün inkübasyona bırakılarak sızıntı ve bombaj oluşumu kontrol edilmelidir. Analize tabi tutulan konserve örneklerinin hiçbirinde 37°C'de 10 gün, 55°C'de 7 gün inkübasyonu sonunda bombaj ve sızıntı görülmemiş olup analize tabi tutulan barbunya pilaki konservelerinde tespit edilen tuz miktarı standarda uygun bulunmuştur. Konserve barbunya pilaki örneklerinden 1. ay periyodundaki 3 adedinin yağ oranı kriterine uygun olmadığı tespit edilmiştir.

Fiziksel ve kimyasal analize alınan tüm konserve numunelerinin (biber dolma, yaprak sarma, bamyaya, türlü, fasulye pilaki, barbunya pilaki) analiz sonuçları yapılan birçok çalışma ile uyumluluk göstermiştir (Seçer, 2019; Ersus, 1999; Nehir El ve ark., 1997).

Tablo 1. Biber Dolması Konservesi Fiziksel ve Kimyasal Analiz Sonuçları

	Özellik	1. Ay	2. Ay	3. Ay
Bombaj	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Sızıntı	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Yağ miktarı (%)		7.87	7.6	7.62
Tuz miktarı (%)		0.79	1.18	1.98

Tablo 2. Yaprak Sarma Konservesi Fiziksel ve Kimyasal Analiz Sonuçları

	Özellik	1. Ay	2. Ay	3. Ay
Bombaj	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Sızıntı	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Yağ miktarı (%)		9.38	8.39	11.37
Tuz miktarı (%)		0.89	1.14	1.49

Tablo 3. Bamyaya Konservesi Fiziksel ve Kimyasal Analiz Sonuçları

	Özellik	1. Ay	2. Ay	3. Ay
Bombaj	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Sızıntı	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Dolgu Sıvısında Tuz Miktarı (%)		1.25	1.33	1.3
Dolgu Sıvısında Asitlik (Sitrik asit cinsinden) (%)		0.44	0.47	0.44



Tablo 4. Türlü Konservesi Fiziksel ve Kimyasal Analiz Sonuçları

	Özellik	1. Ay	2. Ay	3. Ay
Bombaj	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Sızıntı	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Dolgu Sıvısında Tuz Miktarı (%)		1.02	1.1	1.09
Dolgu Sıvısında Asitlik (Sitrik asit cinsinden) (%)		0.24	0.36	0.26

Tablo 5. Fasülye Pilaki Konservesi Fiziksel ve Kimyasal Analiz Sonuçları

	Özellik	1. Ay	2. Ay	3. Ay
Bombaj	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Sızıntı	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Yağ miktarı (%)		21.21	7.21	12.7
Tuz miktarı (%)		1.18	0.69	1.17

Tablo 6. Barbunya Pilaki Konservesi Fiziksel ve Kimyasal Analiz Sonuçları

	Özellik	1. Ay	2. Ay	3. Ay
Bombaj	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Sızıntı	37°C'lik inkübasyon	Yok	Yok	Yok
	55°C'lik inkübasyon	Yok	Yok	Yok
Yağ miktarı (%)		5.4	10.83	8.3
Tuz miktarı (%)		0.15	0.702	0.6

4. SONUÇ

Sonuç olarak konserve ürünlerin raf ömrünün uzun olmasından ve tüketici için kolaylık sağlamasından ve fazlaca tüketilmesinden ötürü konserve gıdaların üretiminde uygulanan işlem basamaklarına dikkat edilmesi, son ürün kontrollerinin yapılarak tüketiciye risk oluşturabilecek etmenlerin saptanması ve giderilmesi gerekmektedir. Ayrıca konserve gıda ürün yelpazesinin genişlemesiyle yeni üretilen ürünlerin halk sağlığını korumak amacıyla gıda güvenliği sistemlerinin uygulamalarının takibinin yapılması elzem olup üretim metotlarında standardizasyon sağlanmalıdır. Bu koşullar ise kaliteli hammadde kullanımı, üretimde gelişmiş teknolojilerin tercih edilmesi ve bilinçli uygulamaların sürekliliği ile mümkün olabileceği öngörülmektedir.



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AGRONOMIC CHARACTERISTICS OF WINTER BARLEY MUTANT LINES

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ABSTRACT

The use of mutation breeding to enriched genetic variation for barley improvement has been widely recognized. The aim of the study was to assess the agronomic performance of mutant lines developed after treatment of seeds of winter barley (*Hordeum vulgare* L.) variety Susi with the chemical mutagen sodium azide. Twenty-five selected lines along with their parent variety and two local standard varieties Emon and Obzor were grown in replicated trials at the Institute of Agriculture – Karnobat, Southeastern Bulgaria, during three growing seasons (2017-2019). The traits grain yield (t/ha), days to heading, plant height (cm), lodging (score 9-1), 1000-grain weight (g), protein content (%), and extract content (%) were studied. Significant variation between mutant lines for investigated agronomical traits was found. Mutant lines 21/1-34, 21/2-4, 21/2-8, and 21/2-11 had higher mean grain yield compared to parent variety. The highest protein content 12.90% was found in mutant line 21/2-10 and mutant line 21/2-20 had the lowest protein content- 10.26%. Mutant lines 21/1-41, 21/2-1 and 21/2-20 showed superiority in extract content (79.03%, 79.30%, and 80.87%, respectively). A negative correlation between grain yield and day to heading was observed. Protein content was positively associated with 1000-grain weight and negatively with extract content. Cluster analysis for agronomic traits showed important information about genetic diversity among barley mutant lines. Mutant lines with improved agronomic traits can be used in the breeding program for the development of new winter malting barley varieties.

Keywords: *Hordeum vulgare* L, mutant lines, agronomic traits, correlation analysis, cluster analysis



INTRODUCTION

In barley, mutation breeding has been extensively used for the improvement of ergonomically important traits. Selection of barley mutants with improved brewing qualities as well as higher protein and lysine content have been reported (Micke, 1983; Mueller, 1984; Molina-Cano, 1989; Ramesh et al., 2001; Kumar and Ramesh, 2004; Shewry, 2009).

The application of induced mutagenesis in barley has given very good results in terms of improving lodging resistance (Maluszynski and Szarejko, 2005) and shortening the vegetation period (Konzak, 1984; Deniz, 2007).

Shevtsov et al. (2003) show that with the help of chemical mutagenesis, mutants with increased cold resistance and the altered reaction of the photo- and thermoperiod can be obtained. An example of increasing the adaptive capacity of barley through mutational selection is the barley varieties grown in Peru at high altitudes. Under these unfavorable conditions, the cultivation of mutant varieties between 1978 and 2002 led to a 52% increase in grain yield in barley (Gómez-Pando et al., 2009).

More than 300 barley cultivars have been developed as a result of applying experimental mutagenesis worldwide (FAO/IAEA Mutant Variety Database, 2021). The economic effect of the cultivation of barley cultivars developed by experimental mutagenesis is enormous. Examples of this are the distribution of short stature mutant cultivars - Pallas in Northern Europe, Diamant in Central Europe, Golden Promise in the UK, Luther, and Pennrad in the USA (Maluszynski and Szarejko, 2005).

Experimental mutagenesis has been used in breeding work with barley since the 1970s at the Institute of Agriculture – Karnobat. Presently, in the variety list of Bulgaria, there are four mutant barley varieties IZ Bori, Bojin, Zemela, and Ahil all of which were developed by this breeding program (Vulchev and Dyulgerova, 2011; Dyulgerova and Vulchev, 2012; Dyulgerova et al., 2017).

The aim of the present study was to assess the agronomic performance of mutant lines developed after treatment of seeds of winter barley (*Hordeum vulgare* L.) variety Susi with the chemical mutagen sodium azide.

MATERIAL and METHODS

Mutant lines were obtained after mutagenic treatment of pre-soaked for 16-hour seeds from German two-rowed winter variety Susi with 2 mM sodium azide for 2 hours, prepared in a buffer solution (pH=3) at room temperature. Selection for high yield and other desirable agronomical traits was applied from M3 to M6. The selected 25 mutant lines along with their parent variety and two local standard varieties Emon and Obzor were used as plant material in the present study.

A field trial in complete block design with 4 replications on plots of 10 m² was conducted in three growing seasons from 2017 to 2019 at the Institute of Agriculture - Karnobat, Bulgaria (42°39' N, 26°59' E).

The studied traits included grain yield (t/ha), days to heading, plant height (cm), lodging (score 9-1 L, where 9 = no lodging and 1 = 100% lodging), 1000-grain weight (g), protein content (%), and extract content (%). Grain yield were estimated on a plot basis. The protein content (%) was determined by the Kjeldahl method, and a conversion factor of 6.25 was used to convert total nitrogen to crude protein. The 1000-grain weight (g) was taken from 200 random grains multiplied by 5. Grain samples were micro-malted using automated malting equipment. Grounded malt samples were mashed and extract content was determined by a refractometric method (Gothard et al., 1980).



The mean values were compared by the least significant difference (LSD) at the 0.05 probability level. Pearson correlation coefficients between studied traits were estimated. Cluster analysis using Average Linkage between Groups method with squared Euclidean distance and standardized means variables was performed. All data were processed with the program SPSS for Windows (version 20.0; SPSS Inc., Chicago, IL, USA).

RESULTS and DISCUSSION

The mean values of studied traits of the mutant lines, their parent, and standard varieties are presented in Table 1. Grain yield among mutant lines varied from 4.93 t/ha (21/1-3) to 6.17 t/ha (21/1-34 and 21/2-11). Parent variety Susi showed mean grain yield that not differ significantly from those of standard Emon (5.53 t/ha vs. 5.46 t/ha) but greater than the yield of variety Obzor (5.07 t/ha). Four lines (21/1-34, 21/2-4, 21/2-8, and 21/2-11) had significantly higher grain yield compared to parent variety. The number of days to heading varied from 186.33 (21/2-4) to 189.33 (21/1-4 and 21/1-11). The significantly lower number of days to heading was observed in 21/1-32, 21/1-34, 21/2-4, and 21/2-7. Plant height ranged from 87.33 cm to 100.00 cm. Superior lodging resistance was found in lines 21/1-21 and 21/1-32. There were no mutant lines with significantly higher 1000-grain weight than that of the parent. Lower 1000-grain weight was observed in 21/2-19, 21/2-20, 21/2-25, and 21/2-37. The highest protein content 12.90% was found in mutant line 21/2-10 and mutant line 21/2-20 had the lowest protein content-10.26%. Mutant lines 21/1-41, 21/2-1 and 21/2-20 showed improvement in the extract content (79.03%, 79.30%, and 80.87%, respectively).

The correlations between the studied traits of mutant lines are presented in Table 2. Grain yield showed a significant negative correlation with the number of days to heading ($r=-0.584$). Abd El-Mohsen (2013) and Mansour et al. (2018) also reported a negative correlation between yield and days to heading. The early heading of barley is one of the major features of barley adaptation to cultivation in drought conditions. It is important that spike emergence be early enough to ensure that pollination and grain filling occur before the heat and drought stress become too severe (Ceccarelli et al. 1991). A positive association between 1000-grain weight and protein content was observed ($r=0.435$). Extract content was negatively associated with protein content ($r=-0.453$). Arends et al. (1995) and Matthies et al. (2014) emphasized the importance of this negative relationship between protein concentration and extract content as the extract content has been the main breeding objective in malting barley. While Laidig et al 2017 also found strong negative phenotypic relation between both traits but a non-significant genetic correlation and concluded that probably both traits are not genetically related to each other.



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Table 1. Mean values of agronomic traits of mutant lines, their parent variety Susi and standard varieties Obzor and Emon (2017-2019)

Genotype	YLD	DH	PH	LOD	TGW	PC	EC
Obzor	5.07	188.67	92.33	7.67	46.83	11.71	77.90
Emon	5.46	188.00	90.67	9.00	46.63	12.55	78.67
Susi	5.53	189.67	93.33	7.33	48.50	11.76	77.77
21/1-3	4.93	188.67	90.33	8.00	47.50	11.75	78.87
21/1-4	5.40	189.33	87.33	8.33	48.17	11.84	78.00
21/1-7	5.37	189.67	90.00	8.67	48.20	12.25	76.60
21/1-8	5.59	188.33	91.33	7.67	49.83	12.14	76.00
21/1-11	5.76	189.33	92.00	7.67	48.00	12.51	76.87
21/1-13	5.82	187.00	95.33	7.67	47.67	12.20	77.13
21/1-17	5.73	187.67	95.33	7.33	47.00	11.86	77.13
21/1-21	5.77	187.33	95.00	9.00	47.67	11.77	76.47
21/1-32	5.72	186.67	88.00	9.00	47.83	12.59	77.60
21/1-34	6.17	186.67	90.00	8.67	48.33	11.86	77.60
21/1-41	6.04	187.33	96.33	7.67	47.90	12.12	79.03
21/2-1	5.66	187.00	99.00	7.33	49.33	12.03	79.30
21/2-3	5.97	188.67	98.00	8.33	48.33	12.03	76.13
21/2-4	6.13	186.33	93.00	7.67	46.67	11.73	78.63
21/2-6	5.61	187.00	93.33	8.33	49.17	12.59	76.33
21/2-7	5.95	186.67	96.67	8.00	46.83	11.62	78.53
21/2-8	6.16	187.33	90.33	8.00	47.50	12.39	78.17
21/2-9	5.93	188.00	93.00	8.67	49.00	12.34	76.87
21/2-10	5.42	187.00	94.67	8.33	47.67	12.90	75.93
21/2-11	6.17	187.33	96.00	8.33	44.67	12.66	76.73
21/2-19	5.07	187.33	93.00	7.33	47.00	11.60	78.13
21/2-20	5.38	187.00	94.67	8.33	45.17	10.26	80.87
21/2-21	5.01	188.67	98.33	8.33	47.17	11.59	78.07
21/2-25	5.24	189.00	95.33	8.33	45.67	11.11	76.87
21/2-37	5.94	187.33	100.00	8.00	46.33	10.60	77.33
<i>LSD 0.05</i>	0.52	2.94	5.22	1.53	2.03	1.09	1.25

YLD - grain yield (t/ha), DH - number of days to heading, PH - plant height (cm), LOD - lodging (score 9-1), TGW - 1000-grain weight (g), PC - protein content (%), EC - extract content (%)



Table 2. Correlation coefficients between studied traits of 25 mutant lines from variety Susi

Traits	DH	PH	LOD	TGW	PC	EC
YLD	-0.584**	0.273	0.047	0.149	0.312	-0.280
DH		-0.217	-0.048	0.165	-0.017	-0.189
PH			-0.293	-0.230	-0.344	-0.020
LOD				-0.092	0.170	-0.180
TGW					0.435*	-0.341
PC						-0.453*

YLD - grain yield (t/ha), DH - number of days to heading, PH - plant height (cm), LOD - lodging (score 9-1), TGW - 1000-grain weight (g), PC - protein content (%), EC - extract content (%)

Cluster analysis was performed and the resulting dendrogram is presented in Figure 1. Cluster analysis grouped the barley genotypes into two distinct groups. Cluster I included 13 mutant lines. Line 21/2-20, which showed the highest malting quality was clustered separately within this group. The two standard varieties and parent were grouped into Cluster II along with the rest of the studied mutant lines. The clustering pattern indicated the existence of considerable variability for studied agronomic traits among the barley mutant lines. Characterization of mutants and clustering them on the basis of their agronomic traits help in the identification and selection of the best parents for hybridization for the barley improvement program.

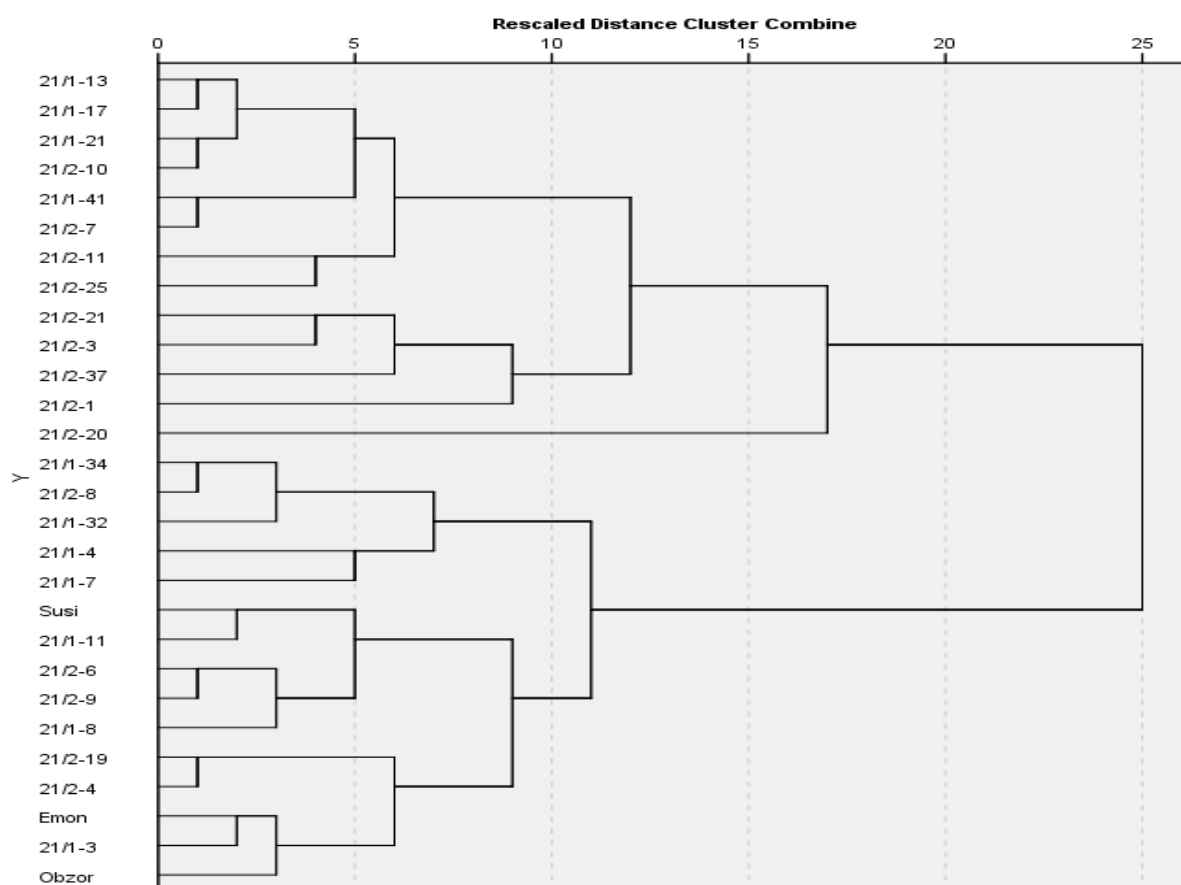


Figure 1. Dendrogram using Average Linkage between Groups for agronomical trait



The results of the present study showed that barley mutants with improved important agronomic traits included grain yield could be selected after mutagenic treatment with sodium azide. Induction of sodium azide-induced mutants with improved yield-related traits were also reported by Rachovska (1998), Srivastava et al. (2011), and Dubey et al. (2017) in wheat, Samiullah et al. (2004) in mungbean, Khan et al. (2006) in lentil.

CONCLUSIONS

This study showed significant variation between mutant lines for investigated agronomical traits. Mutant lines 21/1-34, 21/2-4, 21/2-8, and 21/2-11 had higher mean grain yield compared to parent variety. The highest protein content 12.90% was found in mutant line 21/2-10 and mutant line 21/2-20 had the lowest protein content - 10.26%. Mutant lines 21/1-41, 21/2-1 and 21/2-20 showed superiority in extract content (79.03%, 79.30%, and 80.87%, respectively). A negative correlation between grain yield and day to heading was observed. Protein content was positively associated with 1000-grain weight and negatively with extract content. Cluster analysis for agronomic traits showed important information about genetic diversity among barley mutant lines. Mutant lines with improved agronomic traits can be used in the breeding program for the development of new winter malting barley varieties.



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SİLAJLIK MISIR ÇEŞİT GELİŞTİRME ISLAHI PROGRAMLARINDA DİKKATE ALINMASI GEREKEN KRİTERLERE GENEL BİR BAKIŞ

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ÖZET

Mısır silajı süt sığırı rasyonlarında kullanılan en önemli kaba yem kaynaklarından birisidir. Ancak diğer kaba yemlerle karşılaştırıldığında mısır bitkisi tane ve diğer bitki kısımlarından (yaprak, sap, koçan) oluştuğundan yapısındaki nişasta ve lif ile daha fazla sindirilebilir enerji sağlamaktadır. Bu yüzden mısır silajı diğer geleneksel kaba yemlere göre (yonca, saman) daha fazla ve daha kaliteli bir sindirilebilirliğe sahiptir. Kaliteli bir mısır silajı elde etmenin yolu, kalitesi yüksek bir silajlık mısır çeşidiyle çalışmaktan geçer. Hibrit tohumun ekim zamanı, hasat koşulları, doğru zamanda hasat işlemini yapma (silaj olgunluk derecesi) ve silaj yapma uygulamalarındaki hatalar (fermantasyon süresi) gibi konular ise ikinci derecede etkili faktörler olarak karşımıza çıkmaktadır. Bütün bu faktörler mısır silajının sindirilebilirliğini etkilediğinden, sonuç olarak süt sığırlarının performansını da etkilemektedir. Son yıllardaki mısır genetiği çalışmaları hayvan performansını arttırmaya yönelik olarak geliştirilen hibritlerin ekim yoğunluğu ve tane/bitki kısımları oranını değiştirmeye yönelik olarak devam etmektedir. Ancak unutulmaması gereken en önemli nokta, mısır silajından hayvanların en üst düzeyde faydalanabilmesi için tane/ diğer bitki kısımlarının dağılımı ve bu kısımların sindirilebilirliğidir. Yapılan çalışmalarda silajlık mısır ıslah programlarında agronomik faktörlerin yanı sıra silaj kalite parametrelerine de dikkat edilmesi gerekliliği vurgulanmaktadır. Silaj kalitesi belirlemede ise sadece insan faktörüne dayalı fiziksel gözlemlere bakılarak (renk, koku, parlaklık v.b) silaj kalitesi hakkında bir yargıya varmanın yanlış olduğu, kimyasal analizin daha objektif olması nedeniyle mutlaka ön planda olması gerekliliği pek çok yayında vurgulanmaktadır. Hatta ham protein, kül, nişasta, pH gibi temel yem analizlerinin yanı sıra sindirilebilirlikle ilişkilendirilen ADF (Asit deterjanda çözünmeyen lif), NDF (Nötr deterjanda çözünmeyen lif) ve NDL (Nötr deterjanda çözünmeyen lignin) gibi parametrelerin silaj kimyasal analizlerinin temel parametreleri olduğunu söylenmekte ve çeşit ıslah programlarından geliştirilen aday çeşitlerin adaptasyon denemelerinde de bu özellikler açısından mutlaka teste tabii tutulması gerekmektedir.

Anahtar Kelimeler: Mısır, silaj, kalite



AN OVERVIEW OF THE CRITERIA TO BE CONSIDERED IN SILAGE CORN VARIETY BREEDING PROGRAMS

ABSTRACT

Corn silage is one of the most important roughage sources used in dairy cattle rations. However, compared to other roughages, since the corn plant consists of grain and other plant parts (leaves, stems, cobs), it provides more digestible energy with the starch and fiber it contains. Therefore, corn silage has a higher and better digestibility than other traditional roughages (alfalfa, straw). The way to obtain a good quality corn silage is to work with a high quality corn silage variety. Sowing time of hybrid seed, harvesting conditions, harvesting at the right time (silage maturity) and errors in silage making practices (fermentation time, etc.) are secondary factors. Since all these factors affect the digestibility of the corn silage, they ultimately affect the performance of dairy cattle. Corn genetics studies in recent years continue to change the sowing density and grain / plant part ratio of hybrids developed to increase animal performance. However, the most important point that should not be forgotten is the distribution of grain / other plant parts and the digestibility of these parts in order for animals to benefit from corn silage at the highest level. In the studies conducted, attention should be paid to silage quality parameters as well as agronomic factors in maize breeding programs for silage. In determining the silage quality, many publications emphasize that it is wrong to make a judgment about the silage quality by only looking at physical observations based on human factors (color, odor, brightness, etc.), and the necessity of being at the forefront because the chemical analysis is more objective. It is even said that parameters such as ADF (acid detergent insoluble fiber), NDF (neutral detergent insoluble fiber) and NDL (neutral detergent insoluble lignin) are the basic parameters of silage chemical analyzes, as well as basic feed analyzes such as crude protein, ash, starch, pH. In addition, candidate varieties developed from variety breeding programs must be tested in terms of these characteristics in adaptation trials.

Keywords: Corn, silage, quality



GİRİŞ

Ülkemizde değişik kullanım amaçları olan mısırın %35'i insan beslenmesinde, geri kalanı ise kesif yem ve kaba yem olarak hayvan beslenmesinde kullanılmaktadır. Silajı yapılan bitkiler arasında mısır, uyum gösterdiği bölgelerde, dekara enerji üretimi açısından en üstün durumdadır. Bunun yanında, lezzetli oluşu, diğer silajlık ürünlere oranla daha az işçilik istemesi ve makinalı tarıma elverişliliği diğer avantajlarıdır. Silajlık mısırın hasat ve depolama kayıpları da oldukça düşüktür (İptaş ve Acar, 2003).

Silajlık olarak ekimi yapılacak mısır çeşitlerinin dış görünüş özellikleri aşağıdaki gibi olmalıdır:

-Uzun boylu olmalı

-Yaprak sayısı ve yaprak oranı fazla olmalı

-Bitkide tane bağlayan koçan ağırlığı yüksek olmalı

-Silaj kalitesine olumsuz etkisi nedeni ile sap çapı fazla kalın olmamalı

Sadece bu kriterleri dikkate alarak çeşit geliştirmek bizi yanılgıya götürür. Çünkü silajlık mısır ıslah programlarında dikkate alınması gereken en önemlisi kriter yüksek verimin yanında iyi kalitenin de sağlanmasıdır. Ayrıca üretim yapılacak bölgenin I. veya II. ürün tarımı olanaklarına göre çeşit geliştirilmesinin yapılması, II. üründe erkenci, ana üründe geççi çeşitlerin olması gerekmektedir. (Kaya ve Polat, 2010, Anonim, 2004, Ak ve Doğan, 1997, Konak, 1994, ; Dolstra and Miedama, 1986, Aldrich et all, 1982).

Sadece insan faktörüne dayalı fiziksel gözlemlere bakılarak (renk, koku, parlaklık v.b) silaj kalitesi hakkında bir yargıya varmanın yanlış olduğu, kimyasal analizinin daha objektif olması nedeniyle daha ön planda olduğu pek çok çalışmada vurgulanmaktadır. Hatta ham protein, kül, nişasta, ph gibi temel yem analizlerinin yanı sıra sindirilebilirlikle ilişkilendirilen ADF (Asit deterjanda çözünmeyen lif), NDF (Nötr deterjanda çözünmeyen lif) ve NDL (Nötr deterjanda çözünmeyen lignin) gibi parametrelerin silaj kimyasal analizlerinin temel parametreleri olduğu söylenmektedir (Stokes and Prostko,2014, Adesogan, 2006, Stalling, 2005).

Özetleyecek olursak silajlık mısır çeşit geliştirme programlarında agronomik verilerle beraber kalite verilerinin de beraber harmanlanması durumunda başarıya ulaşmamız mümkündür.

MATERYAL ve YÖNTEM

Çalışmanın materyalini araştırma enstitülerinden temin edilen Akdeniz, Özgem, Güney, Side, TTM-8119, TTM-813, Karadeniz yıldızı, ADA-9510, ADA-9516, TTM-815 ve Kompozit Arifiye isimli kamu çeşitleri ile özel firmalara ait çeşitlerden silajlık ekimi yapılan ve sektörün öngördüğü ana üründe 20, ikinci üründe ise 17 çeşit oluşturmaktadır. Çeşitler olum süreleri dikkate alınarak gruplara ayrılmıştır. Ana ürün için orta geççi ve geççi; II.ürün için ise erkenci ve orta erkenci ürün grubundaki çeşitler bir araya getirilmiştir. Deneme Ege Tarımsal Araştırma Enstitüsü tarlalarında 2005 ve 2006 yıllarında tesadüf blokları deneme deseninde 4 tekerrürlü olarak kurulmuştur. Denemeden elde edilen verilerin ve yapılan gözlemlerin ışığında silajlık mısır çeşit geliştirme ıslahı programlarında dikkate alınabilecek kriterlerin neler olduğu belirlenmiştir.

BULGULAR ve TARTIŞMA

Silajlık mısır hibritlerinin seçiminde uzun yıllardır geleneksel bir tutum olarak kullanılan seçim kriterlerine bakıldığında temelin agronomik faktörlere (yeşil ot verimi, hastalıklara, zararlılara dayanıklılık, gövde sağlamlığı v.b) dayandığı göze çarpmaktadır. Öte yandan dane içeriği, yumuşak endosperm yapısı ve bitki görünümü de bize mısır silaj hibritlerinin sindirilebilirliği hakkında genel bir fikir verebilir. Fakat kesin fikri ancak laboratuvar analizleriyle ve hayvan performans denemeleriyle bilgi edinmemiz mümkündür.



Menemen koşullarında 2 yıl olarak yürüttüğümüz “Silajlık Mısır Adaptasyon Denemesi” ile “Silajlık Mısır Çeşit Geliştirme Islahı “ programlarında dikkate alınması gereken parametreleri gözlemlene ve değerlendirme şansına sahip olduk. Çalışmanın materyalini bölgede silajlık olarak yaygın ekimi yapılan kamu ve özel sektördeki tüm mısır çeşitleri oluşturduğu için gözlem aralığı oldukça fazla varyasyonu içermekteydi. Gözlemi yapılan pek çok kriterden öne çıkanları bu makalede bir araya getirmiş bulunmaktayız.

Aşağıda denememizden silajlık kriterler bakımından öne çıkan sonuçları bir arada değerlendirdiğimiz özet çizelgeler yer almaktadır:

Çizelge 1’e bakıldığında silaj olgunluklarının ana üründe 92-112 gün arasında; 2.üründe 78-97 gün arasında değiştiği görülmekte, ana ürün için orta geççi ve geççi; II.ürün için ise erkenci ve orta erkenci ürün grubundaki çeşitlerin tercih edildiği anlaşılmaktadır

Çizelge 1. Silajlık mısır çeşit adaptasyon denemesi verileri (Olgunluk, bitki boyu ve çap uzunlukları)

Silajlık Mısır Adaptasyon (20çeyt ana ürün, 17 çeşit 2.ürün)	Silaj Olum (gün)	Bitki Boyu (cm)	Yaprak Sayısı (adet)	Sap Çapı (cm)	Koçan Çapı (cm)
Ana ürün çeşitleri	92-112*	202-233*	11-14*	2,13-2,67*	3,85-4,95*
Cv	0,328	6,866	4,699	8,905	9,44
Lsd*	0,490	14,958	0,574	0,213	0,419
2.ürün çeşitleri	78-97*	215-266*	10-14*	2,08-2,53*	4,68-5,09*
Cv	0,797	6,148	21,023	8,795	4,523
Lsd*	0,998	14,416	2,545	0,195	0,221

*: İstatistiki olarak önemli çıkmıştır.

Bitki boylarının 202-266 gün arasında; yaprak sayısının 11-14 arasında dağılım gösterdiği denememizde 2 m’den yüksek boyağıdaki bol yapraklı çeşitlerin tercih edildiği anlaşılmaktadır. Bitki boyu ve yaprak sayısı yeşil verim karakteri ile doğrudan ilişkili karakterler olup silajlık çeşitlerde yüksek olması arzu edilir (Akdeniz ve ark, 2004-b, Avcıoğlu et al, 2003 ve İptaş ve ark, 2002, Cox ve Cherny, 2001). Sap çapının 2,08-2,67 cm arasında değiştiği; koçan çapının 3,85-5,09 cm arasında değiştiği denememizde sap çapının kalın olmamasının istendiği, koçan çapının ise büyük olmasının tercih edildiği ve çeşitlerin seçiminin buna göre yapıldığı anlaşılmaktadır. Kalın saplılık bitkilerin toprak üzerinde dik kalmasını sağlayarak karbonhidrat asimilasyonuna doğrudan etki eden ve rüzgar, vb unsurlara karşı direnç göstererek bitkinin mekanik olarak yıkılmasını engelleyen bir mekanizmadır. Buna rağmen kalın saplılık üretilen yemin verimini de yükseltmekte, fakat yüksek oranda sellüloz, hemisellüloz, lignin, vb sindirimi çok zor olan maddeleri de çokça içerdiğinden fazlaca istenmemektedir (Geren v.d 2003).

Çizelge 2. Silajlık mısır çeşit adaptasyon denemesi verileri (Yeşil-kuru ot verimleri, bitki oranları)

Silajlık Mısır Adaptasyon (20çeyt ana ürün, 17 çeşit 2.ürün)	Yeşil Ot Verimi (kg/da)	Kuru Ot Verimi (kg/da)	Yaprak Oranı (%)	Koçan Oranı (%)	Sap Oranı (%)
Ana ürün çeşitler	5073-6545*	1530-3232*	15-23*	23-40*	41-57*
Cv	14,667	23,997	12,257	16,505	8,755
Lsd*	829,577	562,418	2,253	5,059	4,370
2.ürün çeşitler	4831-6543*	1877-3328*	13-21*	37-44*	40-55*
Cv	11,434	18,397	14,788	8,015	6,276
Lsd*	669,843	450,690	2,358	3,097	2,787

*: İstatistiki olarak önemli çıkmıştır.



Çizelge 2’de silaj verimine direkt etkisi olan özelliklerden yeşil ot verimi ve kuru ot verimi verileri açısından çeşitler ele alınmıştır. Yeşil ot verimlerinin 4831-6545 kg/da arasında; kuru ot verimlerinin 1530-3328 kg/da arasında değişim gösterdiği görülmektedir. Silaj verimine direkt etkisi olan özelliklerden yeşil ot verimi ve kuru ot verimi özelliklerinin yüksek olması istenen bir durumdur (Öktem ve Öktem, 2009, Kılıç ve Gül, 2007, Bal ve ark, 2005, Akdeniz ve ark, 2004, İptaş ve ark, 2002).

Çizelge 2’de silaj verimine dolaylı etkisi olan yaprak, sap ve koçan oranları açısından çeşitler ele alınmıştır. Yaprak oranının %13-23; koçan oranının %23-44 ve sap oranının %40-57 arasında değişim gösterdiği gözlemlenmiştir. Yüksek yeşil ot verimi getirmesi açısından bitkinin yaprak ve koçan kısımlarının yüksek paya sahip olması istenen bir özelliktir. Sap oranının ise mümkün olduğunca düşük olması istenir çünkü sap selüloz içerir ve sindirilebilirlik özelliğine olumsuz yansır. Bütün bu faktörler mısır silajının sindirilebilirliğini etkilediğinden, sonuç olarak süt sığırlarının performansını da etkilemektedir. Ancak unutulmaması gereken en önemli nokta, mısır silajından hayvanların en üst düzeyde faydalanabilmesi için tane/diğer bitki kısımlarının dağılımı ve bu kısımların sindirilebilirliğidir. Son yıllardaki mısır genetiği çalışmaları hayvan performansını artırmaya yönelik olarak geliştirilen hibritlerin ekim yoğunluğu ve tane/bitki kısımları oranını değiştirmeye yönelik olarak devam etmektedir (Krawosky et al,2005, Bal, M.A., 2005).

Çizelge 3.Silajlık mısır çeşit adaptasyon denemesi verileri (Kalite verileri)

Silajlık Mısır Adaptasyon (20çeit ana ürün, 17 çeşit 2.ürün)	Ham Protein (%)	Ham Yağ (%)	NDF (%)	ADF (%)	ADL (%)
Ana ürün çeşitleri	9,90-12,10	2,09-3,26	53-61	21-32*	3,04-4,83
Cv	-	-	-	10,00	-
Lsd*	-	-	-	4,35	-
2.ürün çeşitleri	10,30-12,30*	2,58-4,27	53-60*	23-27	3,08-5,27
Cv	6,29	-	4,33	-	-
Lsd*	1,19	-	4,14	-	-

*: İstatistiki olarak önemli çıkmıştır. (-): İstatistiki olarak önemsizdir

Çizelge 3’de kalite verileriyle ilgili değerlendirmeler yer almaktadır. Silajlık amaçlı yetişen çeşitlerden elde edilen verilerde ham protein oranının %9,90-12,30 arasında; ham yağ oranının ise 2,09-4,27 arasında değişim gösterdiği göze çarpmaktadır. Ham protein kelimesinin “ham” olarak nitelendirilme sebebi direkt olarak protein ölçümü değil de besindeki nitrojene dayalı toplam proteinin tahmini değeri olduğu içindir (Ham protein= nitrogenx6,25). Ruminantlar için hazırlanan günlük besinlere yüksek protein konsantrasyonu içeren (soya v.b) katkı maddeleri protein içeriğini arttırma amaçlı katılır. Yüksek protein seviyeli mısır hibritleri bu anlamda daha az ilaveye gerek duyarlar bu da daha düşük besin maliyeti demektir. Sonuç olarak yüksek protein içeriği istenen bir durum olduğu için ham protein miktarı parametresinin yüksek olması iyidir (Minyo et al, 2005., Garcia et al., 2003). Adesogan.,2006; silaj analizlerinde kaliteli bir mısır silajı için ham protein oranının %7’den büyük olmasını önermektedir. Ham yağ terimi ele alındığında ise: ether ekstraktı olarak da bilinen (EE) bu terim ether içindeki çözünebilir maddeleri kapsar. Ana olarak lipidleri içermekle beraber, aynı zamanda diğer yağda çözünebilir maddeleri (klorofil ve yağda çözünen vitaminler) de içerir ve yüksek olması tercih sebebidir.

Çizelge 3’de NDF değerleri % 53-61 arasında değişim göstermiştir. Dane verimi iyi olan çeşitlerin aynı zamanda iyi bir silajlık çeşit olacağı ön görüşü (hayvan besleme değeri hesaba katılmadan) eskiden hakim olmaktadır. Fakat son yıllarda ruminantlarda (geviş getiren



hayvanlarda) yapılan sindirilebilirlik ve metabolik enerji ölçümü deneyleri bizleri mısır silajındaki kalite kriterlerini belirlemede daha farklı parametreleri de (ADF, NDF ve ADL gibi) dikkate almaya yöneltmiştir. NDF (Neutral detergent fiber) kelimesinin karşılığı Nötr deterjanda çözünmeyen lif'dir. Bu tanım mısır silajındaki lif içeriğinin bir ölçümüdür. NDF değeri yüksek yemler daha düşük enerjiye sahiptir. NDF aynı zamanda potansiyel besin alınımının da bir ölçütüdür. Yüksek NDF değerleri potansiyel besin alınımını azaltır. Özetle NDF'nin düşük olması istenir (Stokes and Prostko,2014, Farhad and Hajibabaei., 2012). Denememizdeki ADF değerleri %21-32 arasında değişim göstermiştir. ADF (Acid detergent fiber) kelimesinin karşılığı asit deterjanda çözünmeyen lif'dir. ADF, mısır silajının selüloz, lignin ve ısıdan zarar görmüş protein gibi daha az sindirilebilir kısmını ifade eder. ADF yemin sindirilebilirliğiyle yakından ilgilidir. Hasat dönemindeki gecikmeler ADF değerini yükseltir. ADF değeri düşüğe yem daha fazla sindirilebilir. Özetle ADF'nin düşük olması istenir (Minyo et al, 2005., Garcia et al., 2003). Çizelge 3'de ADL değerleri 3,04- 5,27 arasında değişim göstermiştir. ADL (Acid detergent lignin) kelimesinin karşılığı: asit deterjanda çözünmeyen lignin'dir. Lignin bitki hücre duvarının bitkiye katılık ve yapısal desteklik sağlayan bir polimer bileşenidir. Hayvan enzimleri tarafından sindirilemez. Bu değer bitki olgunlaştıkça yükselir ve ılık hava koşullarının olduğu yerlerde yetişen bitki türlerinde daha yüksektir. Lignin içeriğinin artması sindirilebilirliğin azalmasına neden olur bu nedenle ADL'nin düşük olması istenir (Stokes and Prostko,2014, Adesogan.,2006, Garcia et all.,2003). Silaj kalite kriterleri hakkında dünya çapında kabul edilmiş kesin sınırlar yoktur. Fakat bunla birlikte herkesçe kabul edilen birkaç genelleme vardır. Bunlar şöyledir: yüksek protein oranına sahip bir mısır silajı düşük proteine sahip olandan protein katkı maddelerinin fiyatlarının yüksek olması nedeniyle daha ekonomik ve karlıdır. Silajda ve kuru ot yemlerinde NDF ile ADF değerlerinin yüksekliği besin alınabilirliğini ve sindirilebilirliği olumsuz yönde etkileyen 2 faktör olarak karşımıza çıkmaktadır (Anononymous, 2001). Silaj katkı maddesi olarak enzim kullanılmasının sebebi bitki hücre duvarını oluşturan polisakkaritlerin parçalanmasını sağlamak ve silajın ADF ve NDF içeriğini azaltarak silajın organik maddelerinin sindirilebilirliğinin artırılmasını sağlamaktır (Erdoğan ve Koca,2020, Stokes and Prostko,2014, Farhad and Hajibabaei., 2012, Uygur, M, 2007).Kalite kısmında özetle şunu diyebiliriz: Silajlık amaçlı yaygın olarak yetişen çeşitlerden elde edilen verilerden anlaşılacağı üzere ıslah programlarında geliştirilecek çeşitlerin ADF, NDF ve ADL değerlerinin yüksek olmayacak şekilde seleksiyon (seçim) yapılması tavsiye edilmelidir.

SONUÇ ve ÖNERİLER

Silajlık mısır geliştirme ıslah programlarında pek çok agronomik kriter (Bitki boyu, koçan çapı, yaprak sayısı, yaprak, sap, koçan oranları, yeşil ot ve kuru ot verimleri, v.b) önemlidir fakat tek başına doğru sonuca ulaştırmakta yetersiz kalır. Silaj kalitesi için sindirilebilirliğin ön planda olduğu ADF, NDF, ADL, ham protein, ham yağ, nişasta içeriği gibi parametrelerin de oldukça büyük önem taşıdığı hem bizim yürüttüğümüz denemede hem de pek çok araştırmacı tarafından vurgulandığı ortaya çıkmaktadır. Başarıya ulaşmak için bu parametrelerin de agronomik kriterlerle beraber aynı anda ele alınarak, seleksiyon (seçim) kriterlerine eklendiği ıslah programlarının düzenlenmesi gerekmektedir.

TEŞEKKÜR

T.C. Tarım ve Orman Bakanlığı tarafından finanse edilen proje (Ege Bölgesinde Ana ve 2.Ürün Koşullarında Uygun Silajlık Mısır Çeşitlerinin Belirlenmesi) TAGEM (Tarımsal Araştırmalar Genel Müdürlüğü) bünyesindeki Ege Tarımsal Araştırma Enstitüsü Arazisinde yürütülmüş ve bütçesi TAGEM tarafından karşılanmıştır.



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TRADITIONAL FOOD PRACTICES OF LODHA: A GATHERING-HUNTING INDIGENOUS COMMUNITY OF WEST BENGAL, INDIA

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ABSTRACT

Any nutritious substance that people eat or drink in order to maintain life and growth can be defined as food. The way in which humans use foods can be referred as food habit which includes how they are selected, obtained, stored, cooked, distributed and even discarded. Humans use food symbolically and thus, for humans, food is more than just nutrients. Cultural identity is an essential symbolic function of food. And tribal strictly adhere to such practices in order to maintain their group identity. Traditional food systems of indigenous peoples are defined as being composed of items from the local, natural, and culturally accepted items. Present cross-sectional study has made an attempt to explore the traditional food practices of Lodha, the largest Particularly Vulnerable Tribal Group (PVTG) of West Bengal, India. Their daily dietary pattern, including normative aspect (daily food), festive affair i.e., ceremonial food and way of the collection, and the preparation and consumption of their fermented beverages involve complex networks of individual bonds, collective management of resources, and group decisions. Primary data on different food items were collected by interview with pre-structured questionnaire and focus group discussions. Food recipes and their documentation, from collection to preparation has been done. 24-hour Dietary Recall method has been used to capture information on consumption from 54 Lodha households. Average intake of food stuff (g/CU/day) by Lodhas from their floral and faunal consumption are cereals (378.5), pulses (66.7), green-leafy vegetables (38.3), other vegetables (76.5), tubers (182.9), Fat & Oils (16.9) and sugar (4.7). Average nutrient intake (CU/day) are; energy (1727 Kcal), protein (43.9g), fat (18.8g), calcium (140.4mg), iron (7.1mg), Vitamin C (57.7mg), respectively. All parts of Indigenous food systems are inseparable and ideally function in healthy interdependent relationships to transfer energy. Understanding a culture through food is an exciting process because its answers obtained go beyond culinary learning. In these answers, food tells us something about a culture's approach to life. But the impacts of globalization and admixing with other cultures is a great threat to the very existence of cultural food practices of these indigenous peoples because of the voluntary surrender to the modern ways of life. Hence it is the need of the hour to protect such native food systems before they are lost and forgotten.

Keywords: Lodha, nutrient, traditional food practices, plant food, identity



1. INTRODUCTION

Food studies have proved an important arena for debating the cultural and symbolic explanations of human behaviour. It has also refined the understanding of variation in ethnographic enquiries. Food can be any nutritious substance that people eat or drink in order to maintain life and growth. Food, besides providing nourishment also plays an important role in enhancing quality of life. The process of food procurement, preparing, serving and consuming is significantly unique to human. This can be broadly defined as dietary or food habit. These habits can be assessed with 'dietary diversity', which measures the number of different types of food items included in a food basket. It comprises variety of foods across and within food groups. Food tells us much about a people and their culture (Deori, 2015). The importance of food, its significant role in the culture is a careful choice of ethnographic analogues (Samuel, 1996). Traditional food systems of indigenous peoples are defined as being composed of items from the local, natural, and culturally accepted items. Tribals strictly adheres to such practices to maintain their identity. India abodes world's largest tribal population. With 8.6% Scheduled Tribe population, according to census 2011, it records 705 tribes among which 75 tribes are marked as Particularly Vulnerable Tribal Groups (PVTGs). These groups are relatively more isolated, archaic, vulnerable, deprived and backward and are the most disadvantaged among the tribals. They live in small, scattered habitats in remote, inaccessible areas. West Bengal is the 9th highest tribal populated state of India comprising 5.1% of the nation's tribal population and 5.8% of West Bengal's total population (Census of India, 2011). The Lodhas are one of the three PVTGs of West Bengal. In the British period, the Criminal Tribes act 1924 was formulated. This act listed several communities as "habitually criminal". The Lodhas were designated one such group. In 1952, the Criminal Tribes Act was repealed. Post-independence, the Lodhas were first listed in the census 1951 as a Scheduled Caste, which was then changed to De-Notified Tribe in the sixties. In 1971, the Lodha tribe was denoted as a Primitive Tribal group. They are currently known as Particularly Vulnerable Tribal Group. According to Census 2011 of India the total population of Lodha (including Kheria and Kharia) in West Bengal is 108,707 among which 54,692 are male and 54,015 are female. The sex ratio of Lodha was 988 (females per 1000 males). Their major concentration is found in undivided Paschim Medinipur district. The colour of their skin and hair are brown to dark brown. They exhibit a medium (mesoprosopic) face and medium to flat nose. The Lodha used to speak Lodha language akin to Savara, which is belong to Austro-Asiatic language group. Literacy rate of the total Lodha (including Kheria and Kharia) population of West Bengal is 38.6%. Lodha male literacy rate with 46.3% is higher than female literacy rate which is 30.7% (Dutta and Bisai, 2020). There exists large gender gap (15.6%) in respective of literacy rate. The Lodhas were originally semi-nomadic hunter gatherer people. Their traditional occupation is collection and sale of forest produce - mainly edible roots, tubers, mushrooms, and leaves are gathered, while wild reptiles, fish, tortoise, molluscs, and such are hunted. They gather grass and leaves and make plates, collect cocoons, and also sell wood, honey and wax. This current paper explores indigenous foodways of the Lodhas. Consumption of liquor is more or less a part of their food habits. Both male and female drink country liquor when they feel tired. Both men and women are having the habits of chewing the betel leaves along with tobacco. Men are smoking bidi and cigarette for pleasure. But the impacts of globalization and admixing with other cultures is a great threat to the very existence of cultural food practices of these indigenous peoples because of the voluntary surrender to the modern ways of life. Hence it is the need of the hour to protect such native food systems before they are lost and forgotten.



2. OBJECTIVE

The present study was undertaken to explore the food environment of Lodha tribal community specifically with respect to traditional knowledge of indigenous foods and the assessed the nutritive value of their foods consume day to day.

3. MATERIALS and METHODS

This was an exploratory cross-sectional study conducted in villages of Paschim Medinipur, West Bengal, India. The villages were purposively selected based on high concentration of Lodha tribal community inhabiting forest fringe areas. This work is part of a Centrally Sponsored Scheme Research Project that documented the role of indigenous foods in addressing nutritional and food security among three Particularly Vulnerable Tribal Groups of West Bengal. The fieldwork was conducted from January, 2017 to January, 2018. Informed consent was obtained from all the fifty-four participated households in the study before data collection.

Primary data on different commonly consumed indigenous food items were collected by interview with pre-structured questionnaire and focus group discussions. These were used to assess the range of available foods and the contribution of indigenous wild foods to the regular diets of the Lodha community. Food recipes and their documentation, from collection to preparation has been done. 24-hour Dietary Recall method has been used to capture information on consumption from Lodha households. The foods identified were categorized under various food groups based on their edible parts. The nutritive value of the individual food items were assessed by the method as described by Gopalan et al (1989).

Anthropometric characteristics like height, weight and mid upper arm circumference (MUAC) were measured by standard methods. Adult nutritional status has been assessed based on Body Mass Index (BMI) which is body weight (in kg) divided by stature (in m²) and mid upper arm circumference which will provide an index of the body energy stores and protein mass. Child nutritional status was evaluated by Z-score method. A z-score value less than two standard deviation is considered as poor nutritional status and termed as underweight (low weight-for-age), stunting (low height-for-age) and wasting/thinness (low weight-for-height), respectively.

4. RESULTS

The study revealed that principal food of the Lodhas is rice. Rice in the form of puffed rice and rice flakes were also commonly consumed. They take meals twice or thrice a day. They make a dish with burnt potatoes and tomato with mustard oil, roasted drum stick leaf which is their common accompany of rice. During lunch they take boiled rice with different vegetable items. Sometimes they take roasted fish with mustard oil. In the night they eat the same food prepared for the lunch. They prefer to eat vegetables they grow from their land and which they collect from nearby forest or water bodies. Besides vegetable food they also eat non-vegetable food like chicken, mutton, fish and dried fish. Their festive food consists of *mangsho pitha* (pancakes made with pork meat), *gur pitha* (pancakes made with jaggery) etc. Consumption of liquor is more or less a part of their food habits. They make *Handia* by fermenting rice and adding *Bakhor bori* (tablets) in it. This tribal delicacy is being consumed on every occasion and also offered to God during different festivals. It is rich in glucose and carbohydrate which supports their energy consumption and helps to stay cool while working under scorching sun. They also prepare *Mahua* by fermenting Mahul (*Madhuca longifolia*) flowers. Both men and women are having the habits of chewing the betel leaves along with tobacco (*Dokta*). Habit of smoking *bidi* is also very common.



Table 1. List of commonly consumed food items by the Lodhas

Food Category	English Name	Scientific Name	Seasonality	Consumption Type
Cereal	Rice (Milled)	<i>Oryza sativa</i>	Throughout the year	Boiled
	Puffed Rice			Raw
	Rice Flakes			Baked
	Wheat Bread	<i>Triticum aestivum</i>		
Pulses and Legumes	Soyabean	<i>Glycine max Merr.</i>	Throughout the year	Boiled & Cooked
	Lentil	<i>Lens esculenta</i>		
	Pigeon Pea	<i>Cajanus cajan</i>		
	Bengal Gram	<i>Cicer arietinum</i>		
	Bengal Gram	<i>Cicer arietinum</i>		
Green Leafy Vegetables	Drumstick Leaves	<i>Moringa olifera</i>	Spring	Cooked
	Spinach	<i>Spinacia oleracea</i>	Winter	
	Malabar Spinach	<i>Basella alba</i>	Rainy	
	Gourd Leaves	<i>Lagenaria siceraria</i>	Summer	
	Margosa Leaves	<i>Azadirachta indica</i>		
Other Vegetables	Mushroom	<i>Agaricus bisporus</i>	End of Monsoon	Fried & Cooked
	Bamboo	<i>Bambusa oldhamii</i>	Rainy	
	Tomato	<i>Lycopersicon esculentum</i>	Winter	Cooked
	Cabbage	<i>Brassica oleracea</i>		
	Cauliflower	<i>Brassica oleracea</i>		
	Peas	<i>Pisum sativum</i>		
	Brinjal	<i>Solanum melongena</i>	Summer	
	Raddish	<i>Raphanus sativus</i>	Winter	
	Drumstick	<i>Moringa olifera</i>	Spring	
	Carrot	<i>Daucus carota</i>	Winter	
	Beetroot	<i>Beta vulgaris</i>	Summer	
	Turnip	<i>Brassica rapa</i>	Winter	
	Arum	<i>Colocasia esculenta</i>	Summer	
	Pumpkin	<i>Cucurbita maxima</i>		
	Bitter Gourd	<i>Momordica charantia</i>		
	Cheek Pea	<i>Cicer arietinum</i>	Throughout the year	
	Cucumber	<i>Cucumis sativus</i>	Summer	
	Ladies Finger	<i>Abelmoschus esculentus</i>	Summer-Rainy	
	Ridge Gourd	<i>Luffa acutangula</i>	Summer	
	Bottle Gourd	<i>Lagenaria siceraria</i>		
	Pointed Gourd	<i>Trichosanthes dioica</i>		
Hyacinth bean	<i>Lablab purpureus</i>	Winter		
Lemon	<i>Citrus limon</i>	Throughout the year		



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	Wild Pumpkin	<i>Cucurbita maxima</i>	Summer	
Roots and Tubers	Potato	<i>Solanum tuberosum</i>	Throughout the year	Boiled & Cooked
	Onion	<i>Allium cepa</i>		Raw & Cooked
	Coccinia	<i>Coccinia cordifolia</i>	Summer	Boiled & Cooked
	Taro root	<i>Colacasis esculenta</i>		
	Purple Yum	<i>Dioscorea alata</i>		
	Air potato	<i>Dioscorea bulbifera</i>		
	Chinese yam	<i>Dioscores oppositifolia</i>		
	Yam	<i>Dioscorea sp.</i>		
	Speared-leaved yam	<i>Dioscorea glabra</i>		
Fruits and Nuts	Common Jujube	<i>Ziziphus jujuba</i>	Spring	Raw
	Bel	<i>Aegel marmelos</i>	Summer	
	Tamarind	<i>Tamarindus indica</i>	Summer	Mixture
Condiments and Spices	Green Chilli	<i>Capsicum annum</i>	Throughout the year	Raw or Cooked
	Dry Chilli	<i>Capsicum annum</i>		Fried
	Cumin Seeds	<i>Cuminum cyminum</i>		Spice
	Garlic	<i>Allium sativum</i>		Paste
	Ginger	<i>Zinziber officinale</i>		Powder or Paste
	Turmeric	<i>Curcuma domestica</i>		
	Wild Garlic	<i>Allium ursinum</i>	As Available	Paste
Fishes and Seafoods	Rohu	<i>Labeo rohita</i>	As Available	Fried & Cooked
	Crab	<i>Scylla tranquebarica</i>		
	Yellowtail Catfish	<i>Pangasius pangasius</i>		
	Walking Catfish	<i>Clarias batrachus</i>		
	Freshwater Snail	<i>Theodoxus fluviatilis</i>		
	Freshwater Mussel	<i>Lamellidens marginalis</i>		
	Swamp barb	<i>Puntius chola</i>		
	Prawn	<i>Macrobrachium sp.</i>		
	Katla	<i>Catla catla</i>		
	Painted Catfish	<i>Pseudolaguvia ribeiroi</i>		
	Honey gourami	<i>Trichogaster chuna</i>		
Common Carp	<i>Cyprinus carpio carpio</i>			
Meat and Poultry	Duck	<i>Anas platyrhynchos</i>	As Available	Cooked
	Hen	<i>Gallus gallus domesticus</i>		
	Pork	<i>Sus domesticus</i>		
	Goat	<i>Capra aegagrus hircus</i>		
	Rabbit	<i>Oryctolagus cuniculus</i>		
	Wild Pig	<i>Sus scrofa</i>		
	Snake	<i>Serpentes sp.</i>		



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	Monitor Lizard	<i>Varanus sp.</i>		Boiled & Cooked
	Deer	<i>Cervidae sp.</i>		
	Dove	<i>Zenaida macroura</i>		
	Egg (Hen)	<i>Gallus gallus domesticus</i>		
Fats and Edible Oils	Mustard Oil	<i>Brassica juncea</i>	-	Cooking medium
Sugar	Sugar Cube	<i>Saccharum officinarum</i>	-	As required

Table 2. Average foodstuff intake (g/CU/day) of Lodha people.

Food stuff	West Bengal (NNMB, Rural 2012)	West Bengal (NNMB, Tribal 2009)	All states (NNMB, Rural, 2012)	All states (NNMB, Tribe 2009)	Lodha (Present study)
Cereals	314.0	610.4	339.0	418.6	378.5
Pulses	15.0	10.1	31.0	30.1	66.7
Green Leafy Vegetables	39.0	77.7	18.0	22.3	38.3
Other Vegetables	50.0	44.0	46.0	41.4	76.5
Tubers	129.0	86.1	63.0	45.9	182.9
Milk	35.0	1.8	85.0	21.2	-
Fat & Oils	10.0	7.7	15.0	10.0	16.9
Sugar & Jaggery	7.0	3.7	13.0	9.1	4.7

Reference: Gopalan et. al. 1989

Table 2 shows average foodstuff intake of Lodhas in a day. The present study has been compared with other national level rural and tribal studies. It can be seen that as the lodhas are pre-dominantly semi-nomadic and food gathering people they have access to the jungle and do avail good number of tubers, vegetables and green leafy vegetables. Milk consumption is absent among them.

Table 3. Average nutrient intake (CU/day) of Lodha people.

Nutrient	West Bengal (NNMB, Rural 2012)	West Bengal (NNMB, Tribal 2009)	All states (NNMB, Rural, 2012)	All states (NNMB, Tribe 2009)	Lodha (Present study)
Energy (kcal)	1525.0	2303.0	1842.0	1805.0	1727.0
Protein (g)	38.4	50.2	50.2	43.5	43.9
Fat (g)	17.4	10.6	29.0	17.9	18.8
Calcium (mg)	345.0	195.0	419.0	223.0	140.4
Iron (mg)	12.4	11.1	14.7	9.9	7.1
Thiamine (mg)	1.1	1.5	1.3	1.0	0.6
Riboflavin (mg)	0.6	0.4	0.8	0.5	0.4
Niacin (mg)	15.1	24.5	14.6	13.4	10.8
Folic acid (mg)	91.3	61.4	131.6	46.1	76.3
Vitamin-C (mg)	69.0	37.8	46.0	22.0	57.7

Reference: Gopalan et. al. 1989



Table 3 shows average nutrient intake (CU/day) of Lodhas of present study and being compared with other studies conducted by National nutritional Monitoring Bureau (NNMB 2009, 2012). It can be seen that almost every nutrient consumption is quite low in respect to recommended dietary allowances (RDA) as recommended by Indian Council of Medical Research (ICMR 2020).

Table 4. Anthropometric characteristics of adult Lodha People of present study

Lodha	Height (cm)	Weight (kg)	BMI (kg/m ²)	MUAC
Male	159.4 (7.0)	47.5 (5.9)	18.5 (2.4)	25.1 (2.1)
Female	148.9 (6.0)	39.4 (7.2)	17.7 (3.0)	23.2 (3.2)

Table 4. portrays the physique of adult Lodha male and female based on anthropometric characterisation.

Table 5. Nutritional status of adult Lodha People of present study

Lodha	CED (BMI<18.5 kg/m ²)	Normal (18.5 – 24.9 kg/m ²)	Overweight/Obese (BMI>25 kg/m ²)	Total
Male	22 (42.3)	30 (57.7)	0 (0)	52
Female	40 (66.7)	19 (31.7)	1 (1.7)	60
Total	63 (56.3)	49 (43.8)	1 (0.9)	112

Table 5. describes the nutritional status of the adult lodha people of the present study. Malnutrition is significantly high among females with 66.7% of Chronic Energy Deficiency (CED).

Table 6. Nutritional status of Lodha children of present study

Age group	Underweight	Stunting	Wasting/thinness
Preschool children (1-5)	14 (70.0)	06 (30.0)	10 (50.0)
School going Children (6-17)	08 (28.6)	15 (29.4)	20 (39.2)

Table 6. reveals the nutritional status of lodha children from present study. Most of the children in the age group of 1-5 years are suffering from underweight (70%). Thinness (39.2%) is high among children of 6-17 years of age group.

5. DISCUSSION

Indigenous people inhabit widely varying ecological and geoclimatic conditions in different concentrations throughout the country and are distinct biological isolates with characteristic cultural and socio-economic background. Food habits of these people depend on the standards of living being judged very often from the quantity and quality of food. The difference is judged by the quantity of rice (staple food mainly) eaten, by the frequency of meat intake in the diet, by the use of spices, fats & oils, jaggery and sugar in the preparations of food. Their consumption depends on economic ability and availability of food stuff. Beliefs, customs, tradition, social connotations etc., regarding eating habit, depends on such factors (Sanyal, 1997). The dietary pattern of the Lodhas is peculiar by the inclusion of local or natural resources or unconventional foods (Jana, 2004). Though the forest fringe lodha residents are consuming the jungle produces but are still low in nutritional status. The availability of the forest products like green leafy vegetables, other vegetables, roots, tubers, fruits etc. highly depend on seasonality. During crucial months the tribals collect tubers to supplement their hunger (Vidyarthi, 1987). Even the games which they hunt have become a luck by chance. In times of scarcity, tribals, mostly depend upon various species of wild plans to sustain their short-supplied staple food (Sinha and Lakra, 2005). Thus, nutrient intake among them is not a continuing factor. Consumption of milk and fruits are almost negligible. This indicates that



they are susceptible to be suffering from protein energy malnutrition. The dietary intake by the Lodha children had an inadequacy in the all-food groups (Sabud et. al., 2020). Mean nutrient intake of both Lodha male and female was less than the Recommended Dietary Allowance (RDA) for Indian (ICMR-NIN, 2020).

6. CONCLUSION

According to an estimation from a study in 1994, 80% of forest dwellers of West Bengal depend on forest for 25 to 50% of their annual food requirements (Tiwari, 1994). And it is a matter of fact that majority of the tribal population dwells in forest ecosystem and has their own socio-cultural pattern, tradition and typical food practices. The present study helped in documenting the indigenous foods in Lodha tribal community which could be used for quantification of nutrient intake in this community. It demonstrates the richness of nutrients available in the forest-based edible NTFPs. Studies revealed the nutritional and medicinal importance of *Dioscorea alata* (Chaudhury et. al., 2018) and *Dioscorea glabra* R. Baron (Seal et. al., 2018), potent wild edible plants consumed by the Lodha tribal community of West Bengal. Fruits of Bael (*Aegel marmelos*) are excellent source of carbohydrate and acts as a mild astringency (Dutta et.al., 2014). There is an immense scope of further study regarding nutritive value and food security to these tribal with such tremendous environmental biodiversity. Data on these aspects will be a valuable resource for the community to build upon and preserve. Their rich biodiversity and its expression in the form of diverse indigenous food sources could be leveraged for improving their nutritional status (Ghosh-Jerath et. al., 2015). But with the increasing impacts of globalization and admixing with other cultures have further threatened these indigenous people's food practices today. To protect such native food systems before they are lost and forgotten, documentation of their food pattern, food habit can be done.

ACKNOWLEDGEMENT

Authors are grateful to the authority of Cultural Research Institute, Backward Classes Welfare Department and Tribal Development Department, Government of West Bengal.



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KARBON NOKTA TEMELLİ BİYOSENSÖRLER ve GIDA GÜVENLİĞİ

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ÖZET

Karbon nanopartikül ailesi nano-fiberler, nano-elmaslar, nanotüpler, fulleren, karbon noktalar ve grafen gibi birçok nanopartikülü kapsar. Bu ailenin en son üyelerinden olan karbon noktalar 2004 yılında tesadüfen keşfinden itibaren her geçen gün artan farklı uygulamaları ile dikkat çekmektedir. Grafen kuantum nokta, polimer nokta, karbon kuantum nokta gibi farklı isimlerle de adlandırılan bu nanopartiküller boyutları 10 nm'den küçük floresans maddelerdir. Mükemmel elektronik ve optik özelliklerinin yanında, suda çözünmeleri, basit, yeşil yöntemlerle ve düşük maliyette sentezlenebilmeleri, fotostabil olmaları, biyoyumlu ve düşük sitotoksitiye sahip olmaları, kimyasal olarak inert olmaları ve kolay fonksiyonlaştırılmaları gibi üstün karakterleri nedenleriyle geleneksel kuantum noktaların alternatifleri olarak düşünülmektedir. Karbon noktalar, karbon içeren herhangi bir kaynaktan sentezlenebilir. Gıda atıkları/ gıdalar bol miktarda karbon içermeleri nedeniyle karbon nokta sentezinde kullanılmaktadır. Karbon noktaların sentez yöntemleri ark-boşalım, lazer ile aşındırma metotları gibi yukarıdan aşağıya ve yakma, mikrodalga ile yakma, hidrotermal sentez gibi aşağıdan yukarıya yaklaşımlar olarak sınıflandırılabilir. Karbon noktaların biyosensörler, biyogörüntüleme, ilaç taşınımı, gen taşınımı, katalizörler, korozyon önleyici, gıda ambalajı, güneş pilleri, gübreler, LED'ler gibi birçok alanda artan uygulamaları bulunmakta olup, popülerliği artıkça yeni uygulama alanları da ortaya çıkmaktadır. Gıda güvenliği, dünya çapında en önemli ve yaygın araştırma konularından biridir. Bu sebeple gıda güvenliğinin sağlanmasında basit, hızlı, güvenilir ve ekonomik biyosensörlerin geliştirilmesi ve uygulanması büyük önem arz etmektedir. Son yıllarda gıda güvenliği analizlerinde yüksek performansa sahip sensörlerin kullanımı olağanüstü gelişmeler göstermiştir. Yüksek duyarlılık ve seçicilikte tayin yapabilen karbon noktalar, gıda kalitesi ve güvenliği alanlarında nütrientlerin ölçümü dahil olmak üzere pestisitler, patojen mikroorganizmalar, mikotoksinler ve katkılar gibi birçok bileşenin tayininde kullanılmaktadırlar. Bu bildiride, karbon noktaların özellikleri, karbon nokta sentezinde gıda/gıda atıklarının kullanımı, sentez metotları ve gıda güvenliği alanında biyosensör olarak uygulamaları incelenecektir.

Anahtar Kelimeler: Karbon noktalar, gıda güvenliği, floresans, biyosensör, gıda atıkları



CARBON DOT BASED BIOSENSORS and FOOD SAFETY

ABSTRACT

The family of carbon nanoparticles covers many nanoparticles such as nanofibers, nano diamonds, nanotubes, fullerene, carbon dots and graphene. Carbon dots, one of last members of this family have received attention with their increasingly different applications since their incidental discovery in 2004. These nanoparticles, called with different names, such as graphene quantum dots, polymer dots, carbon quantum dots are fluorescent materials with their diameters smaller than 10 nm. In addition to superior electronic and optical properties, they are considered as alternatives to traditional quantum dots due to their outstanding characteristics such as water solubility, their ability to be synthesized by simple, green, and low-cost methods, photostability, biocompatibility and low-cytotoxicity, chemically inert and easy to functionalize. Carbon dots can be synthesized from any source containing carbon. Food waste / foods are used in carbon dot synthesis due to their high carbon content. The synthesis methods of carbon dots can be classified as top-down approaches such as arc discharge and laser etching, and bottom-up approaches such as burning, microwave combustion, and hydrothermal synthesis. Carbon dots have increasing applications in many areas such as biosensors, bioimaging, drug transport, gene transport, catalysts, anti-corrosion, food packaging, solar cells, fertilizers, LEDs, and new application areas are emerging as their popularity increases. Food safety is one of the most important and widespread research topics around the world. For this reason, the development and application of simple, fast, reliable and economical biosensors is of great importance in ensuring food safety. The use of high-performance sensors in food safety analysis has shown extraordinary progress in recent years. Carbon dots with high sensitivity and selectivity are used in the determination of many components such as pesticides, pathogenic microorganisms, mycotoxins, and additives, including the measurement of nutrients in food quality and safety. In this paper, the properties of carbon dots, the utilization of food / food waste in carbon dot synthesis, synthesis methods and their applications as a biosensor in the field of food safety will be investigated.

Keywords: Carbon dots, food safety, fluorescence, biosensor, food waste



1. GİRİŞ

İlk defa 2004 yılında Xu vd. tarafından tek duvarlı karbon nanotüplerin elektroforetik analizi sırasında tesadüfen keşfedilen karbon noktalar (KN) fevkalade özellikleri ve uygulamalarından dolayı nanoteknolojinin en kıymetli hediyesi olarak ortaya çıkmışlardır (Xu vd., 2004; Gayen vd., 2019). İki yıl sonra Sun vd. (2006) ilk defa stabil fotoluminesans özelliğe sahip farklı boyutlardaki karbon noktaları sentezlemişler ve “karbon kuantum noktalar” olarak adlandırmışlardır (Gayen vd., 2019). Karbon noktalar, grafen kuantum nokta ya da polimer noktalar olarak da adlandırılmaktadırlar (Wang vd., 2019). Karbon noktalar; doğal karbon kaynakları, atıklar, kimyasallar, inorganik karbon kaynakları, karbon nanotüp ve grafen gibi kaynaklardan sentezlenebilmektedir (Dinç ve Kara, 2018; Zhang vd., 2018; Speranza 2021). KN’ların sentezlenmesinde yukarıdan aşağıya (top-down) ve aşağıdan yukarıya (bottom-up) yaklaşımları kullanılmaktadır. Yukarıdan aşağıya yaklaşımı elektrokimyasal oksidasyon, ark boşalımı ve lazer ile aşındırma yöntemlerini kapsamaktadır. Aşağıdan yukarıya yaklaşımına ise mikrodalga ile yakma, piroliz, ultrasonik ve solvotermal metot örnek verilebilir (Kang vd., 2020).

Boyutları 10 nm’den küçük olan floresans özellikteki KN’lar suda çözünür, toksik olmayan, kolay yüzey modifikasyonu, kimyasal olarak inert olması, biyouyumlu ve kolay sentezlenebilme gibi birçok avantajıyla bugüne kadar biyogörüntüleme, biyosensör, fotokataliz, LED’ler, güneş pilleri, gübre ve ilaç salınımı gibi birçok alanda kullanılmışlardır ve kullanılmaya devam etmektedir (Dinç ve Kara, 2018; Wang vd., 2018; Liu vd., 2020; Kang vd., 2020). KN’ların kimyasal olarak inert olmaları ve optik stabiliteye sahip olmaları bu grup nanopartiküllerin özellikle optik biyosensörlerin geliştirilmesinde avantaj sağlamaktadır. Bu bildiride temel olarak KN’ların gıda güvenliği alanındaki biyosensör uygulamaları incelenecek ve ayrıca KN’ların bazı özellik ve sentez metotları, KN sentezinde gıda/gıda atıklarının kullanımını ele alınacaktır.

2. KARBON NOKTALARIN BAZI ÖZELLİKLERİ

Sıfır boyutlu karbonik nanomateryaller olarak ortaya çıkan 10 nm’den daha küçük boyutlara sahip küresel ya da yarı-küresel yapıdaki KN’lar mükemmel lüminesans özellikler sergilemektedirler. KN’ların yapısal olarak merkezde bir karbon çekirdek ve yüzeyinde fonksiyonel grupları içerdiği kabul edilmektedir. Karbon çekirdek genellikle sp^2 hibrit kristal formda ya da sp^3 hibrit amorf karbon yapıda ve yüzeyde ise hidroksil, karboksil, amino ve diğer fonksiyonel gruplar bulunmaktadır (Zhu vd., 2021; Luo vd., 2020). Floresans emisyonu KN’ları önemli bir optik özelliğidir. Ancak floresans mekanizması hâlen tartışmalıdır. Kuantum ölçek etkisi, yüzey kusur durumları (surface defect states), moleküler ve molekül-benzeri durumlar raporlanan mekanizmalardandır. Kuantum ölçek etkisi; boyutun elektron-hole çiftlerinin rekombinasyonu ile oluşan ışımaya olan etkisidir. Yüzey kusur(defect) durumu ise oksidasyonla yüzeyde oluşan kusurları ifade etmektedir. Çok yakın geçmişte, moleküler ve molekül-benzeri durumların KN’ların bazı koşullardaki (özellikle sitrik asitten elde edilen KN’larda) floresansının kaynağı olduğu ortaya çıkmıştır. Eksitasyon-bağımlı ve pH-bağımlı özellik gibi birçok floresans özellik bu mekanizmalarla açıklanabilmektedir. Eksitasyon dalga boyunu ayarlayarak farklı floresans emisyonları elde edilebilmektedir. Bununla birlikte floresans özellik, pH’dan da etkilenmektedir (Liu, C., 2021; Shi vd., 2019) ve son yıllarda floresans pH nanosensörleri yaygın bir biçimde geliştirilmiştir. Floresans algılama ve görüntüleme uygulamalarında floresans sinyalinin stabil olması ve uzun emisyon ömrü önemli kriterlerdir. KN’lar sulu ve tuz oranı yüksek çözeltilerde uzun süre stabil kalmaktadırlar. Ayrıca floro-ışıldama bozulmasına (photo-bleaching) mükemmel bir direnç göstermektedirler. UV ışını eksitasyonuna maruz bırakılan KN’ların çoğu mavi emisyon yaymaktadırlar. Biyo-dokular



ve hücreler de UV ışınına maruz bırakıldıklarında mavi emisyon yaydıkları için bu durum, mavi emisyon yapan KN'ların biyolojik analizlerde kullanımı çok da ikna edici değildir ancak uzun dalga boyuna sahip floresans özellikteki KN'ların kullanımıyla bu problem aşılmaktadır (Shi vd., 2019). KN'ların in-vitro ve in-vivo toksisitesinin araştırıldığı birçok çalışmada metal kuantum noktalarla karşılaştırıldığında oldukça düşük toksisiteye sahip, biyoyumlu ve çevre-dostu oldukları belirlenmiştir (Shi vd., 2019; Sun vd., 2020).

3. KARBON NOKTA SENTEZ METOTLARI

KN'ların sentez metotları genellikle yukarıdan aşağıya ve aşağıdan yukarıya olmak üzere iki gruba ayrılmaktadır. Yukarıdan aşağıya metodunda (ark boşalımı, lazer aşındırma, yakma, elektro-kimyasal sentez gibi) KN'lar grafit tozu, grafen, karbon nanotüpler, grafit oksit, is ve diğer karbon kaynaklarının nano-boyuttaki partiküllere parçalanması sonucu elde edilir. Aşağıdan yukarıya doğru metodunda (Mikrodalgada sentez, solvotermal metot, hidrotermal sentez, ultrasonik metot gibi) ise KN'lar küçük organik moleküllerin pirolizi ve karbonizasyonu ile elde edilmektedir. Aşağıdan yukarıya metodunda prekürsör ve sentez prosesleri dizayn edilerek KN'ların yapı, şekil ve boyutları kontrol edilebilmektedir (Shi vd., 2019; Jiang vd., 2021, Thangaraj vd., 2019). Son yıllarda oldukça popüler olan hidrotermal sentez metodunda prekürsörü içeren çözelti kapalı bir kabın içinde yüksek sıcaklık ve basınç altında ısıtılarak KN sentezi gerçekleştirilmektedir. Bu metotun toksik olmaması, yeşil olması, düşük maliyetli ve basit olması gibi avantajları vardır. Atık çay, domates, yosun ve şeftali gibi bazı doğal ürünlerden hidrotermal metoduyla KN sentezi ile ilgili güncel çalışmalar literatürde yerini almıştır. Mikrodalga ile yakma metodu KN eldesinde son yıllarda oldukça etkin kullanılan bir metottur. Mikrodalga gücü ve süre ayarlanarak prekürsör çözeltisi homojen bir şekilde ısıtılarak çok kısa bir sürede KN elde edilebilmektedir. Bu yöntemle muz kabuklarından mavi floresans veren KN'lar elde edilmiştir (Lin vd., 2021; Shi vd., 2019). Yukarıdan aşağıya metotlarından biri olan lazer ile aşındırma yönteminde hedef karbon kaynağı yüksek sıcaklık ve basınçta aşındırılarak karbon nanopartiküller elde edildikten sonra modifiye edilerek ve yüzeyleri fonksiyonlaştırılarak KN'lar elde edilmektedir (Jiang vd., 2021)

4. KARBON NOKTA SENTEZİNDE GIDA/GIDA ATIKLARININ KULLANIMI

Enerji krizi, çevresel bozulma ve artan tüketici ihtiyaçları, yenilenebilir kaynaklardan yenilikçi ileri malzemelerin üretiminde bilim insanlarını kolay, ucuz ve yeşil yöntemlere zorlamıştır. Keşfedilen birçok materyal arasından karbon temelli nanomateryaller özellikle grafen ve grafen kuantum noktalar yüksek iletkenlik, geniş yüzey alanı, biyoyumluluk, düşük toksisite ve uzun ömürlü olmalarından dolayı son zamanlarda daha çok dikkat çekmeye başlamıştır. Karbon temelli bu materyaller geleneksel olarak kömür ve petrol koku gibi yenilenmeyen kaynaklardan elde edilmektedir. Ancak artan talepler ve yenilenmeyen kaynakların hızlı bir şekilde azalması karbon esaslı bu materyallerin yenilenebilir hammaddelerden üretilmesini gerektirmiştir. Biyokütle atıklar (tarımsal artıklar, gıda atıkları, gıdalar, kentsel katı atık vb.), çevre dostu, bolca bulunan ve yenilenebilir kaynaklar olarak yüksek karbon içeriklerinden dolayı karbon esaslı materyallerin üretiminde oldukça değerlidirler. Biyokütllerden elde edilen karbon temelli nanomateryaller son zamanlarda hidrojen depolama, biyotıp ve sorpsiyon materyali olarak birçok sahada uygulama alanı bulmuştur. KN'ların hazırlanmasında biyokütle kaynaklı prekürsörlerin bol grafit, karbon fiber, karbon nanotüp ve sitrik asit gibi prekürsörlerden daha ucuz oldukları tahmin edilmektedir. Bitki yaprakları çim, pirinç kabukları, kahve taneleri ve odun kömürü gibi çeşitli biyokütllerden yüksek verimde KN'lar elde edilmiştir (Abbas vd.,2018). Ceviz kabukları, sarımsak, papaya suyu, pirinç kabuğu, kış kavunu, liçi tohumları, kaz tüyü, arı poleni, süt ve kızarmış kuzu, yoğurt, melas KN elde edilen diğer biyokütle kaynaklarıdır (Fan vd., 2020; Dinç vd., 2017, Yavuz vd., 2020). Biyokütle esaslı KN'ların



kuantum verimleri grafen türevlerinden oldukça yüksektir. Heteroatomik grupları içeren doğal ürünler yüksek kuantum verimlerine sahip, stabil özelliklerde ve ek bir pasivasyon işlemine gerek kalmadan şaşırtıcı özellikler sağlamaktadır ki bu da KN'lara floresans sensörlerde kullanım olanağı vermektedir (Abbas vd.,2018; Lin vd.,2021). Bitki yapraklarından herhangi bir pasivasyon, indirgeyici, yükseltgeyici ya da organik çözücü kullanmadan KN'lar yeşil olarak elde edilebilmektedir. (Abbas vd.,2018). KN'ların hazırlanmasında bugüne kadar birçok doğal ürünleri kullanılmıştır. Örneğin, elma suyundan elde edilen KN'lar *Pseudomonas aeruginosa* tayininde, baldan elde edilen KN'lar Fe+3 tayininde, mısır unundan elde edilenler ise Cu+2 tayininde kullanılmışlardır (Fan vd.,2020). Çay ve üzüm atıklarının karbon kaynağı olarak kullanıldığı bir çalışmada çay atıklarından elde edilen KN'ların iyi bir antioksidan aktivite gösterdiği belirlenmiştir (Murru vd., 2020). Şeker kamışı endüstriyel atıklarından üretilen KN'ların test edilen Gram (+) ve Gram (-) bakterilere karşı etkili olduğu, biyogörüntüleme ve biyomedikal uygulamalarda kullanılabileceği rapor edilmiştir (Pandiyan vd.,2020).

5. KARBON NOKTALARIN GIDA GÜVENLİĞİ BİYOSENSÖRLERİNDE KULLANIMI

Gıdaların metal iyonları, anyonlar, pestisitler, veteriner ilaçlar ve yasaklı katkılarla kimyasal kontaminasyonu ciddi sağlık problemlerine neden olmaktadır. Bu da gıda güvenliğini garanti edecek metotları gerektirmektedir (Shi vd., 2019). Gaz kromatografi (GC), yüksek basınçlı sıvı kromatografi (HPLC), GC-MS, LC-MS gibi geleneksel analitik tayin metotları yüksek duyarlılık ve doğruluk avantajlarına sahip olmakla beraber ekipmanların maliyetli olması, zaman alan ve kompleks analiz adımları, profesyonel teknik personel gereksinimi gibi dezavantajlar gıda üretim zincirinin etkin bir şekilde ve eş-zamanlı izlenmesini zorlaştırmaktadır. Bundan dolayı gıda güvenliğinin garanti altına alınması için hızlı, duyarlı ve hassas tayin metotlarına gereksinim vardır. Floresans-temelli tayin metotları hız, basitlik, taşınabilirlik, duyarlılık ve düşük maliyet gibi avantajlarından dolayı gıda güvenliği analizlerinde ümit vaat eden metotlar grubunda yer almaktadırlar. Bununla birlikte, floresans özellikteki ağır metal içeren geleneksel kuantum noktalar yüksek toksisiteye sahip olup biyouyumlulukları zayıf, stabiliteleri düşük ve maliyetleri yüksektir. Bu sebeplerle kuantum noktaların gıda güvenliği analizlerindeki pratik uygulamaları sınırlıdır. KN'lar yüksek spesifikite ve duyarlılıklarından dolayı biyojen aminler, pestisitler ve veteriner ilaç kalıntıları gibi zararlı ürünlerin tayininde kullanılmaktadırlar.

Mikrodalgada yakma yöntemiyle laktozdan elde edilen KN'lar hızlı hazırlama, yüksek floresans verimi, tekrarlanabilirlik ve stabilite gibi avantajları sunmuştur. Bu KN'ların herhangi bir ekstra fonksiyonlaştırma adımına gerek kalmadan kullanılabilmesi sayesinde dört farklı heterosiklik aromatik aminlerin kantifikasyonu başarıyla gerçekleşmiş ve analitler KN'ların floresansını sönmüştür.

Bozulmuş gıdalarda en çok bulunan maddelerden biri olan histamin, gıda güvenliği indikatörlerinden biri olarak sıklıkla kullanılmaktadır (Zhu vd.,2021). Shi vd. histamin tayini için peptit ve KN temelli yeni bir platform geliştirmişlerdir. N-asetil-L-sistein (NAC) ile kaplanmış KN'ların floresansı başlangıçta peptitler (histamine afinitesi yüksek peptitler) tarafından sönmülmüş (quenching) ve sonrasında histamin ilavesiyle floresan geri kazanılmıştır. Histamin varlığında floresansın geri kazanılmasının nedeni, histaminle peptitler arasındaki kuvvetli interaksiyondur. Örnek matriksi kompleks yapıda olduğu için histamini ayırmak analizlerde oldukça zordur. Ancak geliştirilen sensörle bu sorun aşılmıştır (Shi ve ark., 2020).



Pestisit ve veteriner ilaçların yaygın kullanımı nedeni ile bitkisel ve hayvansal ürünlerde küçük miktarlarda pestisit ve veteriner ilaç kalıntılarında rastlanmaktadır ve bu kalıntılara uzun süre maruz kalmak insan sağlığını ve çevreyi ciddi bir şekilde etkilemektedir. Dolayısıyla gıda güvenliğinde bu kalıntıların kontrolü kilit noktayı oluşturmaktadır. Nagarajan ve ark. amin-fonksiyonlaştırılmış selüloz süngerle hurmadan sentezlenmiş KN'ları kaplayarak toksik bir herbisit olan endokrin bozucu atrazini sudan uzaklaştırmışlardır (Nagarajan vd., 2020). Wang vd. kanamisin tayininde KN'ların floresansını sönmölemek için absorplayıcı olarak altın nanopartikülleri kullanmışlardır (Wang, 2020).

Kükürt ve azot doplanmış KN'lar, sulu çözeltide yüksek stabilite göstermiş ve balık ve domuz örneklerinde tetrasiklinin florometrik tayininde kullanılmıştır. Tayin metodu kabul edilebilir geri kazanım ve bağıl standart sapma değerleri sergilemiştir (Xing vd., 2020).

Gıda işleme proseslerinde tahıl ve diğer hammaddelerdeki mikotoksinler tamamıyla yok edilememektedir. Dolayısıyla son ürünler mikotoksinlerle kontamine olarak kalmaktadırlar. Liang vd. yer fıstığı örneklerinde KN'larla kaplanmış moleküler baskılanmış polimerleri kullanarak aflatoksin B1 tayini için başarılı bir metot geliştirmişlerdir (Liang vd., 2018). Pozitif yüklü azot doplanmış ve pankreatinden hidrotermal yöntemle sentezlenmiş KN'lar aptamer-modifiye altın nanopartiküllere elektrostatik interaksiyonla tutturularak aflatoksin B1 için süper duyarlılıkta bir dedeksiyon (5 pg/mL) gerçekleştirilmiştir (Wang vd., 2016).

Çevrede bulunan birçok element vücudumuza gıda ve içme suları, deri ve solunum yoluyla alınmaktadır. Bu elementlerden toksik metaller olarak da bilinen Cr⁺², Pb⁺² ve Hg⁺ gibi elementler vücutta toksik etki göstermektedirler. Kobalt doplanmış KN'lar, çeşme suyu ve deniz ürünlerinde Cr (VI) tayininde başarıyla kullanılmıştır. KN'lar, Cr (VI) varlığında sönmöleme yapmışlardır (Zhu vd., 2021).

Tıbbi teşhis, çevresel izleme ve gıda güvenliği alanlarında bakterilerin identifikasyonu çok önemli bir husustur. Kültür ve PCR gibi çok iyi bilinen metotlar bakteri identifikasyonunda etkili ve güvenilir olmasına rağmen uzun süren kültüre alma işlemleri, tecrübeli personel gereksinimi ve pahalı ekipmanlar bu yöntemlerin yaygın kullanımını sınırlandırmaktadır. Son yıllarda array-temelli algılama yaklaşımları benimsenmiş olup bir tane hedef analit yerine çoklu tanıma reseptörleri kullanılmaktadır. Zheng vd. boronik asit, polimiksin ve vankomisin ile fonksiyonlaştırılmış üç çeşit KN kullanarak yeni çoklu floresans sensör (array) sistemi geliştirmişler ve altı çeşit bakteriyi %91,6 doğrulukta ayırt edebilmişlerdir (Zheng vd., 2019).

SONUÇ

Bu bildiriye KN'ların tanımı, bazı özellikleri, sentez yöntemleri, sentezde kullanılan kaynaklar ve gıda güvenliği biyosensörlerinde kullanımları özetlenmiştir. Karbon nokta temelli nanosensörler yeni geliştirilen teknolojilerden olup son on yılda hızlı bir gelişim göstermişlerdir. Gıda matrisleri komplike sistemler oldukları için hedef analiti örnekte girişim yapan diğer bileşenlerden spesifik olarak ayırmak hâlâ zordur. Ancak hedef analite yüksek afinite ve seçicilikte bağlanabilecek ligantların kullanımı çok önemlidir. Biyosensörlerin geliştirilmesinde özellikle seçicilik gibi hususlar başarılı bir şekilde çözümlendiği takdirde KN'ların farklı gıda çeşitlerinde tayin amaçlı daha fazla kullanım alanı bulacağı beklenmektedir.



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AN REVIEW OF BIOSTIMULANT APPLICATIONS ON WHEAT CROP

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ABSTRACT

Biostimulant are novel, biodegradable, nontoxic, organic materials or microorganisms other than fertilizers applied to plants to promote growth, regulate physiological processes, enhance nutrient uptake, mitigate abiotic stresses, stimulate growth, increase yields, improve quality of crop products and reduce agricultural production costs in environmental-friendly and safe ways. They are increasingly becoming popular among farmers and researchers.

Here in this review we analysed and abstracted the biostimulant studies conducted on wheat crop in different international research organisations. We focused on nonliving biostimulants originated from biodegradable nontoxic organic based materials.

Keywords: Biostimulants, crops, yield, quality, abiotic stress



1. INTRODUCTION

Agricultural practices are shifting to organic, sustainable and environmental friendly systems to reduce inputs without reducing the yield and quality (Bulgari et al., 2015). Plant biostimulants are diverse substances and microorganisms used to enhance plant growth (Calvo et al., 2014). They are any substance or microorganism targeting to enhance nutrition efficiency, abiotic stress tolerance and quality traits of plants or plant products (Du Jardin, 2015).

Highly inefficient fertilizer usage in modern agriculture is releasing much of the applied fertilizer into the environment. Fertilizer consumption may be reduced without yield loss by enhancing crop uptake of nutrients by biostimulants (Halpern et al., 2015), particularly for increasing N fertilizer use efficiency which is essential for maintaining both yield and grain quality in bread wheat (Maignan et al., 2020). Because nitrogen losses during wheat cultivation results with economic and environmental problems. Biostimulants are increasingly used in wheat to improve N use efficiency (Maignan et al., 2021).

Usage of agricultural biostimulants is emerged as a good alternative to agrochemicals to indirectly sustain plant growth and productivity. It was demonstrated that the soil biostimulants show a delayed effect on the soil microorganisms and activate both plant growth promoting bacteria and saprophytes at the medium time scale. Biostimulants also may increase the active fungal richness to a higher level (Hellequin et al., 2020).

Marine algal seaweeds are underutilized bioresources of food and industrial raw materials for centuries. Seaweed and derived products are low exploited amendments in crop production systems which contains many plant growth-stimulating compounds (Khan et al., 2009).

Protein hydrolysates are a group of biostimulants which are mixture of peptides and amino acids. They are produced by enzymatic and/or chemical hydrolysis of proteins of animal or plant originated raw materials (Colla et al., 2015). Plant derived protein hydrolysates may increase crop tolerance to alkalinity and salinity (Rouphael et al., 2017). Applications of biostimulants were shown to enhance plant resilience for abiotic stresses (Campobenedetto et al., 2021).

Developing biostimulants from wastes by recycling and reduction is also possible. Criteria to select by products or wastes are absence of pesticide residues, low cost of collection, low cost storage and sufficient supply (Xu & Geelen, 2018).

As a strategy to apply biostimulants, seed priming with plant extracts containing biostimulants for healthy growth and productivity of stressful plants was addressed (Alharby et al., 2020).

Laurent et al., (2020) applied marine (DPI4913) and fungal (AF086) extracts as biostimulants on leaves of durum wheats. In greenhouse, biostimulants increased grain yield, total N in plant and the proportion of plant N in ears. When water was limited in greenhouse experiment, biostimulants were ineffective. In the field, marine extracts increased nitrogen accumulated in grains.

In a study of Ali et al., (2020), Different levels of *Cuscuta reflexa* extract used for water soaking of wheat seed priming. Low doses of *Cuscuta reflexa* extract (10, 20, and 30%) ameliorated the adverse effects of water stress on seed germination. But negative impacts were recorded at higher doses (40 and 50%) of *Cuscuta reflexa* extract. Maximum seed yield increases of 15% and 12% were obtained from seeds treatments with 20% and 10% *Cuscuta reflexa* extract, respectively. Low doses of *Cuscuta reflexa* extract as seed priming can be used in wheat production in semi-arids and arids.

Biostimulants (Vigro, Biomin, Humiplus and Humacare) consisted of micronutrients, humic acid, extracts of seaweeds, plants and amino acids were tested in Saudi Arabia on wheat crops. Field tests resulted with enhanced crop yields and product quality. All biostimulants were



effective but Vigro showed significant yield increases with an increase in the total tiller number of 21%, a greater number of fertile florets per spike. Grain yield increase was 8.2% (Al Majathoub, 2004).

Wheat seeds were seed soaked with maize grain extracts or antioxidants (ascorbic acid and glutathione) or polyamines (spermine, spermidine and putrescine) to compare under Cd²⁺ stress. Maize grain extract reduced the damage of Cd²⁺ stress to wheat plant; growth, yield and photosynthetic efficiency were maintained. Activities of antioxidants were elevated in Cd²⁺-stressed wheat by seed soaking in maize grain extract. Phytohormone contents were increased in stressed wheats by seed soaking with maize grain extract. Maize grain extract was more effective than soaking in antioxidants and polyamines (Alzahrani & Rady, 2019).

Matysiak et al., (2018) assessed the effect of usage of popular herbicides (MCPA + dicamba, dicamba + triasulfuron, florasulam+2,4-D) with biostimulants based on seaweed extract (Kelpak) and nitrophenols (Asahi) on weed control efficiency, yield and quality of wheat. Different tank mixture preparations of herbicides and biostimulants were applied at BBCH 30 crop growth stage to wheats. Mixing biostimulants with herbicides was not affected weed control efficacy but influenced yield and quality parameters of wheat.

Amino acid based biosimulant (AminoPrim and AminoHort; 15% and 20% amino acids, respectively; 0.27% and 2.1% microelements, respectively) was applied on winter wheat (*Triticum aestivum* L.) under field conditions. Increase in grain yields of winter wheat were 5.4% and 11%, respectively, for AminoPrim at 1.0 L/ha and AminoHort at 1.25 L/ha compared to the controls without biostimulant. Grain ash content, Zeleny sedimentation index and protein contents were also increased. Grain nutrient contents were increased (copper 31–50%; sodium 35–43%; calcium 4.3–7.9% and molybdenum 3.9–16%) (Popko et al., 2018).

A protein hydrolysate, rich in proteinogenic and nonproteinogenic amino acids produced from chicken feathers by alkaline hydrolysis procedure, were foliarly applied (solutions at 0.05%, 0.075% and 0.1% concentrations) on wheat seedlings (*Triticum aestivum* cv Bezostaya). Applications increased RuBisCo expression, root lengths, shoot lengths, fresh seedling weights, dry seedling weights and photosynthetic pigment contents. Also same concentrations decreased contents of reactive oxygen species, levels of lipid peroxidation and phenolic compounds (Ebru & Atıcı, 2019).

Seaweed biostimulant Kelpak applied on spring wheat (*Triticum aestivum* ssp. vulgare) at 2 l/ha dose alone or in mixture (1.5 l/ha Kelpak + 1.5 kg/ha Lithovit (finely milled limestone)). Kelpak applied at shooting increased spring wheat yield, but there was no additional increase with adding Lithovit. Kelpak increased the number of productive tillers. Application of sole Kelpak and mixture with Lithovit increased N, P and K accumulation in grains (Szczepanek & Grzybowski, 2016).

Four variants of biostimulants (seed treatment with Fertigrain Start at 50 ml/100 kg seeds; foliar application with Fertigrain Start at 1l/ha dose at tillering phase; seed treatment + leaf treatment; untreated control) applied on bread wheat. The highest grain yield increase (18% grain yield increase compared to control) was at seed treatment at rate 50 ml + leaf treatment leaf treatment in rate 1l/ha (Sevov & Delibaltova, 2013).

In a field experiment, in Poland with spring wheat (*Triticum aestivum*), seaweed biostimulant Kelpak (*Ecklonia maxima* Osbeck) (containing auxin and cytokinin phytohormones, 11 mg/l and 0.031 mg/l, respectively) applied at different at different doses at different developmental phases of wheat. Favourable response of the grain yield and nutrient uptake were observed by application of seaweed biostimulant Kelpak to spring wheat (Szczepanek et al., 2018).

A plant biostimulant made from the marine brown algae *Ascophyllum nodosum* (Liquid Seaweed Extract; LSE) and chitosan reduce *Fusarium* head blight and mycotoxin contamination



in wheat. Wheat seedlings drenched with LSE and chitosan in combination showed reduced severity of *F. graminearum* infection on leaves as evidenced by a significant reduction in necrotic area and fewer number of conidia produced in the necrotic area. The combination treatments were more effective in enhancing the activity of various defense related enzymes such as peroxidase and polyphenol oxidase. Combination treatments of LSE and chitosan reduced the levels of mycotoxins deoxynivalenol and sambucinol in wheat grains. Systemic disease resistance appears to be induced by LSE and chitosan in response to *F. graminearum* in wheat by inducing defense genes and enzymes (Gunupuru et al., 2019).

Pichereaux et al., (2019) studied the effects of a marine originated (DPI4913) and a fungal originated (AF086) biostimulants applied to wheat leaves. Proteomics analysis of wheat flour samples of 1391 proteins revealed 26 and 38 proteins with a significantly varying abundance after DPI4913 and AF086 treatment, respectively. Major effects of these affected proteins are on in grain hardness, gluten protein gamma-gliadin, transcription regulator proteins and in biotic and abiotic stress defense proteins. Water-use efficiency increased for both DPI4913 (15.4%) and AF086 (9.9%) treatments. Overall, the work showed that DPI4913 and AF086 treatments promoted grain yield, positively affected protein concentration and composition .

The implementation of agronomic activities including the use of biostimulants, is an important part of agroecological practices. Results of studies directly reveal the economic benefits obtained from usage of biostimulants, which are highly important for the farmers (Kocira et al., 2020).

Here in this review we analysed and abstracted the biostimulant studies conducted on wheat crop and focused on nonliving biostimulants originated from biodegradable nontoxic organic based materials.

CONCLUSIONS

Biostimulant are novel and increasingly becoming popular products. They may promote growth, regulate physiological processes, enhance nutrient uptake, mitigate abiotic stresses, stimulate growth, increase yields, improve crop products quality and reduce agricultural production costs in environmental-friendly and safe ways.

Due to ultra high diversity of possible biostimulant sources, double or multiple combinations of these products may boost yields to surprisingly high levels in near future when researchers and farmers test these goods on diversified crops in diversified methods.

Also combinations of these diversified biostimulants with different existing agrochemicals will probably help us to develop a huge valuable data on crop physiology, too.



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GENÇLİĞİN ANAHTARI: KOLAJENLER

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ÖZET

Kolajen, memelilerde en bol bulunan proteindir ve tüm proteinlerin yaklaşık %30'unu oluşturur. Kolajen, vücudumuzda farklı yapılarda görev alır ve bu yüzden olağanüstü fonksiyonel çeşitliliğe sahiptir. Kolajen, bağ dokusu, tendonlar ve korneanın ana proteindir. Ayrıca kemiklerin ve dişlerin matriks yapısını oluşturur. Tüm hücresel yapılar boyunca destek ağları oluşturarak vücut dokularının yapısının korunmasından sorumludur. Yaşla birlikte kolajen lifler zarar görmekte ve ciltte istenmeyen kırışıklık etkisine yol açmaktadır. Son yıllarda yapılan çalışmalarda, oral kolajen uygulamalarının hasarlı liflerin yenilenmesinde ve onarılmasında etkili olabileceği görülmüştür. Sonuç olarak doku iyileşmesinde ve kırışıklıklarda olumlu etkisi olacağı düşünülen kolajenlerin kullanımında hızlı bir artış göstermiştir. Bu nedenle kozmetik endüstrisi, bu proteini ticari olarak kullanabilmek için büyük çaba içerisine girmiştir. Ayrıca kolajenin antioksidan, antihipertansif, kan yağlarını azaltıcı ve hasarlı ciltte onarıcı özellikler gösterdiği de kanıtlanmıştır. Kolajen ciltte ilk olarak elastin ve kolajen oluşumu için yapı taşı olarak rol oynamakta ve hyaluronik asidi uyarmak için fibroblastlarda bağlayıcı reseptörler olarak görev yapmaktadır. Günümüzde kolajen, bitkiler ve hayvanlar gibi doğal kaynaklardan ekstraksiyon yoluyla veya maya, bakteri, memeli hücreleri, böcekler ve bitkilerden rekombinant protein üretim sistemleri yoluyla elde edilebilir. Bu bağlamda tüketiciler için ticari olarak cilt peelingleri, yüz kremleri ve oral takviyeler gibi cilt iyileştirici etkileri oluşturabilecek birtakım ürünler ve teknikler ortaya çıkarılmakta ve tüm bu ticari uygulamaların ana hedefleri arasında tüketicilerin cildinde kolajen üretiminin artırılması veya değiştirilmesi anlamına gelen ortak bir hedefte birleşilmektedir. Artan ticari kolajen kullanımı nedeniyle, pazar büyüklüğünün 2025 yılına kadar 6 milyar ABD dolarını aşacağı öngörülmektedir. Bu bildiride günümüzün popüler ürünlerinden olan kolajenler hakkında genel bir bilgi verilmesi amaçlanmıştır.

Anahtar Kelimeler: Cilt sağlığı, kolajen kaynakları, kolajen kullanımı, kozmetik endüstrisi



THE KEY FOR THE YOUTH: COLLAGENS

ABSTRACT

Collagen is the most abundant protein in mammals, and it makes up about 30% of all proteins in our body. Collagen can be found in different structures of our system and therefore has an extraordinary functional diversity. Collagen is the main protein of connective tissue, tendons, and cornea. It also forms the matrix structure in our bones and teeth. It is responsible for maintaining the structure of body tissues by forming support networks throughout all cellular structures. With age, collagen fibres are damaged and as a result cause wrinkle formation in the skin. In the recent studies, the oral collagen applications can be effective in the regeneration and repair of damaged the fibres. Therefore, there has been a rapid increase in the use of collagen, which is thought to have a positive effect on tissue healing and wrinkles. For this reason, the cosmetic industry has made great efforts to use this protein commercially. It has also been proven that collagen has antioxidant, antihypertensive, blood fat reducing and repairing properties on damaged skin. Collagen acts primarily as a building block for the formation of elastin and collagen in the skin and acts as binding receptors in fibroblasts to stimulate hyaluronic acid. Today, collagen can be obtained by extraction from natural sources such as plants and animals, or through recombinant protein production systems from yeast, bacteria, mammalian cells, insects, and plants. In this context, several products and techniques that can produce skin healing effects such as skin peels, face creams and oral supplements are commercially available for consumers. Among the main goals of all these commercial applications are united in a common goal of increasing or replacing collagen production in the skin of consumers. Due to the increasing commercial use of collagen, the market size is predicted to exceed 6 billion USD by 2025. In this review, it is aimed to give general information about collagen, one of the popular products of today.

Keywords: Skin health, collagen sources, collagen usage, cosmetic industry



1.GİRİŞ

Kolajen, deri, eklemler ve kemiklerdeki bağ dokularında bulunan fibriller bir proteindir. Bu özel molekül, biyolojik yapılardaki bağlayıcı rolü nedeniyle birçok canlı organizmada en bol bulunan protein yapılarından biridir. İnsanlarda kolajen miktarı ve gücü ile cilt yaşlanması arasındaki olası ilişkisi nedeniyle son yıllarda kozmetik endüstrisinde büyük ilgi görmeye başlamıştır. Kolajen liflerinin yaşlanma ile paralel bir şekilde zamanla hasar gördüğü, kalınlık ve mukavemetini kaybettiği tespit edilmiştir. Bir çözüm olarak, kozmetik endüstrisi, kullanıcının gençliğini ve refahını artırmak için farklı tedavilerin bir bileşeni olarak kolajeni çözüm önerisi olarak göstermiş, cildi genç tutmak için kremlerde, kemik ve kırıldak rejenerasyonunu uyarmak için besin takviyesi olarak kullanmaya başlamıştır (Avila Rodríguez ve ark., 2018).

Günümüzde kolajen, bitkiler ve hayvanlar gibi doğal kaynaklardan ekstraksiyon yoluyla veya maya, bakteri, memeli hücreleri, böcekler veya bitkiler dahil rekombinant protein üretim sistemleri yoluyla elde edilebilir. Artan ticari kolajen kullanımı nedeniyle, pazar büyüklüğünün 2025 yılına kadar 6,63 milyar ABD dolarını aşacağı öngörülmektedir (Grand View Research, 2020). Bu sunumda, kolajenler hakkında genel bir bilgi verilmesi amaçlanmıştır.

Günümüz toplumunda genç ve sağlıklı cilt, bir güzellik standardı olarak kabul görmeye başlamış ve bu durum kozmetik sanayinde cilt dokusunu pürüzsüz ve genç bir görünüme kavuşturacak alternatiflerin araştırılması konusunda daha fazla araştırma yapılmasına sebep olmaktadır. Bu bağlamda tüketiciler için ticari olarak cilt peelingleri, yüz kremleri ve farklı hidrolizat biyomolekülleri içeren oral takviyeler gibi cilt iyileştirici etkileri oluşturabilecek birtakım ürünler ve teknikler ortaya çıkarılmakta ve tüm bu ticari uygulamaların ana hedefleri arasında tüketicilerin cildinde kolajen üretiminin artırılması veya değiştirilmesi anlamına gelen ortak bir hedefte birleşilmektedir (Ganceviciene ve ark., 2012).

Kolajen, hayvanlarda olarak en bol bulunan proteindir ve memelilerdeki tüm proteinlerin yaklaşık %30'unu oluşturur. Kolajen, vücudumuzda farklı yapılarda görev alır ve bu yüzden olağanüstü fonksiyonel çeşitliliğe sahiptir. Kolajen, bağ dokusu, tendonlar ve korneanın ana proteindir ve kemiklerin ve dişlerin matris yapısını oluşturur (Patino ve ark., 2002). Tüm hücrel yapılar boyunca destek ağları oluşturarak vücut dokularının yapısının korunmasından ve gücünden sorumludur. Zaman geçtikçe kolajen lifler zarar görmekte ve birçok etkiden biri olarak ciltte istenmeyen kırışıklık etkisine yol açmaktadır (Chang ve ark 2012). Son yıllara yapılan çalışmalarda, deneklerin hidrolize kolajeni aldığıda hasarlı liflerin yenileriyle değiştirilebileceği ve onarılabilceği görülmüştür. Sonuç olarak doku iyileşmesine ve kırışıklıklarda düzelme etkisi olacağı düşünülen kolajen üretimi hızlı bir şekilde artış göstermiştir. Bu nedenle kozmetik endüstrisi, bu biyomolekülü mevcut ticari olarak kullanabilmek için büyük çaba içerisine girmiştir. Ayrıca kolajen hidrolizatlarının, antioksidan özellikler, antihipertansif aktivite, kan yağlarında düşürücü aktivite ve hasarlı ciltte onarıcı özellikler gösterdiği de kanıtlanmıştır. Kolajen ciltte ilk olarak elastin ve kolajen oluşumu için yapı taşı olarak rol oynamakta ve ikinci olarak daha önce bahsedilen bileşenleri ve hyaluronik asidi uyarmak için fibroblastlarda bağlayıcı reseptörler olarak görev yapmaktadır (Schagen, 2017; Song ve Li, 2017; Fan, 2013).

2.KOLAJEN NEDİR?

Kolajen, çeşitli dokulara destek veren yapısal bir proteindir. Bütün kolajenler kendilerine özel amino asit sekasına ve moleküler yapıya sahiptirler (Cheng, F.Y). Kolajenlerin özel amino asit yapısı vardır. Kolajen, üç polipeptit zincirine sahip bir proteindir. Her zincir 1000 amino aside sahiptir ve tekrar eden Gly-X-Y amino asit dizisinin en az bir uzantısını içerir. Burada X ve Y



herhangi bir amino asit olabilir, ancak genellikle sırasıyla prolin ve hidroksiprolindir (van der Rest ve Garrone, 1991). Yapısında 19 farklı amino asit bulunduran kolajendeki toplam amino asit sayısının %57'sini glisin, hidroksiprolin ve prolin oluşturur. (Li ve Wu, 2018). Bunların yanında esansiyel amino asitlerden lösin, treonin, valini, histidin, metiyonin, fenilalanin, izölösin, lizin ve tirozin amino asit de içermektedir. (Li ve Wu, 2018).

Kolajenin temel birimi olan tropokolajen, yaklaşık 3000 Å uzunluğunda ve 15 Å çapında çubuk şeklinde bir moleküldür. Kolajenlerin iki farklı yapısal bölümü vardır: üçlü sarmal kısım ve globüler bölüm. Çoğu kolajen, iki α -1 zinciri ve bir α -2 zincirinden oluşur. Alfa zincirler sola doğru dönüş yapan bir sarmal yapar her dönüşte yaklaşık olarak 3,3 aminoasit bulundurur. Daha sonra, α zincirleri birleşerek bu sefer sağa doğru bir süper sarmal bir yapı oluşturmak için birlikte bükülür. Farklı zincirler arasında hidrojen bağları bulunur. Her bir kolajen zincirindeki tüm amino asitlerin üçte biri glisindir (Gly). Prolin (Pro) ve hidroksiprolin (Hyp) sıklıkla birbirini takip eder ve molekülün yaklaşık %10'u Gly-Pro-Hyp dizisine sahiptir (Beard ve ark., 1977; Gurgerson ve Nimni, 1992).

Bu üçlü polipeptidik fibril yapı, 10-500 nm çapa, yaklaşık 285 kDa moleküler ağırlığa ve karakteristik olarak her üç amino asitte bir glisine sahip olacak şekilde bir yapıya sahiptir. Bu üçlü kolajen heliks yapısı, deri, kemik ve eklemlerin başlıca proteini olan kolajenin yüksek gerilme gücünü sağlayan özelliğini verir. Kolajen lifleri genellikle beyaz ve opaktır. Yüksek çekme mukavemetine ve düşük uzayabilirliğe sahip viskoelastik bir malzeme olarak kabul edilir. İzoelektrik noktası pH 5.816 civarındadır (Woodly ve ark., 2004; Ottani ve ark., 2002).

3.KOLAJEN TİPLERİ

Bugüne kadar tanımlanmış 26'dan fazla kolajen vardır. Tip I kolajen omurgalılarda en bol bulunan yapısal proteindir. Farklı kolajen türleri, Romen rakamlarıyla keşfedildikleri sıraya göre belirtilmiştir. Çoğu yazar, kolajenleri supramoleküler yapılarına göre iki ana sınıfta sınıflandırmıştır: fibriler kolajenler ve fibriler olmayan kolajenler (Gelse ve ark., 2003; Hulmes, 1992).

3.1.FİBRİLER KOLAJENLER

Bu grup tip I, II, III, V ve XI kolajenleri içerir. Bu kolajenler, oldukça organize lifler ve fibriller oluşturur ve iskelet, cilt, kan damarları, sinirler, bağırsaklar ve organların lifli kapsüllerinde vücut için yapısal destek sağlar (Vuorio ve de Crombughe, 1990). Fibriller sıklıkla demetler veya lameller halinde düzenlenir ve fibrillerin boyutu ve daha yüksek sıralı düzeni dokuya özgü, biyomekanik ve diğer biyolojik özelliklere yol açar (Hulmes, 1992).

3.1.1.TİP I KOLAJEN

Tip I kolajenlerde 2 adet birbirinin aynısı olan α -1 zinciri ile bir adet farklı bir yapıda bulunan α -2 zinciri olmak üzere 3 zincirden meydana gelir. Tip I kolajen kemik, tendon, deri, bağlar, arterler, rahim ve korneada bol miktarda bulunur ve toplam kolajenin %80 ila %99'unu oluşturur (Burgeson ve Nimni, 1992). Tip I kolajenlerde deneysel olarak oluşturulan mutasyonlar birçok dejeneratif bozukluğa yol açmakta (osteogenezis imperfekta ve Ehlers-Danlos sendromu gibi) ve bu kolajenin önemini göstermektedir (Fratzl ve ark., 1997).

3.1.2.TİP II KOLAJEN

Tip II kolajen, kıkırdaklı dokularda bulunan başlıca kolajen türüdür, ancak intervertebral diskin nükleolus pulposus ve humor vitreus gibi diğer bağ dokularında da önemli miktarlarda bulunur. Tip II kolajen, tip I kolajenin α -1 zincirlerine benzer özelliklere sahip üç özdeş α zinciri içerir. Bu zincirler α -1 olarak adlandırılır. Kıkırdak dokuda bulunan Tip II kolajen, nispeten yüksek



bir hidroksilizin ve glikosile hidroksilizin içeriğine sahiptir ve mezoderm gelişiminin kondrojenik aşamaları sırasında sentezlenir (Burgeson ve Nimni, 1992).

3.1.3. TİP III KOLAJEN

Tip III kolajen, üç özdeş α -1 zincirinden oluşur. Bu kolajen, yüksek bir hidroksiprolin içeriğine sahiptir ve hidroksilisin bakımından düşüktür. Cildin normal bir bileşenidir (toplam kolajenin %10-20'si) ve diğer birçok bağ dokusunda bulunur. Akciğer, kalp kapakçıkları, kalp kası, rahim, sinirler, karaciğer, plasenta, göbek kordonu, kan damarları, dalak, diş eti, böbrek, lenf düğümleri, kemik ve göz yapısında tip I kolajen ile birlikte bulunur. Tip III kolajen, elastik dokuların esneklik özelliğine katkıda bulunan özel bir kolajendir (Kadler ve ark., 1996).

3.1.4. TİP V KOLAJEN

Tip V kolajen, vasküler dokularda bol miktarda bulunur ve tipik olarak fibrilin iç kısmında bulunur, dış kısmında ise bulunmaz. Amino asit bileşimi, yüksek hidroksilisin:lizin oranı ve düşük alanin içeriği dışında interstisyel kolajenlerinkine benzer. Tip V kolajenin zincir bileşimi değişkendir: en yaygın yapı iki α -1 zinciri ve bir α -2 zinciridir, ancak α -1, α -2 ve α -3 şeklinde zincir yapıları da gözlemlenebilir (Burgeson ve Nimni, 1992; Kadler ve ark., 1996).

3.1.5. TİP XI KOLAJEN

Tip XI kolajen kırıkdağı dokularda bulunur. Tip XI kolajenin baskın formu α -1, α -2, ve α -3'dir. Tip XI kolajenin işlevi net olarak açıklanmamış olsa da tip II kolajen fibrillerinin çapını veya büyümesini düzenlediğinden şüphelenilmektedir (Eyre ve Wu, 1987).

3.2.FİBRİLER OLMAYAN KOLAJENLER

Fibriler olmayan kolajenler moleküler özelliklerine, supramoleküler yapılarına ve bazal membran kolajenlerinde, kısa zincirli kolajenlerde ve fibrille ilişkili kolajenlerde hücre dışı ağ tiplerine göre sınıflandırılır (Hulmes, 1992).

3.2.1.BAZAL MEMBRAN KOLAJENLERİ

Bazal membranların ana bileşenleri tip IV kolajen, lamininler ve heparan sülfat proteoglikanlardır. Tip VII kolajen de bazal membranlarla ilişkisi nedeniyle bu kategoriye dahildir (Patino ve ark., 2002). Tip IV kolajen, çoğunlukla iki α -1 zinciri ve bir α -2 zincirinden oluşur. α zincirleri proteolitik olarak işlenmez ve yüksek hidroksilizin ve glikosile edilmiş hidroksilizin içeriğine sahiptir. Tip IV kolajen yapısal olarak esnek bir ağ oluşturur (Yurchenco ve ark., 1990). Tip VII kolajen, bazal membrana yakın, çok katlı yassı epitelin altında bulunur. Bazal membranı, alttaki hücre dışı matristeki plaklara bağlar. Böylece dermal-epidermal bağlantıyı güçlendirmek için çapa işlevi görür (van der Rest ve Garrone, 1991).

3.2.2. KISA ZİNCİRLİ KOLAJENLER

Bu grup, benzer yapı ve düzeneğe sahip ancak farklı dağılım ve işleve sahip olan tip VIII ve X kolajenleri içerir. Tip VIII kolajen, vasküler endotel hücrelerde ve bazı tümör türevli hücrelerde bulunmuştur. Tip VIII kolajenin işlevi henüz bilinmemektedir. Tip X kolajen, hipertrofik kondrositlerin ürünüdür. Kırıkdağı mineralizasyonu ile ilgili özel bir görevi vardır. Tip X kolajenin fonksiyonunun, kırıkdağı dokudan – kemik doku oluşumu sırasında yapısal yardım ve anjiyogenez sırasında endotel hücrelerine rehberlik etmede rol oynadığı öne sürülmüştür (Vuorio ve Crombugge, 1990, Hulmes, 1992).



3.2.3.FİBRİL İLİŞKİLİ KOLAJENLER

Bu alt grup, kesintili üçlü sarmallı fibril ile ilişkili kolajenler (FACIT) olarak adlandırılır ve tip IX, XII ve XIV kolajenleri içerir. Bu kolajenler, önceden var olan fibrillerin yüzeyine yapışır (Patino ve ark., 2002). Tip IX kolajen kıkırdaklarda ifade edilir (toplam kolajenlerin %1-10'u). Bu bir heterotrimerdir, zincirler arası disülfid bağları olan üç kısa üçlü sarmal alan içerir. Tip IX kolajenin işlevi tam olarak bilinmese de kıkırdaktaki tip II kolajen ve proteoglikanlar arasındaki etkileşime aracılık ettiği düşünülmektedir. Tip XII kolajen, tendonlar ve bağlar gibi yoğun kolajen I içeren bağ dokularında bulunur. Yapısının Tip IX kolajen ile benzerlik göstermesi nedeniyle, benzer bir görev üstlendiği düşünülmektedir. Tip XIII kolajen, cDNA ve genomik seviyelerde karakterize edilmiştir. Bu tip kolajen hem üçlü sarmal hem de kolajen olmayan alanlara sahiptir. Tip XIII kolajenin işlevi bilinmemektedir. Tip VI Kolajen bağ dokuları boyunca dağılır ancak bantlı kolajen fibrilleri oluşturmaz (Eyre ve Wu, 1987; van der Rest ve Mayne, 1988; Patino ve ark., 2002).

Günümüzde çok sayıda kolajen tipi keşfedilmiş olmasına rağmen, kozmetik sanayide en çok fibriler kolajenler kullanılmaktadır. Yaşlanma sürecinin esas olarak meydana geldiği dermis tabakasındaki kolajenlerin %90'ını tip I ve II kolajenler oluşturur (%60-80 tip I ve %15-20 tip II). Bu durum bu iki kolajeni kozmetik endüstrisi için, yaşlanma karşıtı olarak, mükemmel adaylar haline getirmektedir (Asserin ve ark., 2015).

4.KOLAJEN KAYNAKLARI

4.1.DOĞAL KAYNAKLAR

Doğal kolajen hayvansal ve bitkisel kaynaklardan elde edilebilir. Hayvansal kaynaklar arasında en yaygın olanları sığır, domuz, insan kolajeni, balıkları ve balık derisi ve deniz organizmaları sayılabilir (Fan, 2013; Sibilla ve ark., 2015; Gelse ve ark., 2003; Ivipra ve ark., 2015). Tavuk, kanguru kuyruğu, sıçan kuyruk tendonları, ördek ayağı, at tendonları, timsah kemiği ve derisi, kuş ayağı, koyun derisi ve kurbağa derisi de kolajen kaynağı olarak kullanılmaktadır. At derisi ve kıkırdakları önemli Tip I ve II kolajen kaynağı olarak sayılabilir. Tavuk boyun bölgesinden Tip I, II, III ve V kolajen elde edilmektedir. Tavuk embriyo sternal kıkırdağında Tip IX kolajen, tavuk derisinde Tip I ve III ve tavuk kas dokusunda ise tip IV kolajen bulunur. Bu hayvansal kaynaklar arasında sığır kolajeni, ağız dışı yaralar ve vücuttaki yanıkların tedavisi için yaygın olarak kullanılmaktadır (Gupta ve ark., 2009). Domuz kolajeni ise yumuşak doku graftları şeklinde kullanılmaktadır (Herford ve ark 2010). Bahsedilen kaynaklar ucuz ve elde edilmesi kolay olmasına rağmen, uzun süreli kullanımlardan sonra, alerjenik olma riski bulunur ve osteogenezis imperfekta gibi çeşitli hastalıkların oluşumuna yol açabilir (Campbel, 2005; Lupi, 2002).

Bir başka uygun doğal kaynak deniz canlılarından elde edilen kolajendir. Bu kaynakların hastalık bulaştırma riski karasal hayvanlarla kıyaslandığında çok düşüktür ve FDA tarafından da "Genel olarak güvenli" olarak sınıflandırılmıştır. Deniz canlılarının vücut bölümlerinin çoğu kolajen içerdiğinden ve insanların normal şartlarda tüketmediği atık parçalardan elde edilebileceği için daha ucuzdur. Balık derisi, kılçıkları, yüzgeçleri ve pullarında %50-70 oranında tip I kolajen bulunur. Deniz süngeri tip I ve IV kolajeni içerirken, deniz anasında %60 oranında tip II, IV ve V kolajen vardır (Dybka ve Wiczak, 2009).

4.2.SENTETİK KAYNAKLAR

Günümüzde tıbbi olarak kolajen, kanın pıhtılaşmasına ve dokuların iyileşmesi-yeniden şekillenmesine yardımcı olmak için yaygın olarak kullanılır. Hayvan kaynaklı (doğal) kolajen birçok klinik uygulamada kullanılmasına rağmen, ancak alerjik reaksiyona yol açması, ne zaman elde edildiğine göre farklı oranlarda ürün içermesi ve olası hastalık bulaştırma riski



sebebiyle sıkıntı yaşanabilmektedir. Bu tür olası bağışıklık ve hastalık bulaştırabilme problemlerini önlemek için bazı sentetik kaynaklar bulunmuştur. Bunlardan biri olan KOD, üçlü sarmal şeklinde nanofiber ve hidrojelinden 36 amino asitten oluşan sentetik bir proteindir ve yapısı itibarı ile doğal kolajeni taklit eder. Peptidin dizisi (Pro-Lys-Gly) (Pro-Hyp-Gly) (Asp-Hyp-Gly) şeklindedir. Bu materyal, protein yapısı ve zincir yapısı ile doğal kolajene bir alternatif sunmaktadır. Ayrıca trombosit aktivasyonunu ve adezyonunu artırarak prokoagülatör olarak rol oynar. Kanamayı durdurarak hemostat veya pıhtılaşma ajanı olarak kullanılabilir. Aynı zamanda trombositleri bağlayıp aktive ederek pıhtı oluşturur ve enflamasyonu uyarmadan iyileşmeyi destekler (Kumar ve ark., 2014).

5.KOZMETİK ENDÜSTRİSİNDE KOLAJEN

Kolajen biyolojik etkisi sebebiyle kozmetik, farmasötik ve klinik alanda kullanım için büyük bir potansiyele sahiptir. Bu bağlamda en çok kullanılan kolajenler, fibriler yapıda olan tip I, tip II ve tip III kolajendir. Diğer kolajen tipleri genel olarak fibrillerin birbirleri ile birlikteliğine katıldıklarından, kozmetik çözümlerde kullanılmamaktadır (Williams, 2014).

Fibriler yapıdaki kolajenlerden, tip I kolajen, insan vücudu ile yüksek biyo- çalışma özelliğinden dolayı altın standart olarak kabul edilir ve birçok kozmetik uygulamada en çok kullanılan kolajendir. kolajen tip I, kozmetikte, diş kompozitlerinde, cilt dejenerasyonu şablonlarında, biyolojik olarak parçalanabilen matrislerde ve oftalmoloji alanında kolajen kalkanlar olarak kullanılmaktadır (Williams, 2014).

Örneğin tıp alanında, suni deri greftleri, yara örtüleri ve sinir kanalları gibi implantlar için sıklıkla kullanılır. Şimdilerde kozmetikte, yüksek nemlendirme etkisine sahip kremlerin ve jellerin geliştirilmesine yardımcı olur. Yaşlanma karşıtı, kırışık önleyici, UV radyasyon koruyucuları ve diğer uygulamaların yanısıra yaraların iyileşmesi gibi diğer faaliyetler de öngörülmektedir. Kozmetik formülasyonlara dahil edilmesi, uygulandığında cildi kaplayan ve transepidermal su kaybını azaltan, cildi aşındırıcı elementlerden koruyan film oluşturucu özellikleri ile ilgilidir. Deli dana hastalığı riskine rağmen sığır kolajeni, kolajen bazlı ürünlerin ekstraksiyonu ve sentezi için hala yaygın olarak kullanılan bir kaynaktır (Sionkowskaa ve ark., 2016). Domuz kaynaklı kolajen en sık kullanılan ikinci kaynak olmakla beraber; deniz kolajen kaynaklarının ilerleyen yıllarda ilk sırada yer alması beklenmektedir.

6.SONUÇ

Çözünürlük, yüksek gerilme mukavemeti, kontrol edilebilir stabilite, biyolojik olarak parçalanabilirlik ve düşük immünojenisite, kolajeni birçok tıbbi ve dişçilik uygulamasında biyomateryal olarak kullanıma uygun kılan avantajlardan bazılarıdır (Silvipriya ve ark., 2015). Hayvanlar aleminin en bol bulunan proteini olan kolajen, önümüzdeki dönemlerde doku mühendisliği ve rejeneratif tıp için çok önemli olacak ve kullanımı artacaktır (Berillis, 2015). Şu anda kullanılan kolajen kaynaklarında biyogüvenlik alerjik sıkıntılar yaşanabilmekte ve bu nedenle gelecekte kullanılacak çeşitli keşfedilmemiş kolajen kaynaklarını belirlemeye yönelik araştırmalar halen devam etmektedir. Önümüzdeki yıllarda kolajen pazarının kozmetik ve sağlık hizmetlerine yönelik artan talep ve artan küresel nüfus sonucunda hızlı bir şekilde artacağı tahmin edilmektedir. Bu talep sentetik kaynakların da geliştirilmesine etkili olacaktır (Silvipriya ve ark., 2015).



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PREVENTION OF CHRONIC MYCOTOXICOSIS IN SOWS AND PIGLETS

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ABSTRACT

According to the recent surveys 30–100% of feedstuff worldwide is contaminated with mycotoxins, thus co-contamination of pig feed with more than one mycotoxin seems very probable (Palumbo, 2020). The aim of the present study was to evaluate the efficacy of mineral sorbent "Ecosil" against chronic mycotoxicosis in pregnant sows and suckling piglets from 15 days of age to weaning. «Ecosil» absorbs a wide range of mycotoxins, blocks the development of storage molds, maximizes the preservation of the nutritional value, which improves the quality of colostrum and milk in sows and protects piglets. Before the experiment, compound animal feedstuff was tested for the content of mycotoxins, which didn't exceed the maximum permissible concentrations. However, the presence of T-2 in one of the samples and the presence of storage mold in all feed samples allows to conclude that animals consuming such feed are suffering from chronic mycotoxicosis. During the research, appropriate animal welfare inspections were carried out. Animals were owned by PskovAgroInvest LLC, Russian Federation. During the study 2 animal groups were formed: A (experiment - 290 piglets) and B (control - 289 piglets). The average weight of piglets at birth in the experimental group was lower by 6.12%. The sorbent was used in an amount of 3 kg per 1000 kg of feed. The average weight of piglets in group A at weaning at the age of 41 days was 10.6 kg, which exceeded the average weight of piglets in the control group by 400 g. Throughout the feeding period, temperature, ventilation, relative humidity and lighting were controlled in accordance with animals age requirements. The use of «Ecosil» sorbent in the experimental group made it possible to obtain more resistant piglets with greater live weight. Previously, we studied the use of this sorbent in poultry, and it also showed outstanding results, which allows us to recommend it for the prevention of chronic mycotoxicosis in animals.

Keywords: chronic mycotoxicosis, sorbent, piglets, sows, live weight



1. INTRODUCTION

Mycotoxins are toxic secondary metabolites produced by various molds, such as *Penicillium*, *Aspergillus*, and *Fusarium*, which may contaminate feed at all stages of the feed chain (Pierron, 2016). Despite the improvement of agricultural and manufacturing practices, mycotoxin contamination cannot be avoided and contaminants are virtually ubiquitous at some concentrations in the average human and animal diets (Bryden, 2012).

According to the recent surveys 30–100% of feedstuff worldwide is contaminated with mycotoxins, thus co-contamination of pig feed with more than one mycotoxin seems very probable (Raj, 2020). The toxicity of mycotoxins depends on the degree of their absorption in the gastrointestinal tract, the amount of metabolites formed, the period of exposure and the sensitivity of the animal. Mycotoxins such as aflatoxins (AF), ochratoxin A (OTA), fumonisins (FUM), deoxynivalenol (DON) and T-2 toxin play a special role.

The main known aflatoxins are B1, B2, G1 and G2, with established classifications based on their fluorescence in ultraviolet light (B1 / 4 blue, green G 1/4) and mobility in thin layer chromatography. They are mainly produced by *Aspergillus flavus* and *Aspergillus parasiticus*. Recently, however, the species *Aspergillus nomius*, *Aspergillus bombycis*, *Aspergillus pseudotamari*, and *Aspergillus ochraceoroseus* have also been found to be aflatoxigenic (Marin, 2013).

Mycotoxins contamination levels in pig feedstuffs are usually not high enough to cause an overt disease but may result in economical loss through changes in growth, production and immunosuppression (Bryden, 2012; Wild and Gong, 2010).

The aim of the present study was to evaluate the efficacy of mineral sorbent "Ecosil" against chronic mycotoxicosis in pregnant sows and suckling piglets from 15 days of age to weaning. Mineral sorbent "Ecosil" effectively absorbs a wide range of mycotoxins, has antioxidant properties, does not absorb the beneficial microflora of the gastrointestinal tract and the vitamin-mineral part of the feed (Rystsova, 2020). The addition of "Ecosil" slows down the processes of lipid peroxidation, which has a beneficial effect on the safety and availability of vitamins as part of compound feed and their further assimilation by the sow. This sorbent is safe and effective for long-term use, compatible with veterinary drugs, and has no contraindications.

2. MATERIALS and METHODS

During the research, appropriate animal welfare inspections were carried out. Animals were owned by PskovAgroInvest LLC, Russian Federation.

Before the main experiment, compound animal feedstuff was tested for the content of mycotoxins using the method of indirect competitive ELISA. The analysis of feed samples at the beginning of the study was aimed at detecting eight main regulated mycotoxins (T-2, zeralenone, DON, ochratoxin A, citrinin, sterigmatocystin, aflatoxin B1, fumonisin B1). Maximum permissible concentrations of mycotoxins in feed were not exceeded. However, the presence of T-2 in one of the samples and the presence of storage mold in all feed samples made it possible to conclude that animals consuming such feed are suffering from chronic mycotoxicosis (Table 1).

During the main study 2 animal groups were formed: A (experiment – n = 290 piglets) and B (control – n = 289 piglets). The sorbent was used in an amount of 3 kg per 1000 kg of feed. "Ecosil" was used for pregnant sows when transferring to farrowing and until weaning and for suckling pigs from 15 days of age. Accordingly, in the experimental group, sows and piglets received compound feed with the addition of the "Ecosil" mineral sorbent, while in the control



group they did not. Throughout the feeding period, temperature, ventilation, relative humidity and lighting were controlled in accordance with animals age requirements. Piglets had ad libitum access to feed and water. Piglets were weighed at birth, at 21 days of age and after weaning from sows at 41 days of age. Then the average weight gain for the groups was calculated. The obtained data was analyzed by unified methods of variational statistics in Microsoft Excel 2013.

The methodological basis was comprehensive scientific research, zootechnical indicators, as well as morphological, chemical and statistical data to determine the toxicity of feed.

3. RESULTS

According to the results of ELISA, the concentration of T-2, zeralenone, DON, ochratoxin A, citrinin, sterigmatocystin, aflatoxin B1, fumonisin B1 did not exceed the permissible values for the content in feed. Only in one of the samples from farm No. 2, the content of T-2 was 23 µg / kg. However, the total amount of toxigenic fungi in sample no. 1 was equal to 2790 CFU / g, and in sample no. 2 - 2720 CFU / g (Table 1).

Table 1. Examination for the content of mycotoxins.

№	Manufacturer	Consumer	Compound feed	Mycotoxin content µg / kg								Total mold amount, CFU / g
				T-2	ZEN	DON	OTA	Citrinin	Sterigmatocystin	AFB1	FUMB1	
1	JSC "Leningrad KHP named after Kirov"	LLC "PskovAgroInvest"	SSK 58	-	-	-	-	-	-	-	-	2790
2	JSC "Luga KKZ"	LLC "PskovAgroInvest"	SSK 58	23	-	-	-	-	-	-	-	2720

At birth, the average weight of piglets in the control group was more by 0.09 kg (5.8%). When weighed at 21 days, piglets from the experimental group were ahead of their peers from the control group. The difference in weight gain was 0.16 kg or 2.6%. Group A piglets weighed 6.14 kg on average. At the time of weaning from sows, the average weight of piglets in the experimental group was by 400 g (3.8%) higher than the weight of piglets in the control group and was 10.6 kg, respectively (Table 2; Figure 1).

Table 2. Weight gain among piglets.

Indicator	Group A (experience)	Group B (control)	+/-; kg
Average piglet weight at birth	1,47 kg	1,56 kg	- 0,09
Average piglet weight at 21 days	6,14 kg	5,98 kg	+ 0,16
Average piglet weight at weaning at 41 days	10,6 kg	10,2 kg	+0,4
Number of piglets	290	289	-

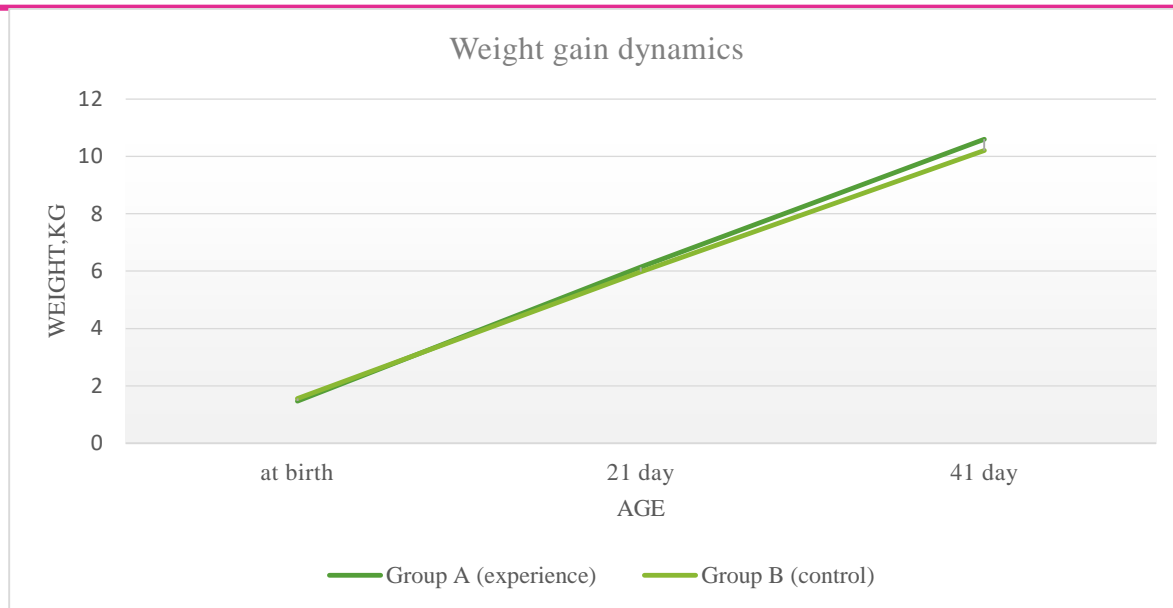


Figure 1. Growth dynamics of piglets.

4. DISCUSSION

Prevention of mycotoxicosis requires pre- and post-harvest strategies. Among post-harvest decontamination approaches, the most widely used is the inclusion of sorbent materials in feed. Such materials create a mycotoxin – adsorbent complex that is not absorbed in the intestinal tract, thus eliminated via feces. Mycotoxin adsorbing agents are divided in inorganic, organic or synthetic compounds (Vila Donat, 2018). Several previous in vitro and in vivo studies have demonstrated the adsorbing ability of mineral clays such as hydrated sodium calcium aluminosilicate (HSCAS) against aflatoxins, bentonites (montmorillonites) against AF, ZEN, ochratoxin A (OTA) and fumonisins, and zeolites against AF and FB, as well as other inorganic mineral adsorbents (diatomite, sepiolite) against AF (Raj, 2020).

«Ecosil» is a high-purity highly dispersed silica (silicon dioxide - 98.5%) with excellent sorption properties. According to the results of our studies, it successfully adsorbs significant mycotoxins (T-2, zeralenone, DON, ochratoxin A, citrinin, sterigmatocystin, aflatoxin B1, fumonisin B1) and is extremely effective for the prevention of chronic mycotoxicosis. It has a pronounced stimulating activity of metabolic processes, which is associated with a decrease in the detoxification load on the gastrointestinal tract and liver of animals.

5. CONCLUSION

Results of the present study show benefits of the test product in cases of ingestion of contaminated feed with mycotoxins in weaned piglets. «Ecosil» absorbs a wide range of mycotoxins, blocks the development of storage molds, maximizes the preservation of the nutritional value, which improves the quality of colostrum and milk in sows and protects piglets. Previously, we studied the use of this sorbent in poultry, and it also showed outstanding results, which allows us to recommend it for the prevention of chronic mycotoxicosis in animals.



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TANE DOLUM DÖNEMİ BOYUNCA MISIR TANESİNDE YAĞ ORANI VE YAĞ ASİTLERİ KOMPOZİSYONUNUN DEĞİŞİMLERİ

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ÖZET

Çalışmada mısır tanesinde tane dolun sürecinde belirli aralıklarla yağ oranı ve bazı esansiyel yağ asidi oranlarının belirlenerek genel yağ asidi kompozisyonlarının ortaya konması amaçlandı. Bunun için tarla denemesi Akdeniz ikliminin hakim olduğu kıyı Ege Bölgesinde (Aydın lokasyonu) 2019 yılında ana ürün koşullarında yürütülmüştür. Materyal olarak SY Fuerza çeşidi kullanılmıştır. Süt olun başlangıcı (17.07.2019), süt olun (24.07.2019), hamur olun başlangıcı (31.07.2019), ¼ süt çizgisi (07.08.2019), ½ süt çizgisi (14.08.2019), 4/5 süt çizgisi (21.08.2019) ve fizyolojik olun (26.08.2019) dönemlerinde tanede yağ oranı değeri ölçülmüştür. Buna ek olarak belirlenen tarihlerde mısır yağındaki yağ asidi dağılımı da belirlenmiştir. Sonuç olarak yağ oranı değerlerinin düşükten (%1.71) başladığı ve tane dolun dönemi boyunca arttığı (%3.03) gözlenmiştir (ikinci örnekleme hariç). Doymuş yağ asitleri (miristik, palmitik, heptadekanoik, stearik ve arasidik asitler) toplamının en yüksek değerinin (%17.27) ilk örnekleme zamanında belirlendiği ve tane dolun dönemi boyunca azaldığı (%14.53) görülmüştür (dördüncü ve altıncı örnekleme hariç). Buna karşın tekli doymamış yağ asitleri (palmitoleik, heptadekanoik, oleik ve eikosenoik asitler) toplamı başlangıçta en düşük (%19.62) değeri vermiş ve tane dolun dönemi boyunca artarak (dördüncü örnekleme hariç) en yüksek değere (%24.08) ulaşmıştır. Periyot boyunca çoklu doymamış yağ asitlerinin (Linoleik ve linolenik asitler) toplamlarında ise dalgalanmalar belirlendi. İlk ve dördüncü ölçümlerde yüksek sayılabilecek değerler (sırasıyla %63.12 ve %63.41) elde edilmesine rağmen diğer örnekleme zamanlarında (ikinci, üçüncü, beşinci altıncı ve yedinci) düşmeler olmuştur (sırasıyla %62.37, %62.57, %61.75, %61.49 ve %61.48). Tane dolun dönemi boyunca esansiyel yağ asitleri olarak tanımlanan linoleik (Omega 6) asidin oranı düşerken (%3.13 den %1.25'e), linolenik (Omega 3) asidin oranı kısmen yükselmiştir (%59,99 dan %60.23'e).

Anahtar kelimeler: Mısır, yağ oranı, yağ asitleri, blister, linoleik asit



THE CHANGES OF OIL CONTENT AND FATTY ACID COMPOSITION IN CORN SEED DURING THE GRAIN FILLING PERIOD

ABSTRACT

The study was aimed to reveal the general fatty acid compositions by determining the oil rate and some essential fatty acid rate at certain intervals during the grain filling process in corn seed. For this, the field trial was conducted as main crop in the coastal Aegean Region (Aydın location), under Mediterranean climate in 2019. SY Fuerza variety was used as material. In the periods of beginning of milk stage (17.07.2019), milking (24.07.2019), beginning of dough stage (31.07.2019), $\frac{1}{4}$ milk line (07.08.2019), $\frac{1}{2}$ milk line (14.08.2019), $\frac{4}{5}$ milk line (21.08.2019) and physiological maturity (26.08.2019), the value of oil in the seed was measured. In addition, the fatty acid distribution in corn oil was also determined on the dates specified. As a result, it was observed that the oil rate values started at low (1.71%) and increased (3.03%) during the grain filling period (except for the second sampling). It was observed that the highest value (17.27%) of the total of saturated fatty acids (myristic, palmitic, heptadecanoic, stearic and arachidic acids) was determined at the time of the first sampling and decreased (14.53%) during the grain filling period (excluding the fourth and sixth sampling). On the other hand, the total of monounsaturated fatty acids (palmitoleic, heptadecenoic, oleic and eicosenoic acids) gave the lowest value (19.62%) at the beginning and increased during the grain filling period (except for the fourth sample) and reached the highest value (24.08%). Fluctuations were determined in polyunsaturated fatty acids (Linoleic and linolenic acids) rates during the period. Although high values (63.12% and 63.41%, respectively) were obtained in the first and fourth measurements, there were decreases in other sampling times (second, third, fifth, sixth and seventh) (62.37%, 62.57%, 61.75%, 61.49% and 61.48%, respectively). During the grain filling period, the proportion of linoleic (Omega 6) acid, defined as essential fatty acids, decreased (from 3.13% to 1.25%), while the proportion of linolenic (Omega 3) acid increased partially (from 59.99% to 60.23%).

Keywords: Corn, oil content, fatty acids, blister, linoleic acid



1- GİRİŞ

Mısır, dünyada üretimi bir milyar tonun üzerinde olan (yaklaşık bir milyar yüz elli milyon ton) bir tarla bitkisidir. Bu üretim miktarıyla tarla bitkileri arasında birinci sırada olan bitki, FAO 2019 rakamlarına göre ekim alanı olarak da buğdayın ardından ikinci sırada yer almaktadır (Anonymous, 2019). Tanesi çok geniş kullanım alanlarına (un, nişasta, bitkisel yağ, kesif yem vb.) sahip olan bitkinin kendisi de (kaba yem olarak) ciddi bir yem kaynağıdır (Kirtok, 1998). Özellikle gelişmiş ülkelerde, gelişmemiş ve gelişmekte olan ülkelerin aksine hem tanesi hem de kendisi (yeşil ot olarak) ve hem de bazı yem bitkileri ile karışımları hayvansal üretimi destekleyen önemli bir potansiyele sahiptir (Geren ve ark., 2019).

Dünyaya paralel bir şekilde ülkemizde (Türkiye) de önemi günden güne daha iyi anlaşılın mısırın üretimi artmaktadır. Milenyumun başlangıcından bu yana (son yirmi yıl içinde) ciddi olarak artan mısır üretimi iki katından fazla bir artış göstererek altı milyon tonu aşmıştır (Anonim, 2020). Özellikle hayvancılığın önemli bir gider kalemi olan yemin (yaklaşık %60-%70) kolay ve ucuz sağlanabilmesi için bitkinin üretimi her geçen gün daha da önem kazanmaktadır (Moran ve Brouwer 2013). Artan mısır üretimi hayvansal üretimine ciddi bir destek vermektedir (Makkar ve Ankers 2014). Üretimin artışı, verimin yanı sıra üretim alanının da artışı ile sağlanabilecektir.

Mısır bitkisinin üretiminin artırılabilmesi için yeni tarım alanlarının ayrılması pek mümkün görülmemektedir. TÜİK'in 2018 yılı verilerine göre, ülkemiz toplam tarım alanı 37.802 bin hektardır (buna çayır ve mera arazisi de dahil edilmiştir). Toplam tarım alanının %52,3'sini işlenen alanlar, %9,1'ini uzun ömürlü bitkiler altındaki alanlar (çok yıllık meyvelikler), %38,6'nı daimi çayır ve mera alanları oluşturmaktadır. Rakamlar değerlendirildiğinde tarım alanlarının farklı ve önemli bitki grupları ile dolu olduğu görülmektedir (Anonim, 2018). Bunun sonucu olarak farklı tarımsal uygulamalar ve farklı üretim değerlendirme metotları ortaya çıkmaktadır. Üretimin artışı için iklimi uygun bölgelerdeki (kıyı Ege ve Akdeniz bölgelerinde) tarım alanlarında birim alandan farklı uygulamalar ile (ikinci ya da üçüncü ürün tarımı) daha fazla ürün elde edilebilmektedir (Kusaksız, 2010). Buna ek olarak bazı lokasyonlarda birinci ürün koşullarında dahi erken hasat edilen mısır koçanı sonrasında (süt mısır) kalan bitki yeşil ot olarak hasat edilerek üretime katılmaktadır.

İkinci ya da üçüncü ürün tarım uygulamaları (bazen birinci üründe) farklı dönemlerde bitki ekimini gerektirmektedir. Bunun sonucu olarak farklı hasat tarihleri de kaçınılmazdır. Bazı bölgelerde sonbahar döneminde ılıman havanın sürme uzunluğuna bağlı olarak (Ekim ayı sonuna kadar) bitkilerin hasadı yapılabilmektedir. Bu da farklı tane dolum dönemlerine denk gelebilmektedir. Benzer şekilde haşlamalık mısır (süt mısır) hasadında da farklı tane dolum dönemlerinde koçan hasat edilerek kullanılabilir. Bunun sonucu olarak gerek insanlar (haşlamalık) gerek se hayvanlar (yeme katılan) için kullanılan mısır tanesinin besleyiciliğinde (kalitesinde) farklılıklar ortaya çıkmaktadır (Charmley, 2001). Bu çalışma ile tane oluşumunun başlangıcı olan blister döneminin sonundan başlayarak (erken süt olum) birer hafta aralıklarla tanede yağ oranı ve yağ asitleri dağılımları belirlenmiştir. Böylece farklı hasat dönemlerinin tanede yağ oranı ve yağ asitleri dağılımlarına olan etkileri ile bu tanelerin besleyiciliği hakkında fikir sahibi olunmaya çalışılmıştır.

2- MATERYAL ve YÖNTEM

Çalışmada Akdeniz iklimine uygun, FAO 600-650 grubunda yer alan ve verim özellikleri yüksek hastalıklara dayanıklı SY Fuerza çeşidi kullanılmıştır. Bölgemizde bazı yıllarda erken gelen bahar aylarında birinci ürün tanelik ya da üreticilerin ihtiyaçlarına göre birinci ya da ikinci ürün silajlık olarak bu çeşitler kullanılabilir. Deneme; 2019 yılı ana ürün yetiştirme



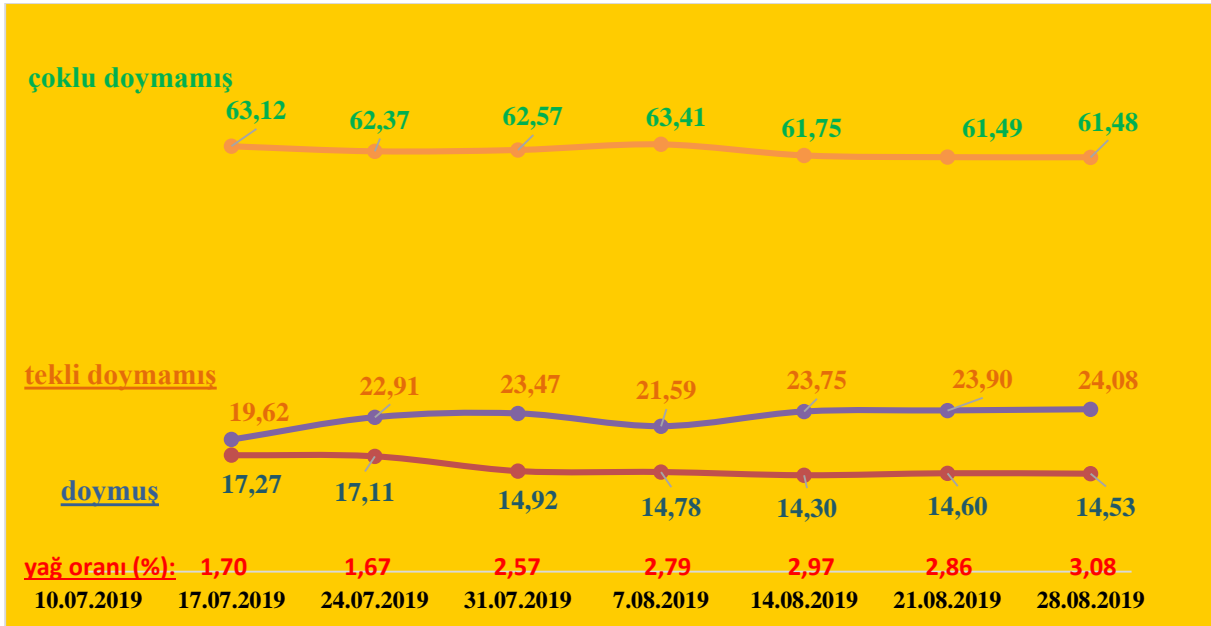
sezonunda Aydın Adnan Menderes Üniversitesi Ziraat Fakültesi Uygulama ve Araştırma Çiftliğindeki Tarla Bitkileri deneme alanında yürütülmüştür. 02.05.2019 tarihinde pnömatik ekim makinası ile ekilmiş ve 13.05.2019 da çıkış gözlenmiştir.

Denemenin yürütüldüğü tarlanın toprak analiz sonuçları Çizelge 1'de verilmiştir.

Çizelge 1'de verilen analiz sonuçlarına göre deneme kurulan arazinin kumlu tınlı bir bünyesi olduğu, organik madde miktarı düşük ve reaksiyonu alkali karakterli bir yapıda olduğu söylenebilir. Ayrıca potasyum miktarının düşük, fosfor miktarının ise yüksek olduğu sonuçları elde edilmiştir.

Çizelge 1. Deneme alanı toprak analiz sonuçları

Toprak tekstürü(%)			ph	Organik Madde (%)	P (ppm)	K (ppm)
Kum	Mil	Kil				
72	16.7	11.3	8.0	1.91	21	176
Kumlu tınlı			Yüksek	Düşük	Yüksek	Düşük



Şekil 1. Örneklemelemlerde ölçülen yağ oranı ve yağ asidi gruplarının toplam değerleri (%)

Taban gübresi olarak 15-15-15 kompoze gübresi ile dekara 10 kg saf azot, fosfor ve potasyum uygulaması yapılmıştır. Parsel başlarından ilk sıralar kenar tesiri olarak kullanılmış ve denemeye alınmamıştır. Üst gübreleme işlemi bitkiler 6-8 yapraklı dönemde iken (18.06.2019) dekara 15 kg saf azot gelecek şekilde üre gübresi ile hesaplanarak uygulanmıştır.

Araştırmanın yürütüldüğü 2019 yılında eylül ayına kadarki periyot da Aydın iline ait ortalama sıcaklık ve yağış değerleri ile uzun yıllara ilişkin değerleri Çizelge 2.'de verilmiştir.

Çizelge 2 incelendiğinde, denemenin yürütüldüğü 2019 mısır üretim sezonunda (Mayıs-Eylül) aylık ortalama sıcaklık değerlerinin uzun yıllara ait ortalama sıcaklık değerlerinin çok az farklılıklar gösterdiği söylenebilir. Buna karşın çalışmanın yürütüldüğü 2019 yılı haziran ayına ait toplam yağış miktarının uzun yıllar yağış miktarının çok üzerinde (yaklaşık 6 katı) olduğu görülmüştür.



Çizelge 2. Araştırma yerinin 2019 yılı ve uzun yıllara ait ortalama sıcaklık ve yağış değerleri

Aylar	Ortalama Sıcaklık (°C)		Toplam Yağış (kg.m ⁻²)	
	2019	Uzun Yıllar Ortalaması	2019	Uzun Yıllar Ortalaması
Mayıs	22.4	20,9	8.3	33,5
Haziran	25.6	25,9	97.7	14,0
Temmuz	26.6	28,4	0.2	3,5
Ağustos	27.2	27,2	0.0	2,2
Eylül	22.1	23,2	11.8	14,4

Bitkiler tepe püskülünü 28.06.2019 tarihinde çıkarmış, 03.07.2019 tarihinde koçan dölleme gerçekleşmiş ve 10.07.2019 tarihinde ise blister dönemi başlamıştır. Tane örnekleme 17.07.2019 tarihinde başlamıştır. 7 günlük periyotlarla 6 defa daha örnek alınmıştır (24.07.2019, 31.07.2019, 07.08.2019, 14.08.2019, 21.08.2019 ve 26.08.2019). Örnekleme tarihlerinde bitkilerin süt olum sonu, hamur olum, dişlenme (1/4 süt çizgisi), dişlenme (1/2 süt çizgisi), dişlenme (4/5 süt çizgisi) ve fizyolojik olum dönemlerinde olduğu belirlenmiştir. Örnekler çalışmayı temsil edecek şekilde 3 tekerrürlü olarak alınmıştır. Parsellerden elde edilen tanelerin kurutularak değirmende öğütüldü. Kurutulan örneklerin yağı sokslet ile çıkartıldı ve başlangıç ağırlığına oranlanarak yağ oranı değeri hesaplandı. Yağ asidi değerleri ise metil esterleri IUPAC yöntemine göre hazırlanmış ve gaz kromatografi ile analiz edilmiştir. Kromatografik ayırım DB-23 silika kaliler kolon (n60 m x 0.25 mm iç çapı x 0.25 µm film kalınlığı) ile gerçekleştirilmiştir. Kolon, enjektör ve detektör sıcaklıkları sırasıyla 195 °C, 230 °C ve 240 °C'dir. Taşıyıcı gazı azot olup, akış hızı 1 ml/dk'dır. Sonuçlar % metil esterleri olarak verilmiştir (IUPAC, 1991).

Çalışmadan elde edilen tekerrürlü veriler varyans analizi (ANOVA) yöntemine göre değerlendirilmiştir. Ortalamalar arasındaki farklılıklar EKÖF çoklu karşılaştırma tesit ile belirlenmiştir (Acikgoz et al., 2004).

3- BULGULAR ve TARTIŞMA

Çalışmadan elde edilen sonuçlar iki kısımda değerlendirilmiştir.

Yağ oranı:

Mısır bitkisinden tane doldurma dönemi boyunca elde edilen yağ oranı değerleri Çizelge 3 de verilmiştir.

Çalışmada en düşük yağ oranı değerleri (%1.71 ve %1.67) süt olum başlangıcı (17.07.2019) ve süt olum (24.07.2019) dönemlerinde ölçülmüştür. Sonrasında yağ oranı değeri hızlı bir yükselme göstererek sadece 7 gün içinde (hamur olum başlangıcı) %2.57 değerine ulaşmıştır. Böylece süt olum döneminden hamur olum dönemine geçerken yağ oranının yarıdan fazla artış gösterdiği söylenebilir. Tane dolun döneminin devamında sürekli artan yağ oranı değeri fizyolojik olum (26.08.2019) döneminde %3.03 olarak ölçülmüştür. Mevcut bilgiler ışığında tanede yağ oranının başlangıçta çok az miktarlarda olduğu ve hamur olum dönemine hızlı bir yükselmeyle girdiği söylenebilir. Sonraki dönemlerde (1/4 süt çizgisi, 1/2 süt çizgisi, 4/5 süt çizgisi ve fizyolojik olum) küçük sayılabilecek artışlar gözlenmiştir. Sonuçlar değerlendirilirken artışların % cinsinden olduğu unutulmamalıdır.



Yağ asitleri dağılımı:

Mısır bitkisinden tane doldurma dönemi boyunca elde edilen doymuş yağ asitleri değerleri Çizelge 3 de verilmiştir. Buna ek olarak tekli doymamış ve çoklu doymamış yağ asitleri değerleri Çizelge 4 de verilmiştir.

Çizelge 3. Tane dolum dönemi boyunca alınan örneklerde yağ oranı ile doymuş yağ asitlerinin oranları (%)

Tarih	Miristik Asit (%)	Palmitik Asit (%)	Heptadekanoik Asit (%)	Stearik Asit (%)	Arasidik Asit (%)	Yağ oranı (%)
17.07.2019	0.04	15.92	0.08	0.97	0.26	1.71
24.07.2019	0.06	15.35	0.08	1.29	0.32	1.67
31.07.2019	0.02	13.45	0.06	1.06	0.32	2.57
07.08.2019	0.03	13.07	0.07	1.31	0.29	2.79
14.08.2019	0.02	12.26	0.05	1.66	0.31	2.97
21.08.2019	0.03	12.05	0.06	2.08	0.38	2.99
26.08.2019	0.02	12.09	0.04	1.85	0.53	3.03
Kareler ortalaması	9.78*	122.42**	8.69**	94.89**	11.60**	84.33*
EKÖF(0.05)	0.015	0.441	0.017	0.130	0.080	0.200

Çizelge 4. Tane dolum dönemi boyunca alınan örneklerde tekli doymamış ve çoklu doymamış yağ asitlerinin oranları (%)

Tarih	Palmitoleik Asit (%)	Heptadekanoik Asit (%)	Oleik Asit (%)	Eikosenoik Asit (%)	Linoleik Asit (%)	Linolenik Asit (%)
17.07.2019	0.43	0.20	18.71	0.27	59.99	3.13
24.07.2019	0.79	0.07	21.64	0.41	61.17	2.20
31.07.2019	1.45	0.03	21.64	0.36	60.81	1.77
07.08.2019	0.70	0.03	20.58	0.28	61.81	1.59
14.08.2019	1.31	0.02	22.16	0.26	60.62	1.14
21.08.2019	1.07	0.01	22.63	0.18	60.25	1.24
26.08.2019	1.23	0.03	22.48	0.35	60.23	1.25
Kareler ortalaması	18.45**	1.27öd	18.23**	4.04*	14.16**	95.83**
EKÖF(0.05)	0.264	-	0.998	0.117	0.494	0.223

Doymuş yağ asitleri (miristik asit, palmitik asit, heptadekanoik asit, stearik asit ve arasidik asit) değerleri incelendiğinde bazı dalgalanmalar göze çarpmaktadır. Miristik asit değerinin başlangıçta %0.04 gibi bir değerle başlayıp, ikinci örnekleme yükseldiği (%0.06) görülmüştür. Süren örnekleme miristik asit değeri düşerek (%0.02) küçük yükselmeler (%0.03) ile dalgalanma göstermiştir (neredeyse sabit). Palmitik asit değeri incelendiğinde başlangıçta (süt olum dönemi boyunca) yüksek sayılabilecek değerler (%15.92 ve %15.35) verdiği görülmüştür. Tane dolum döneminin kalan kısmında düşüşler gözlemlendi. Hamur olum başlangıcındaki sert düşüş (%13.45) sonrasında küçük düşüşlerle devam eden palmitik asit değeri (%13,07 - %12,26 ve %12,05) fizyolojik olumda %12.09 ile sonlanmıştır. Heptadekanoik asit rakamları incelendiğinde başlangıçta %0.08 olarak ölçülen değer sonraki birkaç ölçümde neredeyse sabit kaldığı (%0,08 - %0,06 ve %0,07) söylenebilir. Sonrasında düşme eğilimine giren değer fizyolojik olumda %0.04 olarak ölçüldü. Çizelge 3 deki stearik asit değerleri incelendiğinde ciddi dalgalanmalar görülmektedir. Başlangıçta %0.97 olarak ölçülen değer dalgalı bir şekilde devam edip, 4/5 süt çizgisi oluştuğunda (21.08.2019) en yüksek değeri olan %2.08 i görmüştür. Sonrasında tekrar düşüş gözlenmiştir (%1.85). Tane dolum dönemi boyunca, arasidik asit değerlerinde düzenli sayılabilecek bir yükselme (4. örnekleme hariç) olmuştur. Başlangıçta %0.26 ile başlayan değer en sonunda %0.53 e kadar yükselmiştir.



Tekli doymamış yağ asitleri (palmitoleik asit, heptadekanoik asit, oleik asit ve eikosenoik asit) değerlendirildiğinde palmitoleik asit ölçümlerinin en düşük değerle (%0.43) başladığı söylenebilir. Hamur olum döneminde (31.07.2019) en yüksek (%1.45) değer elde edilmiş ve ilerleyen dönemlerde stabil bir şekilde değerler ölçülmeye devam edilmiştir (4. Örnekleme hariç). Fizyolojik olumda %1.23 değer gözlemlendi. Heptadekanoik asit değerleri izlendiğinde başlangıçta çok yüksek bir değer (%0.20) ölçülmüş, süren dönemlerde sert bir düşüşle devam etmiş ve %0.01 değerine kadar düşmüştür (4/5 süt çizgisi). Oleik asit en düşük değeri başlangıçta verdi ve devam eden sürecin neredeyse tamamında yükseldi (4. Örnekleme hariç). En yüksek oleik asit değeri %22.63 ile 4/5 süt çizgisi döneminde ölçüldü. Çizelge 4 deki eikosenoik asit değerleri incelendiğinde başlangıçta düşük sayılabilecek bir ölçüm gözlenirken, süreçte dalgalanmalar gözlemlendi. En yüksek değer (%0.41) ikinci örnekleme de gözlemlendi. Çoklu doymamış yağ asitleri (linoleik asit ve linolenik asit) değerlendirildiğinde tane dolum dönemi boyunca bazı farklılıklar olsa da linoleik asit değerleri artarken linolenik asit değerleri azalmaktadır. Omega 3 olarak da bilinen linoleik asidin en düşük değeri başlangıçta ölçüldü. Buna karşın Omega 6 olarak da bilinen linolenik asidin en düşük değeri fizyolojik olum döneminde ölçülmüştür. En yüksek Omega 3 değeri (%61.81) ½ süt çizgisi döneminde gözlenirken, En yüksek Omega 6 değeri (%3.13) süt olum başlangıcında gözlemlendi. Şekil 1 de tane dolum dönemi boyunca örnekleme zamanlarında ölçülen yağ oranı değerleri ile doymuş, tekli doymamış ve çoklu doymamış yağ asidi değerlerinin toplamları verilmiştir. Buna göre öncelikle tanede yağ oranının en düşük değerleri (%1.70 ve %1.67) süt olum dönemi boyunca gözlemlendiği ve artarak en yüksek değeri (%3.08) fizyolojik olum döneminde olmuştur. Doymuş yağ asitleri toplamı başlangıçta yüksek bir değer göstermiş (%17.27) ve gelişme dönemi sonuna kadar düşerek (6. Örnekleme hariç) %14.53 değerine kadar gelmiştir. Buna karşın tekli doymamış yağ asidi toplamları başlangıçta düşük (%19.62) ölçümler verirken tane dolum dönemi boyunca yükselme göstermiştir (%20.08). Çoklu doymamış yağ asidi toplamlarında ise başlangıçta ölçülen değer (%63.12) tane dolum dönemi boyunca çok az bir azalma ile %61.48 olarak belirlendi.

4- SONUÇ

Çalışma sonucunda elde edilen sonuçlar maddeler halinde verilmiştir.

- Yağ oranı değeri tane dolum dönemi boyunca artmıştır.
- Doymuş yağ asitleri toplamları tane dolum dönemi boyunca azalmıştır. Tane dolum dönemi boyunca miristik asit, palmitik asit ve heptadekanoik asit değerlerinin azalma eğiliminde olduğu, buna karşın stearik asit ve arasidik asit değerlerinin yükseldiği anlaşılmıştır.
- Tekli doymamış yağ asitleri toplamları tane dolum dönemi boyunca artmıştır. Tane dolum dönemi boyunca heptadekanoik asit değerinin azalma eğilimindeyken, palmitoleik asit, oleik asit ve eikosenoik asit değerlerinin ise yükseldiği anlaşılmıştır.
- Çoklu doymamış yağ asitleri toplamları ise tane dolum dönemi boyunca neredeyse paralel bir durum göstermiştir. Tane dolum dönemi boyunca linoleik asit değerleri artarken linolenik asit değerleri azalmıştır.

Elde edilen bilgiler sonucunda tane dolum dönemi boyunca ölçülen yüzdeler oranların (yağ oranı ve yağ asitlerinin) bazı dalgalanmalar gösterdiği görülmüştür. Bunun dengelenmesi ve daha doğru sonuçlara ulaşabilmek için örnekleme yapıldığı dönemlerde kuru ağırlık değerlerinin de alınarak yüzde değerlerin gram cinsine çevrilmesi uygun olacaktır.



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ATLARDA TEMEL MİKROBİYOM VE ANTİMİKROBİYAL DİRENÇLİ MİKROORGANİZMALAR

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ÖZET

At mikrobiyotasının temel bileşenleri çeşitli araştırmacılar tarafından araştırılmaktadır. Hem insan hem de Equidae bağırsağının *Firmicutes*, *Bacteroidetes*, *Actinobacteria*, *Proteobacteria*, *Fusobacteria* ve *Verrucomicrobia* gibi yaygın mikrobiyal filumlar içerdiği bulunmuştur. Ayrıca fiziksel durum, hastalık, yaş ve beslenme türü, Equidae mikrobiyom çeşitliliği üzerinde bir etkiye sahiptir. Kolitli atlarda *Fusobacteria* daha yüksek miktarda bulundu. Ayrıca evcilleştirilmemiş atların mikrobiyomlarının, evcilleştirilmiş atlara kıyasla daha çeşitli mikrobiyota spektrumu içerdiği bulunmuştur. Mikrobiyomun yapısı ve işlevi, konakçı bağışıklık sistemi aktivitesi ve önceki mikrobiyal etkileşimler tarafından oluşturulur. İlaça dirençli suşlar için tekrarlanan antimikrobiyal kullanımı, konakçıya özgü antimikrobiyal direnç genleri ve organizmaları rezervuarının yanı sıra artan patojen istilası ve hastalık riskleriyle sonuçlanır. Antimikrobiyal dirençli bakteriler veya ilgili direnç genleri, insanlar tarafından gıda üreten hayvanlardan ve ayrıca onların evcil hayvanlarıyla (köpek, kedi, at vb.) etkileşimden elde edilebilir. İnsanlarla doğrudan veya dolaylı etkileşim yoluyla bulaşabilen olası antimikrobiyal dirençli mikroorganizma rezervuarlarından biri de atlardır. İnsan ve evcil hayvan sağlığı için en büyük tehlikeyi oluşturan çoklu ilaca dirençli bakteri türleri; metisiline dirençli *Staphylococcus aureus* (MRSA) ve *Staphylococcus pseudointermedius* (MRSP), *Escherichia coli* ve diğer koliformları üreten genişletilmiş spektrumlu b-laktamazlar (ESBL), Vankomisin-dirençli Enterococci, karbapenemaz üreten *E. coli* ve MDR *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii* ve *Enterococcus faecium / faecalis*, Salmonella türleri ve *Clostridium difficile*'dir. Mikrobiyomda tespit edilen direnç genleri, mikrobiyom ve patojen direnç genleri arasında yakın bir evrimsel ilişki olduğunu göstermiştir. Antimikrobiyal direnç genleri mikrobiyotada zenginleşirse patojenik direncin artması muhtemeldir. Antimikrobiyaller, mikrobiyotanın bileşimini değiştirir ve konakçıdaki antimikrobiyal direnç genleri ve türlerinin havuzunu artırır. Terapötik açıdan bakıldığında araştırmalar, patojenik bakteri enfeksiyonlarıyla savaşmak, antibiyotik kullanımını ve antimikrobiyal direnç gelişimini azaltmak için sağlıklı mikrobiyomun transferine odaklanan tedavilere yol açabilir. Bu derleme çalışması sonucunda toplanan veriler ile atlarda mikrobiyomu oluşturan temel mikroorganizmaların ve son yıllarda yapılan çalışmalardan toplanan atlarda antimikrobiyal dirençli mikroorganizmaların ortaya konulması amaçlanmıştır. Antimikrobiyal dirençli mikroorganizmaların mikrobiyomu değiştirdiği ve baskıladığı son yıllarda gerçekleştirilen çalışmalar ile ortaya konmuş olup antimikrobiyal dirençli bakterilerle mücadelenin önem kazandığı ve bu yöndeki çalışmaların desteklenmesi gerektiği öngörülmektedir.

Anahtar Kelimeler: Mikrobiyom, antimikrobiyal direnç, at, equine



THE CORE MICROBIOME AND ANTIMICROBIAL RESISTANT MICROORGANISMS IN HORSES

ABSTRACT

The core community of equine microbiota was investigated by variety of researchers. It was found out that both human and Equidae gut contain common microbial phyla such as *Firmicutes*, *Bacteroidetes*, *Actinobacteria*, *Proteobacteria*, *Fusobacteria*, and *Verrucomicrobia*. Furthermore physical condition, disease, age and feeding type have an impact on Equidae microbiome diversity. In horses with colitis, *Fusobacteria* were found in significantly higher abundance. Also microbiomes of non-domesticated horses have been found to include a more diverse spectrum of microbiota compared to those of domesticated horses. The structure and function of the microbiome are formed by the host immune system activity and previous microbial interactions. Repeated antimicrobials use for drug-resistant strains result in a host-specific reservoir of antimicrobial resistance genes and organisms, as well as increased risks of pathogen invasion and disease. Antimicrobial resistant bacteria or the associated resistance genes can be gained by humans from food-producing animals, as well as from interaction with their companion animals (dog, cat, horse and etc). Horses are one of the possible antimicrobial resistant reservoirs that can be transmitted via direct or indirect interaction with human subjects. Multidrug-resistant bacteria species that pose the greatest danger to human and companion animal health are methicillin-resistant *Staphylococcus aureus* (MRSA) and *Staphylococcus pseudintermedius* (MRSP), extended-spectrum β -lactamases (ESBL) producing *Escherichia coli* and other coliforms, Vancomycin-Resistant Enterococci, carbapenemase-producing *E. coli*, and MDR *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii* and *Enterococcus faecium* / *faecalis*, *Salmonella* species and *Clostridium difficile*. The microbiome's resistance genes have shown a close evolutionary association between microbiome and pathogen resistance genes. Pathogenic resistance is likely to be increased if resistance genes enrich in the microbiota. Antimicrobials change the composition of the microbiota and increase the pool of antimicrobial resistance genes and species in the host. From a therapeutic standpoint, researches could lead to treatments focused on the transplantation of a healthy microbiome to combat pathogenic bacteria infections, reducing antibiotic use and the development of antibiotic resistance. It is aimed to reveal the basic microorganisms that form the microbiome in horses and the antimicrobial resistant microorganisms in horses that have been collected from the studies carried out in recent years. It has been demonstrated by the researches conducted in recent years that antimicrobial resistant microorganisms alter and suppress the microbiome, and it is predicted that the struggle against antimicrobial resistant bacteria gains more importance and so the studies should be supported.

Keywords: Microbiome, antimicrobial resistance, horse, equine



1. INTRODUCTION

1.1. MICROBIOME

Microbiota refers to the presence of microorganisms in a particular environment, whereas the microbiome relates to the whole habitat, including microorganisms and their genomes. The microbiome contributes to the development of a complex and diverse ecosystem. The number of papers on microbiome research in domestic animals has risen dramatically in recent years, indicating the changes in its composition linked to health and disease. As the composition and functional ability of the gastrointestinal (GI) microbiota is investigated, the relationship between the GI microbiota and disease becomes increasingly clearer (Guinane and Cotter, 2013; Murcia, 2019).

A diverse group of microorganisms consisting of fungi, parasites, protozoa, archaea, viruses and bacteria are present in the intestinal tract of Equidae (Costa and Weese, 2018). Taxonomically, bacteria are classified according to phylum, class, order, family, genus, and species (Laterza et al., 2016). It was found out that both human and Equidae gut contain common microbial phyla such as *Firmicutes*, *Bacteroidetes*, *Actinobacteria*, *Proteobacteria*, *Fusobacteria*, and *Verrucomicrobia*. More than 200 different genera compose the *Firmicutes* phylum, including *Lactobacillus*, *Bacillus*, *Clostridium*, *Enterococcus*, and *Ruminococcus*. *Bacteroidetes* is comprised of several major genera, particularly *Bacteroides* and *Prevotella* (Grigor'eva, 2021).

The core community of equine microbiota was investigated by variety of researchers. According to Dougal et al. (2013), Lactobacillaceae was the most common member of the core group in the ileum, Lachnospiraceae in the proximal large intestine, and Prevotellaceae in the distal large intestine.

In a study conducted with healthy Irish thoroughbred racehorses, *Firmicutes*, *Bacteroidetes*, *Proteobacteria*, *Verrucomicrobia*, *Actinobacteria*, *Euryarchaeota*, *Fibrobacteres*, and *Spirochaetes* were detected as dominated bacteria in fecal microbiota. Furthermore, *Clostridium*, *Fibrobacter*, *Faecalibacterium*, *Ruminococcus*, *Eubacterium*, *Oscillospira*, *Blautia Anaerotruncus*, *Coprococcus*, *Treponema*, and *Lactobacillus* spp. were found in all of the horses at the genus level. Also *Fibrobacter succinogenes*, *Eubacterium coprostanoligenes*, *Eubacterium hallii*, *Eubacterium ruminantium*, *Oscillospira guillermondii*, *Sporobacter termiditis*, *Lactobacillus equicursoris*, *Treponema parvum* and *Treponema porcinum* were detected in all horses. *Paludibacter propionicigenes*, *Phascolarctobacterium faecium*, *Treponema brennaborensis* and *Treponema saccharophilum* were detected at species level in most of the horse samples (O'Donnell et al. 2013).

Costa et al. (2012) found that *Firmicutes* predominated (68%) fecal microbiota among healthy horses followed by *Bacteroidetes* (14%) and *Proteobacteria* (10%). *Actinobacteria* and *Spirochaetes* were found in significantly higher abundance in healthy horses and *Clostridia* species were found in higher numbers in healthy horses. *Clostridia*'s predominancy shows the importance of this bacterial community in healthy horses.

Costa et al. (2015) indicated that there was a limited core microbiota within the same intestinal compartment. In their research the phylum *Firmicutes* was observed as the more abundant in stomach than the rest of the GI tract whereas *Verrucomicrobia* was dominant phylum in the small colon, rectum and feces. Also the *Spirochaetes* phylum was observed more abundant in the feces compared to the stomach, duodenum and ileum. In comparison to the large colon, small colon, and feces, the phylum *Proteobacteria* was slightly more abundant in the duodenum. *Fibrobacteres* were found in higher numbers in the large colon, small colon, and stool than in the stomach and duodenum. In comparison to the stomach, duodenum, and ileum,



Bacteroidetes was found in greater abundance in the cecum. Furthermore, the stomach and duodenum were occupied by *Bacilli*, while the ileum was dominated by *Clostridia* (Costa et al. 2015).

Lactobacillus sp., *Streptococcus* sp., *Actinobacillus* sp., *Sarcina* sp., and unclassified bacteria in the family Enterobacteriaceae and Streptophyta were the most abundant taxa found in the upper GI tract (Ericsson et al. 2016).

There are many researches that observed the impact of physical condition, disease, age and feeding type on Equidae microbiome diversity.

Costa et al. (2012) stated that a common microbiota is present for both of the thoroughbreds which were equally housed with the same feeding system and that feeding systems, physical environment and management factors may effect the microbiota. Feed type using in horse consumption affects faecal microbiota (O'Donnell et al., 2013).

The effects of variations in equine microbiota on some diseases such as equine grass disease, colitis, and laminitis have been investigated. 10–100 fold more anaerobic cocci were found in horses with equine grass sickness samples compared to healthy horses, mainly *Clostridia*. In a research with horses with laminitis, a new bacteria was discovered closely related to the *Anaerovibrio* genus. In another study conducted with horses with colitis, *Fusobacteria* were found in significantly higher abundance (Garrett et al., 2002; Milinovich et al., 2008; Costa et al., 2012). Also microbiomes of non-domesticated horses have been found to include a more diverse spectrum of microbiota compared to those of domesticated horses (Kauter et al., 2019). The intestine contains bacteria or bacterial components immediately after birth, but the newborn microbiota drastically alters. There has been a study that showing the development of microbiome in foals from the moment of birth to the 7th day. Additionally in order to assess potential foal microbiota, the vaginal and oral mucosal microbiota of the mares were also identified by qPCR and 16S rRNA. After foal birth, rectal microbiota contained small amounts of diverse bacteria (*Firmicutes*, *Proteobacteria*, *Bacteroidetes*, *Actinobacteria*) similar to mare feces. 24 hours after birth, the rectum was colonized by *Firmicutes* and *Proteobacteria*, and then *Lactobacilli*, *Corynebacterium*, *Porphyromonas*, *Campylobacter* and *Helcococcus* took place primarily between the first day and 7th day after birth (Husso et al. 2020). Whereas newborn foals have a rich and diverse microbiota with *Firmicutes* as the dominant phyla (Costa et al., 2016; Almeida et al., 2016), foals aged two to thirty days have a lower diversity of microorganisms with *Verrucomicrobia* predominating.

Amplicon sequencing of a part of the 16S rRNA gene is widely used to study microbial communities. Full-length 16S rRNA gene sequencing (with the 27F + 1492R primer) will provide higher taxonomic resolution and accuracy. Kinoshita et al. (2021) analysed the equine gut microbiome with the method combining long amplicon sequencing targeting the rRNA operon with a CCMetagen pipeline to achieve even higher taxonomic resolution with as few false-positives as possible. *Clostridiales* and *Lactobacillales* were found 67.7% and 15.8% by 16S rRNA gene sequencing, 48.9% and 30.7% by rRNA operon sequencing, and 40.3% and 40.2% with shotgun sequencing, respectively. *Desulfovibrionales* and *Corynebacteriales* in 16S rRNA sequencing, *Spirochaetales* and *Campylobacterales* in rRNA operon sequencing, and *Acidaminococcales* in shotgun sequencing were detected significantly less than those from other techniques. Furthermore it is stated that the full-length 16S rRNA gene sequencing could not find any archaeal genomes but both rRNA operon sequencing and shotgun sequencing could detect archaea.

The structure and function of the microbiome are formed by the host immune system activity and previous microbial interactions. Repeated antimicrobials use for drug-resistant strains result in a host-specific reservoir of antimicrobial resistance genes and organisms, as well as increased



risks of pathogen invasion and disease. Vaccines that protect against pathogens can eliminate the need for antimicrobial agents, prevent the growth and dissemination of antimicrobial resistance and prevent the negative impact on the microbiome of these medicines (Relman and Lipsitch, 2018).

Except intestinal microbiome there was few research related to different parts. When the microbiome associated with equine periodontitis and oral health was investigated, *Actinobacillus equi* was frequently isolated from the oral cavity of healthy horses (Kennedy et al., 2016).

1.2. ANTIMICROBIAL RESISTANCE (AMR)

In 2014, World Health Organization (WHO) declared that antimicrobial resistance is the greatest danger for human and veterinary medicine. Bacteria may be resistant intrinsically to some antibiotics, but they may also develop many antibiotic resistance ways through mutations in chromosomal genes and horizontal transfers over time. Acquired resistance is caused by mutations in cell genes (chromosomal mutation) resulting in cross-resistance, gene transfer from one microorganism to other by plasmids (conjugation or transformation), transposons (conjugation), integrons and bacteriophages (transduction) (Giedraitienė et al., 2011). Horizontal gene transfer is the most common way of acquiring AMR to spread within a susceptible bacterial population, allowing it to spread quickly (Barlow, 2009). Multidrug-resistant bacteria are those that are resistant to three or more antimicrobial classes (MDR) (Magiorakos et al., 2012).

Antimicrobial resistant bacteria or the associated resistance genes can be gained by humans from food-producing animals, as well as from interaction with their companion animals. While there is a guideline in the European, Japanese, and US markets for all new applications containing new active ingredients or existing substances for food-producing animals in terms of antimicrobial resistance (CVMP/VICH/644/01-FINAL), there is none for companion animals (dogs, cats and horses) (Pomba et al., 2017). Horses are one of the possible AMR reservoirs that can be transmitted via direct or indirect interaction with human subjects. (Schmiedel et al., 2014; EMA 2015; Bourély et al., 2020).

There is very little data on the use of antimicrobials in horses. Antimicrobials have been stated to be used primarily to treat equine skin infections in a recent study in Finland. Penicillins or trimethoprim/sulphonamides were the most common antimicrobials used in their study for horses (Thomson, 2010). In horses benzylpenicillin combinations are also used in empirical antimicrobial therapy with gentamicin or trimethoprim/sulfonamides. 11% of prescriptions were not approved for use in horses with antimicrobials in UK's equine veterinary practice (Hughes et al., 2013).

MDR species that pose the greatest danger to human and companion animal health are methicillin-resistant *Staphylococcus aureus* (MRSA) and *Staphylococcus pseudintermedius* (MRSP), extended-spectrum b-lactamases (ESBL) producing *Escherichia coli* and other coliforms, carbapenemase-producing *E. coli*, and MDR *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii* and *Enterococcus faecium* / *faecalis*, *Salmonella* species and *Clostridium difficile* (Randle and Page, 2018).

Little research on MDR bacteria infections in horses have been reported, and the world has paid major attention to the detection of equine pathogens with zoonotic potential on methicillin-resistant *Staphylococcus* spp. (MRSA) and *Escherichia coli* developing ESBL (Anderson et al., 2009; van Duijkeren et al., 2010; Maddox et al., 2010; Axon et al., 2011, Dierikx et al., 2012; Walther et al., 2014, de Lagarde et al., 2019). β -lactam antibiotics, one of the most effective antimicrobial groups in veterinary medicine, have established resistance in both species. The



most of these isolates have developed resistance to a variety of other antimicrobial groups (Anderson et al., 2009; Walther et al., 2014).

In foals suspected of being contaminated with *Rhodococcus equi*, prophylactic use of macrolide with rifampin has been shown to encourage MDR in both *R. equi* and gut commensals, raising the risk of environmental shedding (Álvarez-Narváez et al., 2020).

1.2.1. ENTEROBACTERIACEAE

Antimicrobial resistance of *E. coli* isolates from equine fecal samples were detected by disc diffusion and agar dilution methods. Additionally, PCR was conducted in order to search genes conferring resistance to ampicillin (TEM and SHV beta-lactamase), tetracycline (*tetA*, *tetB*, *tetC*, *tetD*, *tetE* and *tetG*), Chloramphenicol (*catI*, *catII*, *catIII* and *cml*) and trimethoprim (*dfrA1*, *dfrA9*, *dfrA12*, *dfrA13*, *dfr7*, and *dfr17*). As a result of this study equine *E. coli* was found resistant to veterinary and human antibiotics. Antimicrobial resistance, MDR, antimicrobial use in veterinary medicine, and the possible zoonotic danger that horses bring to public health (Ahmed et al., 2010).

In another research took place in Netherlands, *Salmonella typhimurium* were cultured from different horses belonged to different owners living throughout the country. Resistance of these isolates against to sulphonamides, ampicillin, chloramphenicol, streptomycin and tetracycline was commonly observed. There was a high prevalence of resistance to trimethoprim and sulphonamides since these antimicrobials were used frequently (Vo et al., 2007).

In another antimicrobial resistance study conducted with horses from Canada, it was found that Gram-negative enteric bacteria were the most common group showing resistance, while streptococci were frequently susceptible to most of the antimicrobials tested including penicillin and trimethoprim-sulfamethoxazole. Additionally, most bacterial isolates were susceptible to ceftiofur (Awosile et al., 2018).

The discovery of equivalent resistant clones in humans and some animal species including dogs, cats, horses, and poultry, as well as in food, can indicate that they spread through animal interaction or food. This type of transmission may also play a role in *E. coli*'s rapid and effective spread (Platell et al., 2011).

There is a research that found ceftiofur or cefquinome resistant *E. coli* in horses (Dierikx et al., 2012) ESBL producing *E. coli* is caused by the gene *bla_{CTX-M-1}*. It is stated that resistance to chloramphenicol, gentamicin, streptomycin, sulphonamides and tetracycline was detected in all isolates and all the isolates were positive for the *catA1*, *strA*, *sul2* and *tet(B)* genes (Dolejska et al., 2011).

ESBL/AmpC-producing *K. pneumoniae* were isolated from healthy race horses in Japan. These enzymes inactivate β -lactam antibiotics and are mainly encoded on plasmids, and can easily be spread to other bacteria in humans, animals, and the environment. Antimicrobial resistance in *Klebsiella* spp. raises the possibility of treatment failure in infected horses. In the horse population, many clinical diseases caused by *Klebsiella* spp. infection have been reported (Sukmawinata et al., 2020).

C. difficile associated colitis and colonization, in humans and horses is one of the key risk factors in antimicrobial treatment (Baverud et al., 2003; Freeman et al., 2010; Rabold et al., 2018).

1.2.2. METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS

Methicillin-resistant staphylococci exist generally on the mucous membranes, especially within the nasal chambers, in combination with non-resistant genus members (Busscher et al., 2006). The transport of MRSA on the skin of horses hospitalised for long periods has also been noted



(Van den Eede et al., 2012). For the hospitalized horses, the prevalence was 2.3–16.4% under normal conditions (Baptiste et al., 2005; Weese et al., 2006) and significantly higher during clinical infection outbreaks, on the contrary lower prevalences from 1.9 to 10.9% have been found for horses at admission to equine hospitals.

Many cases of MRSA colonization and infection in horses come from Canada, and encompass MRSA of sequence type (ST) 8. ST8 is believed to be a horse-adapted clone of a human epidemic clone (Weese and van Duijkeren, 2019).

Regarding AMR, Isgren et al. (2021) has not only searched *E.coli* and *Staphylococcus* spp. but also conducted a reserach with *Citrobacter* spp., *Enterobacter* spp., *Klebsiella* spp., *Serratia* spp., *Pantoea* spp., *Acinetobacter* spp., *Proteus* spp., *Morganella* spp., *Providencia* spp., *Actinobacillus* spp., *Pasteurella* spp., *Pseudomonas* spp., *Proteus* spp., *Morganella* spp., and *Providencia* spp. there was a very high prevalence of tetracycline resistance in *Enterococcus* spp. 235 (49.6%) and >30% for *Staphylococcus* spp. and *Streptococcus* spp. Fluoroquinolone 236 resistance was also high in *Enterococcus* spp. (50.7%) but lower in *Streptococcus* spp. 237 (27.9%) and <15% for other relevant Gram-positive isolates. The prevalence of oxacillin or cefoxitin 238 resistance in *Staphylococcus* spp. isolates was 15.9%, however only 34.3% of isolates (315 of 916 239 isolates) were tested against either of these antimicrobials. In *S. aureus* the prevalence of oxacillin or 240 cefoxitin resistance was 12.1% (30 of 247 isolates) there was a very high prevalence of tetracycline resistance in *Enterococcus* spp. 235 (49.6%) and >30% for *Staphylococcus* spp. and *Streptococcus* spp. Fluoroquinolone 236 resistance was also high in *Enterococcus* spp. (50.7%) but lower in *Streptococcus* spp. 237 (27.9%) and <15% for other relevant Gram-positive isolates. The prevalence of oxacillin or cefoxitin 238 resistance in *Staphylococcus* spp. isolates was 15.9%, however only 34.3% of isolates (315 of 916 239 isolates) were tested against either of these antimicrobials. In *S. aureus* the prevalence of oxacillin or 240 cefoxitin resistance was 12.1% (30 of 247 isolates) there was a very high prevalence of tetracycline resistance in *Enterococcus* spp. 235 (49.6%) and >30% for *Staphylococcus* spp. and *Streptococcus* spp. Fluoroquinolone 236 resistance was also high in *Enterococcus* spp. (50.7%) but lower in *Streptococcus* spp. 237 (27.9%) and <15% for other relevant Gram-positive isolates. The prevalence of oxacillin or cefoxitin 238 resistance in *Staphylococcus* spp. isolates was 15.9%, however only 34.3% of isolates (315 of 916 239 isolates) were tested against either of these antimicrobials. In *S. aureus* the prevalence of oxacillin or 240 cefoxitin resistance was 12.1% (30 of 247 isolates) there was a very high prevalence of tetracycline resistance in approximately half of *Enterococcus* spp. and also in *Staphylococcus* spp. and β -haemolytic *Streptococcus* spp. Half of *Enterococcus* spp. showed fluoroquinolone resistance but less β -haemolytic *Streptococcus* spp. were resistant against it. Resistance to oxacillin or cefoxitin was found to be a little common in *S.aureus* (Isgren et al., 2021). MRSA has been isolated from wound and surgical site infections in horses in Europe, Asia, and North America, as well as from healthy animals (Catry et al., 2010). In an Australian study of veterinary surgeons, those who only worked with horses had the highest rate of MRSA carriage, at 21.4%, compared to 4.9% of veterinary surgeons who worked with dogs and cats



(Jordan et al., 2011). In a study taking place in Israel, Staphylococci colonization was observed in 3.8% of farm horses and 50.6% of hospitalized horses. Only hospitalized horses were found to have methicillin-resistant staphylococci, with a prevalence of 21.6%. None of the farm horses tested positive for MRS isolates (Tirosh-Levy et al., 2015).

Another study found 8.6% of the surfaces and 5.8% of the horses sampled were positive for MRSA (Van Balen et al., 2014).

MRSA can be transmitted between pets (dogs, cats, and horses) and their owners, resulting in zoonotic infections. The *mecA* gene, which encodes the penicillin-binding protein 2a, is responsible for methicillin resistance in staphylococci (PBP2a). Coagulase-negative staphylococci isolated from healthy horses in Japan have also been found to carry the *mecA* gene. *mecA*-positive staphylococci isolated from animals were detected as resistant to ampicillin (Yasuda et al., 2000).

So far, most of the antimicrobial resistant research has emphasized Staphylococci and *E.coli* resistance. Organisms including MRSA and ESBL producing *E.coli* have been the most preferred subject for their multidrug resistance (Maddox et al., 2015).

1.2.3. ENTEROCOCCUS

Although Enterococci has received little attention, Enterococci carrying resistance determinants related to human disease have been discovered in horses. Bacteria that have recovered from horses have recognized antimicrobial resistance since the 1970s (Harihara and Barnum, 1973).

Enterococcus spp. were the most common isolates with no quick treatment for adult horses in the UK, followed by *Acinetobacter* spp., β -haemolytic *Streptococcus* spp, *Pseudomonas* spp, *Actinobacillus* spp, and *Pasteurella* spp. were the most widely susceptible isolates (Isgren et al., 2021).

Healthy horses in Italy, Poland, and Hungary have been found to possess Vancomycin-Resistant Enterococci (VRE) carrying VanA (de Niederhäusern et al., 2007).

Enterococcus gallinarum and *Enterococcus faecalis* a multidrug-resistant (MDR) bacteria, were cultured from synovium and joint fluid samples in horses (Herdan et al., 2013).

In Anyanwu's study (2019) enterococci isolates from horse fecal samples, showed resistance against rifampicin (90%), erythromycin (80%), tetracycline (50%).

There is a transmission risk of antimicrobial resistant enterococci from horses to humans. Kim et al. (2016) highlighted this risk by detecting multidrug-resistant *Enterococcus faecalis*.

High resistance rates towards commonly used antimicrobials in horses included penicillin, gentamicin, trimethoprim-sulfamethoxazole, marbofloxacin and cefquinome. In Switzerland high AMR rates of 2012-2015 period reported from an equine hospital. Coagulase-negative staphylococci, *S.aureus*, showed full resistance towards ampicillin, ampicillin/sulbactam, penicillin, cephalosporins and imipenem. *S.aureus* strains were high resistance against gentamicin and trimethoprim and Sulfamethazole (TMPS). *Enterococcus* spp. showed a gaining high resistance to enrofloxacin, marbofloxacin and tetracycline. Furthermore, *E. Coli* and *P. mirabilis* were seen highly resistant to ampicillin and gentamicin and *E.coli* also acquired more resistance to amoxicillin/clavulanic acid, cefalexin, ceftiofur and cefpirom. However, amikacin and marbofloxacin can be used for *Enterobacter cloacae* and *K. pneumoniae* infected disease. The most effective antimicrobial were ampicillin, ampicillin/sulbactam and imipenem against Enterococcus (Van Spijk et al., 2019).



2. CONCLUSION

When we check the microbiome studies conducted on horses so far, it can be seen that the majority of the findings are related to the microbiota of the GI system. This is understandable since the intestinal microbiota is amongst the most densely populated microbial ecosystem on earth. However, since skin and respiratory diseases are also common in horses, this highlights the need to monitor the microbiome of the blood, skin, respiratory system, and other parts.

Culture-based techniques allow only for superficial evaluation of the microbiome's constituents, which is a major restriction because unknown or uncultivated microorganisms believed to be a large part of the microbiome (Daly et al., 2001; Eckburg et al., 2005).

To determine microbial community in faeces specimens, molecular methods are needed. The advent of next-generation sequencing has resulted in a change in the characterization of diverse microbial communities, as well as new avenues for treatments of diseases (Costa et al., 2012).

On the other hand, although they are important as an equine pathogen, other bacteria such as streptococci are poorly studied and their resistance, particularly in Europe, is little known.

From a therapeutic standpoint, researches could lead to treatments focused on the transplantation of a healthy microbiome to combat pathogenic bacteria infections, reducing antibiotic use and the development of antibiotic resistance (Murcia, 2019).

Although the microbiome offers a variety of health benefits, the large density of microorganisms in this environment also allows for the horizontal transfer of AMR genes to potentially pathogenic bacteria (Penders et al., 2013).

Infections with MDR bacteria are a major problem in human and veterinary medicine. The development of MDR increases human and equine morbidity and mortality as well as higher treatment cost by increasing the duration of hospital stays and the use of medicines as a treatment (Bryan et al., 2010).

Culture-based studies have a place in the current era of molecular techniques since they are needed to determine antibiotic susceptibility. Nevertheless, sequence-based metagenomics are expected to gain a better understanding of the intestinal microbiome's capacity as an AMR reservoir. (Penders et al., 2013).

The microbiome's resistance genes have shown a close evolutionary association between microbiome and pathogen resistance genes. Pathogenic resistance is likely to be increased if resistance genes enrich in the microbiota (Sommer and Dantas., 2011). In vivo experiments have shown that antibiotic resistance genes are transferred within the microbiota. Lester et al. (2006) proved that in vivo transfer of the *vanA* resistance determinant from a donor *E. faecium* strain of animal origin to a recipient *E. faecium* strain of human origin in the intestine of healthy human subjects. Similar findings were obtained for the sulfonamide resistance gene *sul2* within *E. coli* strains isolated from the human intestine (Trobos et al., 2009).

Although there is an increasing number of studies reporting persistent effects on microbiome group structure and resistance levels within the microbiota, in vivo studies in both animal and human microbiota have minimal support (Sommer and Dantas., 2011).

Antimicrobials change the composition of the microbiota and increase the pool of antimicrobial resistance genes and species in the host.

It has been demonstrated by the researches conducted in recent years that antimicrobial resistant microorganisms alter and suppress the microbiome, and it is predicted that the struggle against antimicrobial resistant bacteria gains more importance and so the studies should be supported.



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PEYZAJDA TEMEL GÖRSEL KONSEPT; EFEMERA

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ÖZET

Temel olarak, peyzaj kalite değerlendirmeleri doğal ve kültürel peyzaj öğelerinin peyzajın memnuniyet ve estetik algısının yaratılmasındaki kilit rolüne atıfta bulunmaktadır. Görsel peyzaj kalite değerlendirmesi peyzaj mimarlığı, peyzaj planlama ve mekansal planlamanın temel bileşeni haline gelmiştir. Manzaranın doğal ve kültürel niteliklerini değerlendirmek için son yıllarda farklı yaklaşımlar geliştirilmiştir. Görsel peyzaj kalite değerlendirmesi önemli bir literatür tabanı ile bilimsel araştırma için iyi tanınan bir alandır. Ekosistemler sürekli değişiyor ve istikrarlı değildir ve bu periyodik değişim genellikle sistemin önemli parçalarından sayılmaktadır. Peyzaj estetiği literatürünün incelemesine göre; Mevsim, hava durumu veya diğer geçici etkilerin peyzaj deneyiminin önemli unsurları olduğu, aynı zamanda peyzajın estetik potansiyelinde kalıcı özellikler olduğu ortaya konulmuştur. Efemera kavramı yıl boyunca peyzaj değişiklikleriyle ve hava şartlarına cevap olarak peyzaj algısına katkıda bulunan kısa vadeli etkiler ile ilgilidir. Renklerin ve bitki örtüsü rengindeki geçici değişikliklere önem veren tercihler üzerinde olumlu etkileri olduğu bulunmuştur. Örneğin çiçeklenme mevsimi boyunca çekici olan bitkilerin çiçeklenme mevsimi dışında aynı görsel etkiye sahip olmadıkları ileri sürülmüştür. Bu çalışmada kilit özelliği olan efemera kavramı üzerine odaklanmıştır. Efemeranın hem ekolojik hem de görsel yönlerinden kullanılabilir göstergeleri çeşitli örnekler vererek açıklanmaya çalışılmıştır. Bunlar arasında mevsimsel değişimle birlikte arazi örtüsü ve bitki örtüsünün varlığı döngüsel tarımsal faaliyetlerinin varlığı su derecesi ve belirli hava özelliklerinin varlığı yer almaktadır.

Anahtar Kelimeler: Görsel konsept, efemera, peyzaj kalitesi



BASIC VISUAL CONCEPT IN LANDSCAPE; EPHEMERA

ABSTRACT

Basically, landscape quality assessments refer to the key role of natural and cultural landscape elements in creating the satisfaction and aesthetic perception of the landscape. Visual landscape quality assessment has become an essential component of landscape architecture, landscape planning and spatial planning. Different approaches have been developed in recent years to evaluate the natural and cultural qualities of the landscape. Visual landscape quality assessment is a well-recognized field for scientific research with a substantial literature base. Ecosystems are constantly changing and this is not stable, periodic change is often considered an important part of the system. According to the review of landscape aesthetics literature; It has been demonstrated that seasons, weather or other temporary effects are important elements of the landscape experience, but also permanent features in the aesthetic potential of the landscape. The concept of ephemera is concerned with the short-term effects that contribute to landscape perception in response to year-round landscape changes and weather conditions. Colors have been found to have positive effects on preferences that value temporary changes in vegetation color. For example, it has been suggested that plants that are attractive during the flowering season do not have the same visual effect outside of the flowering season. This study focuses on the concept of ephemera, which is its key feature. The indicators that can be used from both ecological and visual aspects of ephemera are tried to be explained by giving various examples. These include the presence of land cover and vegetation with seasonal variation, the presence of cyclical agricultural activities, the presence of water grade and certain weather characteristics.

Keywords: Visual Concept, ephemera, landscape quality



1. GİRİŞ

Kapsamlı planlama sürecinde peyzaj planlaması, sosyal planlama ve ekonomik planlama ile beraber birkaç girdiden biri sayılmaktadır. Bu planlama türlerinde görsel peyzaj analizinden gelen girdiye ihtiyaç duyulmaktadır. Görsel kaynak yönetim planlarının geliştirilmesinde ilk adımlardan biri görsel peyzaj karakterinin tanımı ve sınıflandırılmasıdır. Görsel peyzaj kalite değerlendirmesi peyzaj mimarlığı, peyzaj planlama ve mekansal planlamanın temel bileşeni haline gelmiştir. Manzaranın doğal ve kültürel niteliklerini değerlendirmek için son yıllarda farklı yaklaşımlar geliştirilmiştir. Görsel peyzaj kalite değerlendirmesi önemli bir literatür tabanı ile bilimsel araştırma için iyi tanınan bir alandır.

Peyzajın estetik kalitesi birçok araştırmacıya göre genellikle peyzajın görsel kalitesi içinde temsil edilmektedir (Çakıcı 2007). Görsel yönleri hesaba katarak, çevrenin her geçen gün zenginleşmesiyle yaşam kalitesinin gelişmesi için olanak sağlanmaktadır. Bu zenginleşmiş çevreler pozitif bir estetik deneyim sağladığı kadar, restoratif ve ilham verici ortamlar sağlayabilir ve dolayısıyla zihinsel ve fiziksel sağlığa iyi yönde katkı sağlar. Dokunma, koklama ve sesleri de içeren estetik deneyimde, görsel bileşen önemli ve genellikle baskın olmaktadır (Ode and Fry, 2002).

“Görsel peyzaj kalitesi, gözlemcinin algısal ve duygusal psikolojik süreçleri ile etkileşim içinde olan belli (görünür) peyzaj özelliklerinin ortak bir ürünüdür. Çevrenin insan üzerindeki davranışa dönüşen bu etkisinin nasıl algılandığı nasıl yorumlandığı ve nasıl değerlendirildiği, görsel algılama süreci sonucunda oluşan "görsel peyzaj kalitesi" olarak tanımlanmaktadır. Görsel peyzaj kalitesi "bir peyzajın göreceli olarak estetik kusursuzluğu" olarak da tanımlanabilir ve gözlemcinin beğenisi aracılığı ile ölçülebilir.” (De La Fuente vd. 2006; Özgeriş ve Karahan 2015; Gültürk ve Şişman 2015). Bu ölçümlerden en önemlilerinden ve metodolojik olarak araştırılan görsel kalite değerlendirmesidir.

Peyzajın görsel değerlendirmesinde problemlerden biri, belli bağlı peyzaj öğelerinin görsel kaliteye etkilerinin belirlenerek, insanların neleri tercih ettiğinin önceden tahmin edilebilmesi için kapsamlı bir yöntemin geliştirilememesidir (Dinçer 2011). Tveit vd., (2006) tarafından peyzaj estetiği literatürünün bir incelemesi sonucu görsel kılavuzlarda ve araştırma literatüründe sunulan görsel manzaranın baskın yönlerini yansıtan dokuz anahtar kavramı tanımlanmıştır.

2. Görsel Karakter

Yıllar boyunca, peyzajın görsel kalitesini ve karakterini analiz etmek ve tanımlamak için çeşitli çerçeveler geliştirilmiştir (Lothian (1999; Zube vd., 1982). Peyzaj estetiği alanında, peyzaj algısını ve tercihlerini açıklamaya yönelik birkaç teori bulunabilir. Bunlar genel olarak evrim teorilerine (Appleton, 1975; Kaplan ve Kaplan, 1989) ve kültürel tercih teorilerine (Tuan, 1974; Carlson, 2001) ayrılabilir. Evrim teorileri, ortak evrimsel tarihimiz tarafından şekillendirilen görsel peyzaj tercihlerini açıklar ve hayatta kalma ve refahı artıran özelliklere olumlu yanıt verdiğimizizi iddia eder. Öte yandan tercihler, güzelliğin esas olarak bakanın gözünde olmasıyla, kültürel ve kişisel deneyimlerle şekillendirilmiş olarak açıklanır (Meinig, 1976). Son zamanlarda, bazı araştırmacılar, kültürel etkiler ve kişisel deneyimler tarafından genetik olarak değiştirilmiş ve değiştirilmiş peyzaj algısı ve tercihini açıklayan, en uygun olan bütünleştirici bir teorik çerçeveyi tartışmıştır (Hartig, 1993; Norton vd., 1998; Tveit, 2006). Fry vd., (2009) tarafından ortak evrimsel geçmişimiz nedeniyle kültürler ve kişisel farklılıklar arasında tercih edilen ortak bir manzara özellikleri kümesi olması doğru bulunmaktadır. Peyzaj tercihlerinde kültürel ve kişisel farklılıklar olsa da farklılıkları şekillendiren güçleri keşfetmenin yanı sıra



ortak yönleri belirlemek de yararlıdır. Bu, peyzaj planlaması ve yönetimine önemli katkılar sağlayabilir ve kavramsal bir yaklaşımdan görsel göstergelerin geliştirilmesi için temeldir.

Tveit vd, (2006) peyzajın görsel karakteri değerlendirmek için şeffaf ve teori temelli bir çerçeve belirlemeye çalışmışlar. Çerçeve, manzaraları ölçmemize ve karşılaştırmamıza yardımcı olabilecek görsel göstergelerin oluşturulmasında ve peyzaj değişiminin görsel karakter üzerindeki etkilerinde yararlı ilk adım olmuştur. Çerçevede dokuz temel görsel kavram; yönetim, tutarlılık, rahatsızlık, tarihsellik, görsel ölçek, görüntülenebilirlik, karmaşıklık, doğallık ve efemera'dan oluşmaktadır. Bu dokuz temel görsel konsept görsel boyutları, boyutlara katkıda bulunan fiziksel manzara özellikleri ve nihayet haritalanabilir ve ölçülebilir görsel göstergeler aracılığıyla tanımlanmaktadır.

Bu kapsamda yapılan çalışmada dokuz temel görsel konseptten kilit özelliğe sahip olan efemera kavramına odaklanmıştır. Efemeranın hem ekolojik hem de görsel yönlerinden kullanılabilir göstergeleri çeşitli örnekler vererek açıklanmaya çalışılmıştır. Bunlar arasında mevsimsel değişimle birlikte arazi örtüsü ve bitki örtüsünün varlığı döngüsel tarımsal faaliyetlerinin varlığı, su derecesi ve belirli hava özelliklerinin varlığı yer almaktadır.

3. Efemera

Efemera, bir sistemdeki mevsimsel değişimin derecesini ifade etmektedir. Görsel yönler için efemeranın, restoratifliğin değerlendirilmesi için önemli olan hayranlık algısına katkıda bulunduğu inanılmaktadır (Kaplan ve Kaplan, 1989). Kaplan ve Kaplan, arazideki geçici etkilerin ve özelliklerin peyzaj deneyiminin 'uzakta olma' yönünü geliştirdiğini öne sürmektedir. Efemera için önemli görsel göstergeler, yansıtılan görüntülerin varlığını içermektedir.

Ekosistemler sürekli değişmekte ve istikrarlı değildir (Turner vd., 2001). Geçici değişiklikler veya döngüsel değişiklikler, türlerin adapte edildiği periyodik varyasyonların örnekleridir (Forman ve Godron, 1986). Periyodik değişim genellikle sistemin önemli bir parçasıdır. Bu değişikliklere uyum sağlama yeteneği, organizmanın genetik hafızasıyla ilişkilendirilebilir (Forman ve Godron, 1986). Geçici değişiklikler, ekosistem koşullarını ve habitat koşullarını etkileyen büyük hava ve mevsimsel değişikliklerdir. Bu tür değişiklikler, ekosistemler için dengeleyici bir güçtür (Turner vd., 2001). Spesifik ekolojik göstergeler arasında sıcaklık ve gıda bulunabilirliği bulunur (Tablo 1). Efemera için hem ekolojik hem de görsel yönleri tanımlamak için kullanılabilir göstergeler vardır. Bunlar arasında döngüsel çiftçilik faaliyetlerinin varlığı, mevsimsel değişimle birlikte arazi örtüsü, bitki örtüsünün varlığı, su derecesi ve belirli hava özelliklerinin varlığı yer almaktadır.

Tablo 1. Ephemera kavramını boyutlar, peyzaj nitelikleri ve hali hazırda uygulanan göstergelerle gösteren hiyerarşik bir çerçeve (Fry vd., 2009).

Efemera						
Görsel		Genel			Ekolojik	
Mevsimsel değişiklikler		Hava ile ilgili değişiklikler				
Su	Arazi Kullanımı	Arazi Örtüsü/ Bitki Örtüsü	Hava Karakteristiği		Habitat Durumu	
Öngörülen ve yansıtılan görüntüler	Döngüsel çiftçiliğin varlığı	Mevsimsel değişim ile arazi örtüsü/Bitki örtüsünün varlığı	% Su Alanı	Su Karakteristiğinin Varlığı	Sıcaklık	Yiyecek Mecburiyeti

Peyzaj estetiği literatürünün incelemesine göre; mevsim, hava durumu veya diğer geçici etkilerin peyzaj deneyiminin önemli unsurları olduğu, aynı zamanda peyzajın estetik



potansiyelinde kalıcı özellikler olduğu ortaya konulmuştur. Efemera kavramı yıl boyunca peyzaj değişiklikleriyle ve hava şartlarına cevap olarak peyzaj algısına katkıda bulunan kısa vadeli etkiler ile ilgilidir. Renklerin ve bitki örtüsü rengindeki geçici değişikliklere önem veren tercihler üzerinde olumlu etkileri olduğu bulunmuştur.

Litton (1972) bunları yakalamak için 'zaman değişkenliği' terimini kullanır; onları " belli bir zamanda meydana gelen doğal olayların etkisi, o anın karakteristiği olan görsel bir ürün üretiyor " olarak tanımlamaktadır. Pachaki (2003) bu gibi unsurları "özel efektler" adı altında tanımlamıştır. Trent ve diğ. (1987), geçici olayların peyzaj deneyiminin önemli unsurları olduğunu, aynı zamanda peyzajın estetik potansiyelinde kalıcı özellikler olduğunu iddia etmişlerdir. Renklerin ve özellikle çeşitli renklerin, bitki örtüsü rengindeki geçici değişikliklere önem veren tercihler üzerinde olumlu etkileri olduğu bulunmuştur (Hands ve Brown, 2002). Özellikle çiçeklerin, tercihler üzerinde olumlu etkileri olduğunu bulunmuştur (Akbar ve diğerleri, 2003), ancak Jorgensen vd., (2002), çiçeklenme mevsimi boyunca çekici olan bitkilerin, çiçeklenme mevsimi dışında olumsuz görsel etkiye sahip olabileceğini ileri sürmüştür. Sis ve kar gibi hava ile ilgili elementler geçici elementler olarak da tanımlanmaktadır (Tveit vd., 2006).

Su, hava, mevsimlere bağlı değişik görseller oldukça farklı ifadeler verdiği için efemera kavramının kilit bir özelliğidir. Bir göl, bitki rengini yansıtarak sonbaharda renk efektlerini artıracaktır; Rüzgârda dalgalanması veya kışın donması nedeniyle yüzeyi değişecektir. Litton vd., (1974) ifade ettiği gibi " . . . rüzgâr, dalga hareketi ve ışıkla değiştirilen yansıtıcı desenler ve hem gökten hem de tabandan çıkan renk desenleri, suya cazibesini veren başlıca dokusal niteliklerden bazılarıdır."

Mevsimsel değişim ve gece-gündüz değişimi ile birlikte arazi örtüsü, bitki örtüsünün varlığı, döngüsel tarımsal faaliyetlerinin varlığı, su derecesi ve belirli hava özelliklerinin varlığına bağlı olarak zengin peyzajlar ortaya çıkmaktadır. Peyzajda temel görsel konseptlerden biri olan efemera çerçevesinde zengin ve ilgi çekici peyzaj görsellerin izlenmesine olan talep aynı zamanda turizmi harekete geçirerek cazip aktiviteleri içinde önemli yere sahip olmaktadır. Bu bağlamda birkaç örnek aşağıda yer almaktadır.

4. Hava ile ilgili değişiklikler

-Kuzey ışıkları: bir doğa harikası olayı Kuzey Işıkları, "Auroralar", Güneş'in Korona tabakasından oluşmaktadır. Dünyanın manyetik alanı, güneş rüzgarında akan bazı parçacıkları yakalar. Bir kez yakalandıklarında, bu parçacıklar manyetik alan çizgileri boyunca dünyanın kutup bölgelerine doğru spiral oluşturarak bu süreçte hız ve enerji kazanırlar. Bu parçacıklar dünya atmosferinde belirli gazlarla çarpıştığında, enerjinin bir kısmı ışığa dönüştürülür. Üretilen ışığın rengi, ilgili molekülün tipine bağlıdır (Aro, 2006).

Bu ışımalar, ağırlıklı olarak kutuplarda meydana geldiği ve kutuplara yakın alanlardan gözlemlendiği için kutup aurorası veya kutup ışıkları olarak da anılır. Bu doğa olayı Kuzey Işıkları turizmini meydana getirmesine yol açmıştır. Dünyada gökyüzü kamera ağlarını kullanarak kuzey ışıklarının izlenmesi birkaç noktadan mümkündür.

Svalbard, Norveç: Svalbard'ın Arktik bölgenin içinde yer alan adada Kasım ve Şubat ayları arasında kuzey ışıklarını gözleme şansı yüksektir (Şekil 1).

Kakslauttanen, Finlandiya: Laponya'nın Finlandiya sınırları içinde kalan bölgede Kuzey Işıkları izlenebilmektedir (Şekil 1).



Şekil 1. Svalbard, Norve (Sol), Kakslauttanen, Finlandiya (Sağ)

Jukkasjärvi, İsveç: Kiruna Bölgesi'ndeki Jukkasjärvi Köyünde Kuzey Işıkları'nı izlemek için gece turları düzenlenmektedir (Şekil 2).

Reykjavik, İzlanda: Bu alan Kuzey Işıkları'nın görülebildiği birçok bölge içermesiyle de Aurora izlemek için bir seçenektir (Şekil 2).



Şekil 2. Kuzey ışıkları Jukkasjärvi/İsveç (Sol), Reykjavik, İzlanda (Sağ)

Hava ile ilgili değişiklikler/Gün batımı: Floransa (İtalyanca: Firenze), İtalya'nın Toskana bölgesinin başkenti ve Rönesans'ın doğum yeri olarak kabul edilen önemli bir sanat şehri. Katedral (Duomo) birçok şehirde olduğu gibi Floransa'da da şehrin en önemli sembolüdür (Anonim, 2021a). Katedralin en iyi görüldüğü izleme noktaları, hemen katedralin yanında bulunan Giotto'nun Çan Kulesi, Michelangelo Meydanı ve buradan 6-7 dakika daha yürüme mesafesinde bulunan ve katedrale daha uzak ama manzaraya daha hakim Piazzale San Miniato Al Monte Bazilikası. En güzel manzaralar güneş ışınlarının yeryüzüne daha yumuşak bir açıyla geldiği ve gökyüzünde harikalar yarattığı gün batımı saatlerinde izlenebilmektedir (Şekil 3). Bu görseli izlemek için ilgili alanda bazen izdiham yaşanma bilmektedir.



Şekil 3. Floransa/ İtalya'da Katedralin gün batımı manzarası

Hava ile ilgili değişiklikler/Gün batımı ve doğuşu: Adıyaman'ın Kâhta ilçesinde, 2 bin 206 metre yükseklikte yer alan Nemrut Dağı 1987'de UNESCO tarafından Dünya Mirası ilan edilen Nemrut Dağı, 1988 yılında tesis edilen Nemrut Dağı Millî Parkı ile korumaya alınmıştır. Nemrut Dağı, tüm kültürleri buluşturmak isteyen Kommagene Kralı I. Antiochos'un başka kültür tanrılarını heykelleri ve kabartmalarıyla bir araya getirmektedir (Anonim, 2021b). Sadece eserleriyle değil özellikle eşsiz gündoğumu ve günbatımı manzaraları ile her sene çok sayıda ziyaretçiyi ağırlamaktadır (Şekil 4).



Şekil 4. Nemrut Dağında/Türkiye'de Gün Batımı (Sol)- Gün Doğumu (Sağ)

Hava ile ilgili değişiklikler/Astro-turizm: Son yıllarda amatör astronomi, turizm endüstrisinin en popüler dallarından biri haline gelmiştir ve astronomik turizm adı altında ilgili kişilerin dikkatini çekmiştir. Bu nedenle son yıllarda bu kategori bilim alanının dışına çıkarak bulduğu ölçüde turizm sektörüne de yayılmıştır (Karaca vd., 2018).

Astro-turizm İran'da gerçekleşme potansiyeline sahip en heyecan verici olanlardan biridir. Bu alanla ilgili peyzajın efemera konseptini İran çöllerinin gece saatlerinde deneyimlemek mümkündür (Şekil 5). Gökyüzünü ve yıldızları gözlemlemek ve olağanüstü fotoğraflar oluşturmak isteyen doğa fotoğrafçıları için belli çöllerde geceler eşsiz ortamlara sahiptir (Anonim, 2021c). Efemera bağlamında aynı alan gece saatlerinde daha etkin ve cazip görsele sahip olup ayrıca bu saatlerde turizme hareketlilik getirmektedir.



Şekil 5. Çölde/İran'da gökyüzünü ve yıldızları gözlemlemek

Mevsimsel değişiklikler/Buz ve kar manzaraları: Görsel estetik özelliklerinden, buz ve kar manzarası ile vizyon arasındaki ilişki ve buz ve kar manzarasının görsel tasarım yöntemi, soğuk şehirlerde buz ve kar peyzaj tasarımının görsel estetik etkisi Sun vd., (2020) tarafından verilmiştir. Kış aylarının soğuk havalarda Kars'ın Sarıkamış ilçesi, Erzurum, Van gibi bölgelerde kar manzaraları eşsiz görselleri sunmaktadır. Doğu Ekspresi; Ankara'da başlayan ve Kars'ta biten, masalsi manzaralar sunan kompartımanlı tren yolculuğuna deniyor. Türkiye'nin en uzun tren yolculuklarından biri olması, kış aylarında özellikle genç kitle arasında popülerliği ve seyahatin eğlenceli geçmesi, Doğu Ekspresi'nin tercih edilmesini sağlamaktadır. Bu yolculuk için kış mevsiminde bilet bulmakta sıkıntı yaşanırken yaz mevsiminde rağbet görmemektedir (Şekil 6).



Şekil 6. Kış manzaraları Kars'ın Sarıkamış İlçesi/Türkiye (Sol), Doğu Ekspresi (Sağ)

Mevsimsel değişiklikler/ Bitki Örtüsü: Isparta İlinin Keçiborlu İlçesi'ne bağlı Kuyucak Köyü'ndeki Lavanta Vadisi son yıllarda yerli ve yabancı turistlerin ilgisini çekmiştir. Yurtiçi ve yurtdışından ziyaretçilerin köydeki lavanta tarlalarında lavanta odaklı fotoğraf çekimlerine olan rağbet tespit edilmiştir. Bu durumun bölge geneline ekonomik anlamda da olumlu etkileri görünmektedir (Ongun vd., 2018). Alan Haziran ve Ağustos ayları arasında çiçek açan lavantalar sayesinde daha cazip görseller sergilemektedir (Şekil 7). Ayçiçeği ve gelincik tarlalarında da çiçekli dönemlerde benzer şekilde daha dikkat çektiği bir dönem olmasına yol açmaktadır.



Şekil 7. Lavanta tarlası Isparta/Türkiye (Sol), Tekirdağ /Türkiye (Sağ)

Mevsimsel değişiklikler/Su: Yoğun sodalı Van Gölünde yaşamını sürdürebilecek özelliklere sahip endemik bir tür olan İnci Kefali (Van balığı) üreme göçü sırasında olağan dışı görüntüler meydana gelmektedir (Oto, 2020). Yerli ve yabancı turistlerin üreme dönemi olan 15 Nisan-15 Temmuz tarihleri arasında neslini sürdürmek için tatlı sulara göç etmelerini ilgiyle takip ettiği görsel şölen olarak dikkat çekmektedir. İnci kefali akıntıya karşı sıçrayarak zorlu bir göç mücadelesi verme görselleri doğa şölenleri turizm çekiciliğini de arttırmaktadır (Şekil 8).

Mevsimsel değişiklikler/Su: Van Gölü Havzasının kuş göç yolu üzerinde bulunması, Erçek Gölünü de ornitolojik açıdan oldukça önemli kılmaktadır. 1-2 m uzunluğunda, tüyleri beyaz ve pembe, kanat uçları siyah olan Flamingolar Güney Avrupa, Afrika, Asya ve Amerika'da yaşamaktalar (Çetin vd., 2018; Anonim, 2021d). Her yıl düzenli olarak Nisan ayında alana gelip Kasım ayına kadar kalan ve burada beslenen flamingoların sayısı bazı yıllarda 10.000'e ulaşmaktadır. Ekim ayının ortalarında düzenlenen "Doğunun Kanatları Erçek Gölü Flamingo Festivali" flamingoların kendine has renk özelliklerinin kattığı görsellik güzel görüntülere sahne olarak ziyaretçilerin bu mevsimlerde dikkatini çekmektedir (Şekil 8).



Şekil 8. Balık göçü, Erciş/Türkiye (Sol), Flamingolar, Erçek Gölü/Türkiye (Sağ)

5. SONUÇ

Peyzaj estetiği literatürünün incelemesinde, görsel kılavuzlarda ve araştırma literatüründe sunulan görsel yapının baskın yönlerini yansıtan dokuz anahtar kavramı tanımlamıştır. Bu çalışmada görsel peyzaj yapısını tanımlayan bu kavramlardan efemera kavramına



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odaklanmıştır. Efemera; yıl boyunca mevsim, hava durumu veya diğer geçici etkilerle ilgili değişiklikleri ifade etmektedir. Çeşitli geçici etkilerden ileri gelen peyzaj çekiciliklerini bitki örtüsü, arazi örtüsü, su varlığı, çeşitli tarımsal faaliyetler sonucu ortaya çıkan görsellerde izlemek mümkündür. Bildiride hava değişimi ile ilgili değişiklikler ve mevsimsel değişikliklerden dolayı farklı peyzajlarda meydana gelen çekici görsel etkilerden örnekler verilmiştir. Aynı ekosistem, arazi örtüsü, gök yüzü, bitki örtüsü, su varlığı, tarımsal arazi ve tarihi alanlar dahi efemera etkisiyle belirli dönemlerde çok ilgi çekici olabiliyorken bunun dışındaki dönemlerde dikkat çekmediği ortaya çıkmaktadır. Peyzajın bu önemli temel görsel konseptinden yola çıkarak yıl boyunca farklı zamanlarda geçici etkilerle ortaya çıkan kaliteli manzaraların; peyzaj planlamada ve yönetiminde kullanması büyük değer taşımaktadır. Manzaranın doğal ve kültürel niteliklerini efemera etkisiyle birlikte değerlendirmek peyzaj planlama ve mekansal planlamada görsel kaynak yönetim planlarının geliştirilmesinde temel bileşeni haline gelerek önemli rol alacağı düşünülmektedir.



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İLKÖĞRETİM OKUL BAHÇELERİ VE ÇOCUKLAR

Yüksek Lisans Öğrencisi Aygül ÇİÇEKDENK

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ÖZET

Günümüzde hızlı nüfus artışı, sanayileşme, sağlıksız kentleşme nedeniyle çocuklar; iklim değişikliğinin yaşandığı, doğal kaynakların azaldığı, verimli toprakların yok olduğu insanların sağlığını tehdit eden çok fazla çevre sorunlarının olduğu bir dünyada doğmaktadır. Nüfus yoğunluğunun yarattığı çarpık kentleşme, arabaların yarattığı yoğun trafik nedeniyle çocukların başta sokaklar olmak üzere oyun alanlarının neredeyse çoğunu kaybetmişlerdir. Literatürdeki mevcut birçok çalışma, bireylerin yetişkinlik çağlarında sahip oldukları kalıcı alışkanlıkları, davranışları ve düşünceleri çocukluk döneminde kazandıkları bulguları ortaya koymaktadır. Okul çağındaki çocukların günün büyük bir bölümünü okulda geçirdikleri dolayısıyla en fazla etkilendiği çevresini oluşturduğu göz önünde bulundurulursa özellikle ilköğretim okul bahçelerinin çocukların gelişimi üzerinde büyük rol oynadığı gerçeğinin önemi ortaya çıkmaktadır. Okulların gerekli standartlarda olması çocuklara psikolojik, fiziksel ve sosyal açıdan olumlu etkiler sunmaktadır. Bu nedenle ilköğretim okul bahçeleri çocukların daha rahat hareket ettiklerine, iletişim kurma becerilerinin geliştiğine, farklı tecrübeler edindiklerine, doğa-insan ilişkisinin kalıcı olarak kurulabilmesine, hayal güçlerinin gelişmesine zemin hazırlayacak ilköğretim okul bahçeleri tasarımı günümüzde önemli çalışma konularından birini oluşturmaktadır. Bu bildiride ilköğretim okul bahçelerinde çocukların gelişimine katkı sağlayacak, çocukların eğlendikleri, eğlenirken öğrendikleri, akranlarıyla iletişim kurabileceği, keşif yapabilecekleri, hayal gücünü geliştirecek okuldaki zamanlarının daha verimli geçmesini sağlayacak tasarımlar yapılmasının önemi üzerinde durulmuştur. İlköğretim okul bahçelerinin çocuklar üzerindeki rollerine odaklanarak dünyadaki ve Türkiye'deki ilköğretim okul bahçelerinden peyzaj uygulama örnekleri verilmiştir. Bu bahçelerin peyzaj tasarım konseptlerinde oluşturulan aktivite alanlarına değinilmiştir. Sonuç olarak ilköğretim okul bahçelerinin tasarımına yapı kadar önem verilmesinin gerektiği ortaya konulmuştur.

Anahtar Kelimeler: Okul bahçeleri, peyzaj uygulamaları, aktivite alanları



PRIMARY SCHOOL GARDENS AND CHILDREN

ABSTRACT

Today, due to rapid population growth, industrialization and unhealthy urbanization, children; They are born in a world where climate change is experienced, natural resources are depleted, fertile lands are destroyed, and there are many environmental problems that threaten the health of people. Due to the unplanned urbanization created by the population density and the heavy traffic created by the cars, the children have lost almost most of the playgrounds, especially the streets. Many existing studies in the literature reveal the findings of the permanent habits, behaviors and thoughts that individuals have in their adulthood, gained in childhood. Considering that school-age children spend most of the day at school and therefore the environment they are most affected by, the importance of the fact that the primary school playgrounds play a major role in the development of children becomes evident. The fact that the schools are at the required standards has positive effects on children psychologically, physically and socially. For this reason, primary school garden design is one of the important study topics today, which will prepare the ground for children to move more freely, to develop their communication skills, to gain different experiences, to establish a permanent nature-human relationship, and to develop their imaginations. In this paper, it is emphasized the importance of making designs that will contribute to the development of children in primary school gardens, where children have fun, learn while having fun, communicate with their peers, make discoveries, develop their imagination, and make their time at school more productive. By focusing on the role of primary school gardens on children, landscape application examples from primary school gardens in the world and in Turkey are given. The activity areas created in the landscape design concepts of these gardens are mentioned. As a result, it has been revealed that the design of primary school gardens should be given as much importance as the building.

Keywords: School gardens, landscape applications, activity areas



1. GİRİŞ

Doğa bütün canlılar için önemlidir. Tarih boyunca sürekli ilişki içinde olduğumuz son zamanlarda ise kentleşme, çevre kirliliği gibi etmenlerden kaynaklı kopmalar yaşadığımız doğa aslında çocukluktan bütün gelişmelerimizi etkiler. Yetişkinlikte sahip olduğumuz tüm alışkanlıklar, çocukluk döneminde kazandığımız alışkanlıklardır. Bunun için de çocuklukta doğa ile iç içe yaşamak çok önemlidir. Günümüzde kentleşmenin artması yeşil alanların azalması nedeniyle çocukların başta sokaklar olmak üzere neredeyse oyun oynayacakları alanlar kalmamıştır. Birçok mahallede okul bahçeleri okul sonrası çocukların güven içinde oyun oynadıkları alanlar olarak belirtilmiştir. Hele ki kentleşmenin yoğun olduğu alanlar da çocukların doğayla hiçbir iletişiminin yoktur. Bu nedenle doğayla iletişim kurabilmeleri, doğaya karşı olumlu davranışları çocuk yaşta kazanabilmeleri için hayatlarının uzun bir dönemini okulda geçirdikleri göz önüne alınarak doğa ile ilişki kurabilecekleri okul bahçeleri tasarlanmalıdır.

Açık havada öğrenmenin hem akademik yükselme hem de zihinsel olarak çocukları iyileştirdiği bilinmektedir. Bu nedenle dünyanın dört bir yanındaki okullar açık havada öğrenmeyi müfredatlarına eklemişlerdir. Özellikle 2020 yılı başından itibaren bütün dünyayı etkisi altına alan Covid 19 pandemisinde bu alanların önemi giderek artmıştır. Bunun yanı sıra Covid 19 pandemisinde insanların kent ortamlarındaki yeşil alanlara olan ihtiyacı daha fazla artmıştır. Eşbah ve Eşbah, (2020)' ye göre klasik sağlıklı şehir modeli peyzaj mimarlığı disiplini ve diğer planlama ve tasarım disiplinlerinin temel amacı olan daha yaşanabilir ve sağlıklı çevre oluşturma eylemini odağına almaktadır. Kent içindeki sağlıklı çevreleri koruma, bağlantılandırma ve desteklemeyi özendirir ve disiplinler sektörler arası birliklerini gerektirir.

Genel Kavramlar

1.1. Eğitim sistemi ve okulun tanımı

Okul her bireyin çocukluk ve gençlik dönemlerinde hayatlarının önemli bir kısmını oluşturan yapılardır. İnsanların hayatlarının önemli bir kısmını geçirdikleri bu mekanların fiziki koşullara uygun olması önemlidir. Bir ülkenin teknolojik ve ekonomik olarak ilerlemesinde en büyük faktör insan faktörüdür. Bu ilerlemelerin oluşması için öncelikli olarak insan faktörünün eğitilmesi yetiştirilmesi gerekir. Buna da eğitim sistemi denir (Karasolak, 2009).

Türkiye'nin eğitim sistemi; 24/6/1973 tarih ve 14574 sayılı Resmi Gazete'de yayınlanan 1739 sayılı Millî Eğitim Temel Kanunu ile belirlenmiştir. Bu kanuna göre ilköğretim okulları 6-13 yaşındaki çocukları kapsar.

1.2. İlköğretim okullarının amaçları

- Çocukların kendilerini ifade ettikleri, sorumluluk alabildikleri, çevrelerine ve kendilerine faydalı olabilecekleri etkili ve verimli eğitim ortamı yaratmak.
 - Aile ve çevre desteğini sağlayan programlar uygulamak
 - Çocukların içinde buldukları topluma uyum sağlamaları için beceriler kazandırmak
- Yorgancılar (2010).

1.3. Okul alanları için yer seçimi

Eğitim kurumlarının planlanmasında en önemli nokta yer seçimidir. Özellikle küçük yaş gurubu olan anaokulu, ilkokul ve orta okul öğrencileri için büyük önem taşır. Çocukların evden okula, okuldan eve güvenli bir şekilde gitmeleri için yer seçimine dikkat edilmelidir (Vural, 2016).

Türkiye Eğitim Yapıları Asgari Tasarım Standartları Kılavuzu (2015)'na göre yer seçimi kriterleri

- Yerleşim yerlerine yakın, mekânsal planlama yönetmeliğine göre mesafelere uyulması gerekir



- Trafik yoğunluğundan uzak olmalı
- Toplu taşıma ile kolay erişilebilir olmalı
- Gürültünün fazla olduğu yerlerden uzak olmalı (demiryolu, otoyol, havalimanı vb.)
- Çöp, kanalizasyon kokusu gibi çevre şartlarının kötü olduğu alanlardan uzak olmalı
- İleriki dönemlerde gelişime açık bölgeler seçilmeli

1.4. Okul bahçelerinin tanımı

Okul bahçeleri; çocukların günün büyük çoğunluğunu geçirdikleri, spor yaptıkları, arkadaşlıklar edindikleri, sosyalleştikleri alanlar olarak tanımlanmaktadır. (Yürük, 2020). İyi veya kötü hangi şartlarda olunursa olunsun her çocuğun hayatının en önemli zamanları okulda geçmektedir (Nicholson, 1971). Şehir hayatının yoğun olduğu bölgede yaşayan çocukların doğal alanlara erişimi zordur. Okul bahçelerinin bir nebze olsa sebze- çiçek yetiştirme gibi eylemleri sunması çocuğun doğa ile ilişkisine yardımcı olur (Laaksoharju ve Rappe 2010).

1.5. Okul bahçelerinin önemi ve yer verilmesi gereken alanları

Günümüz şartlarında çocuklar için en iyi çevre okul ve okul bahçeleridir. Özellikle sınırlarının çevrili olması çocuklar için güvenilir ortamlar sağlar. Bunun yanı sıra okullar kamusal alanlar olduğundan güvenlik açısından denetim altındadırlar. Okul sonrasında da çocukların birlikte oyun oynadıkları, iletişim kurup sosyalleştikleri alanlardır (Güneroğlu vd, 2018).

Okul bahçeleri doğru bir şekilde tasarlandığında çocuklara spor, eğitim, sosyal aktivite, sosyal ilişkiler konusunda imkan sağlamakta böylece bir çok alanda çocukların gelişimine katkı sağlamakta (Önder ve Akay, 2016). Mallone ve Trater (2003)'e göre yapılan çalışmalar sonucunda doğal peyzajla tasarlanan okul bahçelerinde vakit geçiren çocukların daha yaratıcı, bir şeyleri kavrama ve öğrenmeleri daha kolay, okuldaki başarı oranları yüksek, çevreleriyle olan ilişkilerinin daha kuvvetli olduğu belirtilmiştir (Tandoğan, 2016).

Vural (016) ve Erdönmez (2006)' ya göre okul bahçelerinin işlev alanları;

- Dinlenme Amaçlı Alanlar
- Bedensel ve Ruhsal Gelişim Amaçlı Alanlar
- Eğitim Amaçlı Kullanım Alanları
- Diğer Alanlar

1.5.1. Dinlenme amaçlı kullanım

• Teneffüs ve tören alanları

Öğrencilerin ders dışında teneffüs ve tören için kullandığı alanlardır. (Neufert, 2000) 'e göre teneffüs ve tören alanlarının büyüklüğü en az 400 m² olmalı kişi başına ise en az 5 m² alan düşmeli (Erdönmez, 2006). Sesten dolayı dersliklerden uzak, doğa koşullarına uygun kaymaz zemin olmalıdır. Gölgeleme yapması için çevresine ağaç dikilmeli

• Dinlenme alanları

Oturma alanları ise hem öğrenci hem de öğretmenlerin zaman geçirebilecekleri dinlenebilecekleri açık veya kapalı oturma alanları olmalıdır.

1.5.2. Bedensel ve ruhsal gelişim

• Spor alanları

Okul bahçelerindeki tırmanma, atlama, koşma, spor etkinlikleri çocukların bedensel gelişiminde etkilidir. Spor alanları çocukların boş vakitlerini değerlendirecekleri alanlar olarak da tasarlanmalıdır (Tablo 1).



Tablo 1. İlköğretim okulu bahçelerindeki bazı spor amaçlı oyun sahası boyutları (Neufert, 2000).

Oyun sahası	Alan boyutları		
	En fazla	En az	Standart
Futbol sahası	120*90	90*45	
Mini futbol sahası	--	-	70*50
Basketbol	28*15	24*13	26*14
Hentbol	110*65	90*55	
Voleybol			18*9
Küçük hentbol	22*44	18*38	20*40
Tenis(tek)	-	-	23,77*10,97
Tenis (Çift)	-	-	23,77*8,23
Küçük tenis	-	-	12,20*5,50
Tekerlekli paten	20*20	10*10	-
Kriket oyun sahası			20*40

• Oyun alanları

Çocukların gurup çalışmaları, takım oyunları, arkadaş edinme sosyal gelişiminde etkilidirler. Oyun sadece eğlence amaçlı değil çocuğun gelişim süreci için de çok önemlidir. Parklar dışında okul bahçelerinde seksek, körebe, mendil kapmaca gibi geleneksel oyun alanları da tasarlanmalıdır. Okul bahçelerinde oyun alanları tasarlanırken 7-12 arasındaki çocuklar göz önüne alınarak tasarım yapılmalıdır (Erdönmez, 2006). Şekil 1’de okul bahçelerinde olabilecek çizgisel oyun alanları gösterilmiştir.

1.5.3. Eğitim

• Açık hava dersliği



Şekil 1. Okul bahçelerinde yapılabilen çizgisel oyun örnekleri (Anonim 2021).

<https://tr.pinterest.com/aytulay/yere-%C3%A7izilen-oyunlar/>

Yapılan çalışmalar öğrencilerin; fizik, biyoloji, dil bilgisi, matematik ve diğer becerilerini dış ortamda çevreleriyle bütünleştirdiğinde daha fazla istekli ve daha iyi öğrendiklerini göstermektedir. Frontiers in Psychology dergisindeki çalışmaya göre, çocukların açık havada işlenen derslerde ilgi ve odaklarının daha fazla olduğu hatta dersten sonra sınıf ortamındaki derslerde de daha odaklı oldukları belirlenmiştir.



Açık hava derslikleri çocukların açık havada doğayla baş başa olabilecekleri Şekil 2' de görüldüğü üzere çevresi duvar gibi yapısal materyallerle kapalı olmayan alanlar olarak tasarlanmalıdır (Erdönmez, 2006).



Şekil 2. Açık hava dersliği örneği (Anonim 2021, <https://yucelbinici.com/acik-hava-dersleri-basariyi-artiriyor-mu/>)

- **Botanik ve zooloji bahçeleri**

Botanik ve zooloji bahçeleri çocukların hayvan ve doğaya karşı bilinçlenmesi için önemli alanlardır. Bu bahçeler için 500-1000 metre karelik alanlar yeterli olacaktır. Bu alanlarda çocuklar hem bitki ve hayvanları tanıyıp öğrenecek hem de yetişmelerine katkıda bulunacaklardır. Bu da çocuklarda için doğa bilincinin oluşması ve sorumluluk sahibi olmasını sağlamaktadır (Erdönmez, 2006).

- **Uygulama bahçesi**

Çocukların derslerde öğrendiklerini uygulamak için kullanılan önemli alanlardır. Bu alanda çocuklara sebze, meyve ve çiçek yetiştirme olanakları sağlamaktadır. Bu alar rüzgar almayan, güneşli alanlar olmalıdır. Ersoy (1994)' a göre her okul bahçesinde en az 200 metre kare en fazla 1000 metre karelik alanda uygulama bahçesi oluşturulmalıdır (Vural, 2016). Nun ve Kazım Orbay İlkokulu uygulama bahçeleri Şekil 3' de verilmiştir.



Şekil 2. Nun okulları ve Kazım Orbay İlkokulunda uygulama bahçeleri örnekleri



- **Özel bahçeler**

Hobi amaçlı kurulan bahçelerdir. Genellikle kuş bahçesi, kelebek bahçesi, böcek oteli, çiçek bahçesi örnek olarak verilebilir. Satı Öztürk Okulu böcek oteli, Karaman İmaret İlkokulu kuş bahçesi örnekleri Şekil 4'te verilmiştir.



Şekil 3. Satı Öztürk ve İmaret Okulu özel bahçe örnekleri

1.5.4. DİĞER ALANLAR

- **Otopark**

Okul bahçelerinde öğretmen, veli ve misafirlerin araçları için otoparka ihtiyaç vardır. Bu otopark her derslik için 1 olmak koşuluyla misafirler içinde ekstra 3 ila 10 araçlık yer verilmelidir.

- **Çevreleme**

Okul bahçelerinin çocukların güvenliği göz önüne alınarak dış ortamla ilişkisinin kesilmesi için çevreleme yapılmalıdır. bu çevreleme beton, demir, tuğla vb. malzemelerden oluşmalıdır. Görüntü, ses, toz gibi kötü çevre koşullarını engellemek amacıyla duvar önlerine okul bahçeleri için uygun bitkisel tasarlanmalıdır (Vural, 2016).

2. OKUL BAHÇELERİ PLANLAMA İLKELERİ

- Kentin yeşil alan sistemiyle okul bahçesi birlikte düşünülmeli, okul bahçesinin yeşil alan sistemine katkı sağlayacak şekilde planlama yapılmalıdır.
- Betonlaşma ve insan popülasyonlarının yoğun olduğu bölgelerde daha fazla yeşil alan kullanılmalıdır.
- Ana okulu ve ilkokul bahçelerinde daha tesislere göre daha fazla yeşil alan kullanılmalı, ortaokul ve lise bahçelerinde ise tam tersi tesislerin yeşil alana göre daha fazla olması gerekir.
- Okul bahçelerinde çocukların sportif gelişimine katkı sağlamak için jimnastik, atlama, koşma gibi aktivite alanlarına fazla alan ayrılmalıdır.
- Açık hava dersliği veya amfi tiyatro alanları planlanmalı
- Öğretmenlerin kullanmaları için dinlenme alanları tasarlanmalı
- Özellikle biyoloji dersleri için hem bitki hem de hayvanların olduğu alanlar planlanmalı Okulların planlama aşamasında ilkelerin yanı sıra öğretmen, öğrenci, uzman görüşleri de alınmalıdır (Akdoğan, 1972).

3. OKUL BAHÇELERİNDE TASARIM STANDARTLARI

Eğitim Yapıları Asgari Tasarım Standartları Kılavuzu (2015)'na göre;

3.1. Sosyal alanlar ve kentsel dokular

Tören alanı, amfi tiyatro, satranç alanı, geleneksel oyun alanları, dinlenme amaçlı ayrılmış oturma yerlerini kapsar.



- Tören alanında Atatürk büstü, bayrak direği olmalı. Zemini düz malzemelerden yapılmalı.
- Amfi tiyatro alanı gerektiğinde 2 sınıfın aynı anda ders işleyebilecekleri büyüklükte, kötü hava koşulları dikkate alınarak üstü kapalı olmalı.
- Peyzaj düzenlemeleri içerisinde oturma alanlarının yanı sıra çöp kutuları, banklar, aydınlatma elemanları, bitkisel alanların da bulunması gerekir.
- Ana okulları için kum havuzları, küçük oyun gurubu alan için uygun bitkisel kullanılmalı.
- Zemin döşemeleri çocukların düşerken yara almayacağı yumuşak, darbelere dayanıklı kaygan olmayan, suyu çabuk çeken, toz tutmayan materyaller kullanılmalıdır. Asfalt, kilit parke taşı, plak taşlar okul alanlarında kullanılmaması gereken materyallerdir. Okul bahçelerinde çim alan, ağaç talaşları, sıkıştırılmış toprak, kauçuk daha çok tercih edilmelidir (Erdönmez,2007).

3.2. Spor alanları

- Okul bahçelerinde uygun büyüklükte her okulda bir basketbol bir voleybol sahası bulunmalı, duruma göre bir mini futbol sahası da yapılmalı.
- Sahalar kuzey- güney yönlü olmalı
- Saha kenarlarında oturma yerlerine yer verilmeli, yürüyüş yolları bulunmalı.

3.3. Gezinti ve yürüyüş yolları

- Gezinti yolları araç trafiği ile aynı olmamalı
- Yol kenarlarında bank, çöp kutusu, aydınlatma donatılarına yer verilmeli
- Gezinti yollarında arsanın eğimi en fazla % olacak şekilde ayarlanmalı
- Güvenlik nedeniyle tehlike yaratabilecek istinat duvarlarından kaçınılmalı
- Bahçe de merdiven kullanımında 3 basamaktan fazla basamak kullanıldığı durumlarda merdivene korkuluk yapılmalı

3.4. Giriş, servis ve itfaiye yolları

- Eğitim kurumlarında acil bir durum için 2 bir giriş kapısı yapılmalıdır.
- Giriş kapısında güvenliği sağlayacak giriş çıkış kontrollerini yapacak en az 3 metre karelik bir bekeçi kulübesi yapılmalıdır.
- Otopark alanları tören alanı ve öğrencilerin yoğunlukta olduğu bölgelerden uzakta planlanmalı
- Otopark alanlarının zeminleri normal yürüyüş alanlarında farklı bir renkte olmalı
- Otopark alanında en az bir engelli otoparkı bulunmalı

3.5. Bitki örtüsü

- Okullarda soğuk ve monoton hava yaratmamak için çok büyük asfalt ve beton alanlardan kaçınılmalı, peyzaj tasarımına uygun yeşil alanın çoğunlukta olduğu alanlar tasarlanmalı.
- Bölgenin iklim koşulları göz önünde bulundurularak bölgeye uygun bitki seçimi yapılmalı
- Seçilen bitkilerin zehirli veya öğrenciye zarar verecek nitelikte olmamasına dikkat edilmeli

4. Doğanın çocuk gelişimine etkisi

Geçmiş dönemlere göre günümüzde çocukların yaşamları farklılık gösterir. Günümüzdeki çocukların dışarıda oyun onama imkanları çok azdır. Çevresel sınırları farklı etkenlere bağlı olarak küçülmüştür (Francis, 1991). Clements (2004) 'in yaptığı bir çalışmaya göre 3-12 yaş arasında çocuğu bulunan annelerin %82 sinin çocuklarının açık havada oyun oynamalarını



istememektedir. Bunun en büyük nedeni olarak da güvenlik endişesini belirtmişlerdir (White, 2004).

Çocukların dış dünya ile ilişkilerinin neredeyse kopma noktasına geldiği bu zamanlarda çocukların doğayla ilişkilerinin kurulmasında doğaya karşı sorumlu, doğayı koruyan seven nesiller yetiştirebilme açısından okullar büyük fırsat oluşturuyor.

5.1 Fiziksel gelişime

Fjratof (2001)' a göre düzenli olarak doğal oyun alanlarında oyun oynayan çocukların, hareket kapasitelerinin daha geniş olduğu dengede kalma gibi koordinasyon gereken becerilerin daha gelişmiş olduğu ve çocuklarda hastalanma olanaklarının daha az olduğu belirtilmiştir (White, 2004). Yapılan bir çalışmada koşulları birbirine benzer iki okul seçilmiş ve bu okullardan birine doğal peyzajın yoğunlukta olduğu peyzaj tasarımı uygulanmış ve daha sonra yapılan analizle bahçesi doğal peyzaj olarak tasarlanan okulun öğrencilerinin diğer okul öğrencilerine nazaran psikolojik stres dereceleri daha az olduğu belirtilmiştir (Keltz ve ark, 2015).

5.2. Zihinsel gelişim

(Laaksorharju vd. 2012) Doğal ortamlarda zaman geçirmek; ayırt etme, gözlem gibi becerilerin gelişmesine çocuklarda bilişsel gelişime katkı sağlar. Doğal çevreler çocukların özgürce hareket etmeleri açısından önemlidir. Doğal çevrede oyun oynamaları çocukların dil, iş yapabilme becerilerini, iletişim becerilerini geliştirmenin yanında oynadıkları oyunlarla farklı şeylerle karşılaşma olasılıkları yüksek olduğu için hayal güçleri daha da gelişir (Kutlay, 2019). Fjortfort (2001)'e göre çocukların günlük dış ortamda doğaya çok fazla maruz kalmaları çocuklarda ilgi alaka ve doğa bilincini arttırmaktadır. Sabel, (2004) oyun alanlarında doğal yapılar ne kadar artarsa çocuklarına doğayı o kadar deneyimleyip takdir ettiğini belirtmiştir. Taylor ve ark. (2001) Dikkat eksikliği, hiperaktivite sorunu olan çocukların doğa ile temasta bulunmasının sonucunda daha konsantre oldukları görülmüştür. Doğa ile ilgisi veya teması olan çocukların konsantrasyon testlerindeki başarı puanları diğer çocuklara göre daha fazladır (White, 2004). Özetle doğa ile bağlantı içinde yaşayan çocukların becerileri, hayal kurmaları, çevreye bakış açıları açısından çocukların gelişimine büyük katkı sağlar.

5.3.Sosyal gelişim

Nussbauma (2011) doğal çevre çocukların hayvan, bitki, toprak gibi materyallerle etkileşimde olabileceği ve onlara karşı duyarlı olacağı tek yerdir. Doğada oyun oynayan çocukların grup çalışmaları, iş birliği gibi çalışmalar sonucunda daha iyi iletişim kurarlar.

(Laaksorharju ve ark. 2012) 'nun yaptığı çalışmada bir kampta öğretmenlerin gözlemleri sonucunda çocuklar arasında sosyal ilişkilerin arttığı, çocukların daha olumlu olduğu zaman ilerledikçe çocukların daha çabuk iş birliği içine girdikleri ve bu olanların doğada bulunmaları sayesinde gerçekleştiği belirtilmiştir. Çalışma sonucunda çocukların topladıkları ürünler herkese eşit olması konusunda çok hassas oldukları, aynı zamanda kendilerine olan güven duygularının arttığı da saptanmıştır. Çocukların doğal peyzajın için de çalışmaları kendilerini ifade etme, karşılıklı ilişki kurabilme, doğaya saygılı olma, grup çalışmalarında bulunma ve bir şeyleri hep birlikte yapabilme çocukların sosyal alanlarında gelişmelerine neden olur .

5. DÜNYADAN OKUL BAHÇELERİ

The Mount Junior school (İngiltere)

Şehir merkezinde olmasına rağmen büyük bir okul bahçesine sahiptirler. Okulun eski bir beton alanını yoğun bir çalışma sonrası sebze yetiştirme alanı olarak tasarlamışlardır. Genel olarak geri dönüşüm malzemeleri kullanarak bahçe tasarlanmıştır. Çocuklar hafta da bir gün hava şartları ne olursa olsun kesinlikle toplanıp çalışırlar. Yapılan bu çalışma sonrası ebeveynlerin



çocuklarının her türlü oyuncaklarını dışarı çıkarıp kendilerine ait bahçeler tasarlamak için çalışmaya başladıklarını bildirmişlerdir. Şekil 5' te bahçe ile ilgili görseller verilmiştir.



Şekil 4.The Mount Junior School bahçesi (Anonim 2021, <https://schoolgardening.rhs.org.uk/school-stories/the-mount-junior-school>)

Sipoonlahti okulu (Finlandiya)

Sipoonlahti okulu çok yönlü eğitim vermenin yanı sıra okul sonrası da çevre halkı tarafından kullanılan bir park niteliğindedir. 4 ana temaya ayrılmıştır; bilim, sanat, anlatım ve spor. Şekil 6'da okulun üstten görseli bulunmaktadır.



Şekil 5.Sipoonlahti Okulu (<https://www.archdaily.com/951701/sipoonlahti-school-extension-architects-rudanko-plus-kankkune>)



Kirkkojärvi school (Finlandiya)

Okul bahçesinde birden fazla açık mekan bulunmaktadır. Spor, oyun, tırmanma, dinlenme gibi bir çok aktivite alanı bulunmaktadır. Şekil 7’de kış aylarında çekilmiş fotoğraf yer almaktadır.



Şekil 6. Kirkkojärvi School (<https://www.archdaily.com/166597/kirkkojarvi-comprehensive-school-verstas-architects>)

Nightingale Primary School (İngiltere)

Bu okuldaki başlıca amaç sınıf dışında da eğitimin süreklilik sağlaması. Tasarımda konsept olarak vahşi yaşam seçilmiş ve öğrenci istekleri dikkate alınarak tasarlanmıştır. Şekil 8’ de de çocuklar için oluşturulan doğal ortam gösterilmektedir.



Şekil 7. Nightingale Primary School (<https://www.nightingale.redbridge.sch.uk/>)



6. TÜRKİYE'DE İLKOKUL BAHÇELERİ

• Nene Hatun ilkokulu

Bağcılar belediyesinin başlattığı okullar yenileniyor çalışmasında ilk olarak düzenlenen okul şekil 9' da verilen Nene Hatun İlkokuludur. Kitap okuma alışkanlığı kazanmaları için yeşil okuma alanı ve oyun oynarken öğrenme amacıyla geometrik şekillerden oluşan ve geleneksel oyunların yer aldığı oyun alanları tasarlanmıştır.



Şekil 8. Nene Hatun İlkokulu (Anonim 2021, <https://www.gazete365.com/bagcilar-da-okul-bahceleri-renkleniyor-ornek-uygulama/15913/>)

• Çalışkanlar ilkokulu

Ankara'da Okullar hayat olsun projesi kapsamında yapılan Çalışkanlar ilkokulunun bahçesi özellikle körebe, seksek, dokuz taş gibi geleneksel oyun alanları ile tasarlanmış. Çocukların bir arada disiplin içinde oyun oynamaları, yeni ders müfredatına giren oyun dersi içinde daha verimli, daha keyifli olması amaçlanmıştır. Şekil 10'da son hali bulunmaktadır.



Şekil 9. Çalışkanlar İlkokulu (Anonim 2021, <http://www.etkihaber.com/okul-bahceleri,-geleneksel-cocuk-oyunlari-ile-renklendi-164471h.htm>)

• Nun okulları



Öğrencilerin kendileriyle bütünleştiği doğayla iç içe, oyun oynarken hem öğrenmeyi hem de eğlenmeyi amaçlayan, her yaş grubuna hitap eden, çocukların gelişimine katkı sağlayacağı düşünülmüş geleneksel oyunların olduğu oyun alanları ile tasarlanmıştır. Şekil 11’ de bahçe ile ilgili görseller bulunmaktadır.



Şekil 11. Nun Okulları (<https://www.nunokullari.com/kampus/nun-ilkokulu-kampusu>)

7. SONUÇ

Okul bahçelerinin peyzajın yoğun olduğu oyun ortamları haline getirmek büyük fayda sağlar. Bu doğal alanlar çocukların aslında doğarken elde ettikleri hakları olan keşif yapabilecekleri sonuna kadar öğrenme yeteneklerini kazanabilecekleri yerlerdir. En önemlisi çocukların bu doğal ortamları oynayarak içerisinde var olarak tanınması geleceğin bekçileri olarak doğayı korumaları için önemlidir. Gelişmiş birçok ülkede artık okul bahçeleri sadece çocukların teneffüste boş zamanlarını geçirdikleri alanlar değil bir eğitim mekanı olarak görülmektedir. Bundan dolayı okul bahçelerinin tasarımına yapı kadar önem verilmelidir.

Fakat ülkemizde yapılan birçok araştırmaya göre ilköğretim okulu bahçeleri çocukların istekleri dikkate alınmadan yapılmış. Okul bahçelerinin peyzajdan yoksun, bahçenin büyük çoğunluğunun asfalt veya kilit parke taşından ibaret olduğu, çocukların gelişimine katkı sağlayacak çok fazla alanın olmadığı bahçeler olarak karşımıza çıkmaktadır. Oysaki ilköğretim okulu bahçelerinin çocukların gelişimine psikolojik, sosyolojik, bedensel olarak birçok katkısı vardır.

Bu bağlamdan yola çıkarak okul bahçeleri çocukların yaş gruplarına göre, öğrenci isteği göz önüne alınarak, öğretmenler ve uzman görüşleriyle; çocukların gelişimine katkı sağlayacak, çocukların eğlendikleri, eğlenirken öğrendikleri, akranlarıyla iletişim kurabileceği, keşif yapabilecekleri, hayal gücünü geliştirecek okuldaki zamanlarının daha verimli geçmesini sağlayacak tasarımlar yapılmalıdır.



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BALIKESİR İLİNDE MANDALARDA *EIMERIA* TÜRLERİNİN YAYGINLIĞININ ARAŞTIRILMASI

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ÖZET

Manda (*Bubalus bubalis*) hastalıklara olan dirençleri, yemden yararlanma kapasitesinin yüksek olması, yüksek et ve süt kalitesinin nedeniyle Türkiye dâhil birçok ülkede çiftliklerde yoğun şekilde yetiştirilmektedir. Paraziter patojenler sığır, koyun, keçi ve manda gibi çiftlik hayvanlarını enfekte ederek akut, kronik veya subklinik enfeksiyonlara neden olmaktadır. Bu paraziter patojenlerden en önemlilerinden birisi de *Eimeria* soyundaki protozoonlardır. *Eimeria* soyunda çok sayıda etken özellikle 3 haftalık-6 aylık malaklarda gelişme geriliğine, ishale, dehidrasyona, kilo kaybına ve tedavi edilemeyen olgularda ise ölüme neden olabilmektedir. *Eimeria* soyundaki protozoonlar dünyanın birçok ülkesinde olduğu gibi Türkiye’de de çiftlik hayvanlarında oldukça yaygındır. Ancak Türkiye’de mandalarda *Eimeria* türlerinin araştırılması amacıyla yapılan çalışmalar oldukça sınırlıdır. Bu çalışmanın amacı Balıkesir ilinde farklı yaş gruplarındaki mandalarda *Eimeria* türlerinin belirlenmesidir. Bu amaçla Balıkesir ilindeki manda işletmelerinden 6 aylıktan küçük 32 ve 6 aylıktan büyük 47 manda olmak üzere toplam 79 manda dışkı örneği alınarak %33 doymuş çinko sülfat solüsyonu kullanılarak flotasyon ile *Eimeria* sp. yönünden ışık mikroskobu altında incelenmiştir. Tespit edilen *Eimeria* sp. ookistleri *Eimeria* türlerinin belirlenmesi amacıyla %2.5’lik potasyum dikromat içerisinde sporlandırılmıştır. Sporlandırılan ookistlerin morfolojik özelliklerine bakılarak tür teşhisi yapılmıştır. Çalışmada incelenen 79 manda dışkı örneğinin 11 (%13,92)’nin en az bir *Eimeria* türü ile enfekte olduğu tespit edilmiştir. Altı aylıktan büyük 47 manda dışkı örneğinin %17,02 (8/47)’sinden *Eimeria* ookistleri tespit edilirken, altı aylıktan küçük 32 manda örneğinin ise %9,37 (3/32)’sinde *Eimeria* ookistleri tespit edilmiştir. Bu çalışmada dışkı örneklerinde *E. zuernii*, *E. auburnensis*, *E. bovis*, *E. bareillyi*, *E. ellipsoidalis*, *E. subspherica* ve *E. alabamensis* olmak üzere yedi farklı *Eimeria* türü tespit edilmiştir. Hayvanlarda birden fazla *Eimeria* türü ile enfeksiyonun tek *Eimeria* türüyle enfeksiyona oranla daha yaygın olduğu tespit edilmiştir. Bu çalışma ile bildiğimiz kadarıyla ilk kez Balıkesir ilinde farklı yaş gruplarındaki mandalarda *Eimeria* türlerinin yaygınlığı araştırılmıştır. Çalışmada tespit edilen *E. zuernii* ve *E. bovis* gibi türler aynı zamanda buzağuları için de patojen türler olması nedeniyle bölgedeki Veteriner Hekimlerin manda coccidiosisini yakından takip etmesi çiftliklerde hastalık kaynaklı kaybın en aza indirilmesine katkı sağlayacağı düşünülmektedir.

Anahtar Kelime: Balıkesir, *eimeria*, manda, Türkiye



DETERMINATION OF THE PREVALENCE OF EIMERIA SPECIES IN WATER BUFFALO IN BALIKESIR

ABSTRACT

Water buffalo (*Bubalus bubalis*) is known to be one of the most important farm animals, thanks to has the ability to efficiently utilize poor quality feed resources, the source of high-quality milk and meat production, and resistance to diseases. Because of that, these animals have been important farm animals in many different countries, including Turkey. Parasites can cause acute, chronic, and subclinical infections in cattle, sheep, goats, and buffalo herds. Species in *Eimeria* genus are known to be important parasitic pathogens. *Eimeria* species affect especially between 3 weeks and 6 months old buffalo. *Eimeria* species can cause different clinical symptoms such as poor and retarded growth, diarrhea, dehydration, weight loss, and also death if untreated cases. *Eimeria* species have been detected in farm animals in many different countries, including Turkey. But there is very little research on the determination of *Eimeria* species in water buffalo in Turkey. This study aimed to determine *Eimeria* species in water buffalo which are different age groups in Balikesir province. This study was performed on 79 water buffalo stool samples 32 of which were younger than 6 months old, and the remaining 47 were older than 6 months old. All stool samples were mixed with 33% zinc sulfate solution, centrifuged, and examined under a light microscope in terms of protozoan oocysts. All positive samples containing *Eimeria* oocyst were mixed with 2.5% potassium dichromate for the sporulation of oocysts. All sporulated oocysts were identified according to morphological features. Eleven out of 79 animals (13.92%) were detected at least one *Eimeria* spp. oocyst. Infection rates for older than six months old were found 17.02% (8/47), younger than six months old were found 9.37% (3/32). Seven different *Eimeria* species (*Eimeria zuernii*, *E. auburnensis*, *E. bovis*, *E. bareillyi*, *E. ellipsoidalis*, *E. subspherica*, and *E. alabamensis*) were found in the present study. Co-infection (infection with more than two different *Eimeria* spp. in one animal) was found more prevalent than the single infection. To the best of our knowledge, it is the first study on the determination of *Eimeria* species in water buffalo stool samples in Balikesir province. *E. zuernii* and *E. bovis* detecting in water buffalo stool samples in the present study are also pathogens species for the calf. For this reason, water buffalo coccidiosis should be taken into account by veterinarians for reducing economic losses due to coccidiosis.

Keywords: Balikesir, buffalo, *eimeria*, Turkey



GİRİŞ

Manda (*Bubalus bubalis*) hastalıklara olan dirençleri, yemden yararlanma kapasitesinin yüksek olması, yüksek et ve süt kalitesi nedeniyle Türkiye dâhil birçok ülkede yoğun şekilde yetiştirilmektedir (Çetindağ ve Doğanya, 1996; Deb ve ark., 2016; Dubey, 2018; Tüik, 2020). Türkiye’de son yıllarda yerli ırkların korunması ve sayısının artırılması amacıyla yapılan projelerden biriside manda yetiştiriciliğiyle ilgilidir. Bu amaçla yürütülen ‘Halk Elinde Manda Islahı Projesi’ kapsamında Türkiye’deki manda sayısının artırılması amaçlanmış ve sayı 2020 yılında ülke genelinde 188.771’e çıkmıştır (Tüik, 2020).

Paraziter patojenler sığır, koyun, keçi ve manda gibi çiftlik hayvanlarını etkileyerek akut, kronik veya subklinik enfeksiyonlara neden olmaktadır (Taylor ve ark., 2016). Bu paraziter patojenlerden en önemlilerinden birisi de *Eimeria* soyundaki protozoonlardır (Taylor ve ark., 2016; Dubey, 2018). *Eimeria* soyundaki protozoonların konaklarda meydana getirdiği hastalık coccidiosis olarak isimlendirilmektedir. Coccidiosis tüm dünyada çiftlik hayvanlarında oldukça yaygındır (Taylor ve ark., 2016; Dubey, 2018). *Eimeria* soyundaki patojenler özellikle genç yaştaki hayvanların bağırsaklarını etkileyerek hayvanların yemden yararlanmasının azalmasına, gelişme geriliğine, ishale, dehidrasyona ve tedavi edilemeyen olgularda ise ölüme neden olmaktadır (Dubey ve ark., 2008; Taylor ve ark., 2016; Dubey, 2018).

Eimeria soyundaki protozoonlar stenoksen türler olup konak spesifiteleri oldukça yüksektir (Dubey, 2018). Ancak sığırlarda enfeksiyona neden olan bazı *Eimeria* türleri aynı zamanda mandalarda da bulunduğu farklı araştırmacılar tarafından bildirilmiştir (Nalbantoğlu ve ark., 2008; Dubey, 2018). Günümüze kadar mandalarda tespit edilen *Eimeria* türleri sırasıyla *E. alabamensis*, *E. auburnensis*, *E. bovis*, *E. brasiliensis*, *E. bukidnonensis*, *E. canadensis*, *E. cylindrica*, *E. ellipsoidalıs*, *E. subspherica*, *E. wyomingensis*, *E. zuernii*, *E. ankarensis*, *E. bareillyi*, *E. gokaki*, *E. ovoidalis* ve *E. thianethi* olduğu araştırmacılar tarafından bildirilmiştir (Sayın, 1968; Nalbantoğlu ve ark., 2008; Taylor ve ark., 2016; Dubey, 2018).

Eimeria soyundaki protozoonlar dünyanın birçok ülkesinde olduğu gibi Türkiye’de de çiftlik hayvanlarında oldukça yaygındır. Türkiye’de mandalarda *Eimeria* türlerinin araştırılması amacıyla yapılan çalışmalar oldukça sınırlıdır (Sayın, 1968; Sayın, 1973; Çetindağ ve Doğanay, 1996; Nalbantoğlu ve ark., 2008). Bu çalışmanın amacı Balıkesir ilinde bildiğimiz kadarıyla ilk kez manda işletmelerinde *Eimeria* türlerinin dağılımları ve yaygınlıklarının belirlenmesi ve konuyla ilgili literatüre katkı sağlanmasıdır.

MATERYAL ve YÖNTEM

Çalışma materyali 2016-2017 tarihleri arasında Balıkesir ilindeki manda işletmelerinden 6 aylıktan küçük 32 adet ve 6 aylıktan büyük 47 manda olmak üzere toplam 79 manda dışkı örneği ile oluşturulmuştur. Dışkı örnekleri hayvanların direkt olarak rektumdan en az 10 g olacak şekilde alınmış ve plastik kaplara konularak örneğin alındığı yer, tarih ve hayvanın yaşı kaydedilmiştir. Dışkı örnekleri soğuk zincir şartları sağlanarak laboratuvara getirilmiştir.

Dışkı örneklerinde *Eimeria* soyundaki ookistlerinin aranmasında flotasyon yöntemi kullanılmıştır. Bu amaçla örnekler %33 doymuş çinko sülfat ($ZnSO_4$) solüsyonu kullanılarak 2500 rpm’de 5 dk süreyle flotasyon işlemine tabi tutulmuştur. Flotasyon işleminden sonra örnekler ışık mikroskopunda $10\times$ ve $40\times$ büyütmelemler kullanılarak *Eimeria* ookistlerin yönünden incelenmiş ve tespit edilen protozoon ookistleri kaydedilmiştir.

Ookist tespit edilen örneklerdeki *Eimeria* ookistlerinin hangi türe ait olduğunun tespit edilmesi amacıyla örnekler %2.5’lik potasyum dikromat içerisinde sporlandırılmıştır (Sayın, 1973; Nalbantoğlu ve ark., 2008). Sporlandırılan ookistlerin tür teşhisleri ookistlerin şekli ve büyüklüğü, ookist duvarının kalınlığı, mikropil bulunup bulunmaması, sporokistlerin ve



sporozoitlerin şekli ve büyüklüğü, ookist veya sporokist artığının bulunup bulunmaması gibi morfolojik özelliklerine göre yapılmıştır (Arslan, 2001; Taylor ve ark., 2016; Dubey, 2018).

BULGULAR

Çalışmada incelenen 79 manda dışkı örneğinin % 13,92 (11/79)'sinin en az bir *Eimeria* türü ile enfekte olduğu tespit edilmiştir. Altı aylıktan büyük 47 manda dışkı örneğinin %17,02 (8/47)'sinden *Eimeria* ookistleri tespit edilirken, altı aylıktan küçük 32 manda örneğinin ise %9,37 (3/32)'sinde *Eimeria* ookistleri tespit edilmiştir. Çalışmada hayvanlarda birden fazla *Eimeria* türü ile enfeksiyonun tek *Eimeria* türüyle enfeksiyona oranla daha yaygın olduğu tespit edilmiştir. *Eimeria* ookistlerinin yaygınlığının 6 aylıktan büyük hayvanlarda (%17,02), 6 aylıktan küçük hayvanlara (%9,37) oranla daha yüksek olduğu ancak farkın istatistiksel olarak anlamlı olmadığı tespit edilmiştir.

Dışkı örneklerinde *E. zuernii*, *E. auburnensis*, *E. bovis*, *E. bareillyi*, *E. ellipsoidalis*, *E. subspherica* ve *E. alabamensis* olmak üzere yedi farklı *Eimeria* türü tespit edilmiştir. Yaş gruplarına göre tespit edilen *Eimeria* türleri dağılımları Tablo 1'de listelenmiştir.

Tablo1. Yaş gruplarına göre tespit edilen *Eimeria* türlerinin dağılımı.

Hayvanın Yaşı	Enfekte Hayvanlar	Tespit Edilen <i>Eimeria</i> türleri			
		1. Tür	2. tür	3. tür	4. tür
6 aylıktan küçük hayvanlar	1. hayvan	<i>E. zuernii</i>	<i>E. auburnensis</i>	-	-
	2. hayvan	<i>E. bovis</i>	<i>E. ellipsoidalis</i>	-	-
	3. hayvan	<i>E. zuernii</i>	<i>E. auburnensis</i>	<i>E. alabamensis</i>	<i>E. bareillyi</i>
6 aylıktan büyük hayvanlar	1. hayvan	<i>E. ellipsoidalis</i>	<i>E. bovis</i>	-	-
	2. hayvan	<i>E. bovis</i>	<i>E. subspherica</i>	<i>E. alabamensis</i>	-
	3. hayvan	<i>E. auburnensis</i>	<i>E. zuernii</i>	-	-
	4. hayvan	<i>E. zuernii</i>	-	-	-
	5. hayvan	<i>E. bovis</i>	<i>E. auburnensis</i>	-	-
	6. hayvan	<i>E. zuernii</i>	<i>E. ellipsoidalis</i>	-	-
	7. hayvan	<i>E. auburnensis</i>	-	-	-
	8. hayvan	<i>E. subspherica</i>	-	-	-

TARTIŞMA

Manda, Türkiye dâhil birçok ülkede yetiştirilen önemli çiftlik hayvanlarından birisidir (Nalbantoğlu ve ark., 2008; Dubey, 2018; Tüik, 2020). Son yıllarda manda et ve süt ürünlerine olan talebin artması ve manda yetiştiriciliğinin yaygınlaştırılması amacıyla yapılan projelerle Türkiye'de manda sayısı gün geçtikçe artmaktadır (Çetindağ ve Doğanay, 1996; Nalbantoğlu ve ark., 2008; Tüik, 2020). Paraziter patojenler insanlarda ve hayvanlarda olduğu gibi mandalarda da hastalıklara neden olmaktadır (Taylor ve ark., 2016). *Eimeria* gibi paraziter patojenler mandalarda hastalıklara neden olarak verim kayıplarına ve hatta ölümlere neden olmaktadır (Dubey, 2008; Bahrami ve Alborzi, 2013; Taylor ve ark., 2016). Dünyada mandalarda *Eimeria* türlerinin araştırılması amacıyla çok sayıda çalışma yapılmasına rağmen (Dubey ve ark., 2008; de Noronha ve ark., 2009; Bahrami ve Alborzi, 2013; Gupta ve ark., 2016; Dubey, 2018; Ahmad ve ark., 2020; Morgoglione ve ark., 2020), ne yazık ki Türkiye'de az sayıda çalışma yapılmıştır (Sayın, 1968; Sayın, 1973; Çetindağ ve Doğanay, 1996; Nalbantoğlu ve ark., 2008). Bu çalışmanın amacı bildiğimiz kadarıyla ilk defa Balıkesir ilinde farklı yaş gruplarındaki mandalarda *Eimeria* türlerinin mikroskopik olarak araştırılması ve konuyla ilgili literatüre katkı sağlanmasıdır.

Türkiye'de mandalarda *Eimeria* türlerinin araştırılması amacıyla yapılan çalışmalarda incelenen mandalarda yaygınlığın %2-95,4 arasında değiştiği tespit edilmiştir. Yapılan çalışmalarda tespit edilen *Eimeria* türlerinin sırasıyla *E. bareillyi*, *E. ankarensis*, *E. ellipsoidalis*, *E. zuernii*, *E. auburnensis*, *E. bovis*, *E. canadensis*, *E. subspherica*, *E.*



alabamensis, *E. cylindrica*, *E. brasiliensis*, *E. wyomingensis* ve *Isospora* sp. olduğu arařtırcılar tarafından bildirilmiřtir (Sayın, 1968, Sayın, 1973; etindađ ve Dođanay, 1996; Nalbantođlu ve ark., 2008). Bizim alıřmamızda ise manda dıřkı rneklerinin %13,92 (11/79)'sinin en az bir *Eimeria* tr ile enfekte olduđu tespit edilmiřtir. alıřmada *E. zuernii*, *E. auburnensis*, *E. bovis*, *E. bareillyi*, *E. ellipsoidalis*, *E. subspherica* ve *E. alabamensis* olmak zere yedi farklı *Eimeria* tr tespit edilmiřtir. alıřmamızda tespit edilen %13,92'lik yaygınlık Sayın tarafından 1973 yılında yapılan alıřmada bildirilen %2'lik *Eimeria* yaygınlıđından daha yksek bulunurken, diđer alıřmalardan ise daha dřk olduđu grlmřtir (Sayın, 1968; etindađ ve Dođanay, 1996; Nalbantođlu ve ark., 2008). Bu alıřmada *Eimeria* yaygınlıđının Sayın tarafından 1973 yılında yapılan alıřmadan daha yksek bulunmasının nedeninin; muhtemelen alıřmada mandaların sadece *E. bareillyi* ynnden incelenmesi ve arařtırcının diđer *Eimeria* trlerinin yaygınlıđına iliřkin herhangi bir bilgi vermemesi ilgili olabileceđi dřnlmektedir.

Eimeria soyundaki protozoonlar monoksen geliřen trlerdir ve konaklara sporlanmış ookistlerin ađız yoluyla alınmasıyla (su, yiyecekler veya hayvanların birbirlerini yalamasıyla) bulařmaktadır (Taylor ve ark., 2016; Dubey, 2018). Bu soydaki trler manda yavrularında klinik enfeksiyonlara neden olurken daha yařlı hayvanlarda ise subklinik enfeksiyonlara neden olmaktadır (Bahrami ve Alborzi, 2013; Yattoo ve ark., 2013; Dubey, 2018). Subklinik enfekte hayvanlar ise geen hayvanlar iin rezervuar grevi grerek bulunduđu ortamlarda enfeksiyonun devamlılıđını sađlamaktadır (Gupta ve ark., 2016). Ayrıca subklinik enfekte hayvanlarda meydana gelen uzun sreli verim kaybı nedeniyle oluřan ekonomik kayıp hem daha fazla olurken hem de bu hayvanlar hastalıđın geen hayvanlara bulařmasına neden olabilmektedir (Bahrami ve Alborzi, 2013; Gupta ve ark., 2016). *Eimeria* soyundaki patojenlerin neden olduđu ekonomik kaybın en aza indirilmesi iin hem geen hayvanlarda hem de eriřkin hayvanlarda *Eimeria* trlerinin yaygınlıđının ve dađılımlının belirlenmesi olduka nemlidir. Bu nedenle yaptığımız alıřmada hem altı aylıktan kk hem de altı aylıktan byk mandalarda *Eimeria* yaygınlıđı arařtırılmıř ve altı aylıktan byk hayvanların %17,02 (8/47)'sinin en az bir *Eimeria* tr ile enfekte, altı aylıktan kk hayvanların ise %9,37 (3/32)'sinin en az bir *Eimeria* tr ile enfekte olduđu tespit edilmiřtir.

SONU

Sonu olarak coccidiosis zellikle geen hayvanlarda klinik semptomlar meydana getirirken daha yařlı hayvanlarda ise subklinik enfeksiyonlara neden olarak ciddi ekonomik kayıplara neden olmaktadır. Ancak Trkiye'de mandalarda *Eimeria* trlerinin arařtırılmasına ynelik alıřmalar olduka azdır. Bu nedenle de Trkiye'de manda kaynaklı *Eimeria* trlerinin yaygınlıđı ve dađılımı hakkında sınırlı bilgi bulunmaktadır. Trkiye genelinde *Eimeria* trlerinin manda srlerindeki durumunun ortaya konulması ve sz konusu patojenlere karřı korunma ve kontrol tedbirlerinin alınması amacıyla kapsamlı alıřmaların yapılması gerektiđi dřnlmektedir.



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BOR MİNERALİ VE METABOLİZMA ÜZERİNE ETKİLERİ

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ÖZET

Mikro besin elementlerinden biri olan Bor'un bitkiler için esansiyel bir element olduğu uzun zamandan beri bilinmesine rağmen insanlar ve hayvanlar için esansiyel olup olmadığı henüz kesinlik kazanmamıştır. Bor ile ilgili araştırmaların daha ziyade endüstriyel çalışmalar olduğu, hayvan besleme ve insan sağlığına etkilerini inceleyen araştırmaların son yıllarda yoğunluk kazandığı bildirilmiştir. Bor'un, vücutta hayati fonksiyonların yerine getirilmesinde görev yapan enerji substratlarının makro elementler, trigliserid, glukoz gibi) kullanım ve metabolizmalarını etkilediği, beyin, iskelet ve bağışıklık sistemi gibi çeşitli vücut sistemlerinin fonksiyonlarını ve kompozisyonlarını genellikle faydalı yönde değiştirdiği birçok araştırmacı tarafından bildirilmiştir. Borun organizmada kemik, beyin ve kan başta olmak üzere birçok sistem üzerinde etkili bir mineral olduğu bildirilmektedir. Hücre zarı fonksiyonları üzerinde borun etkin bir rolü olduğunu; bu etkilerin özellikle hücre zarlarında hormonal yanıtların oluşumunda önem taşıdığını, bor etkisiyle transmembran sinyal oluşumu ve transmembran hareketlilik aşamalarının gerçekleşebildiği belirtilmektedir. Bor enerji üretim metabolizmasında, insulin salgılanmasında, oksidasyonda ve bağışıklık sisteminde görev alan enzimlerin aktivitesinde rol oynamaktadır.

Anahtar kelimeler: Bor, element, metabolizma



BORON MINERAL AND ITS EFFECTS ON METABOLISM

ABSTRACT

Although it has been known for a long time that Boron, one of the micronutrients, is an essential element for plants, it has not yet been determined whether it is essential for humans and animals. It has been reported that researches on boron are mostly industrial studies, and studies examining its effects on animal nutrition and human health have increased in recent years. It has been reported by many researchers that boron affects the use and metabolism of energy substrates (such as macro elements, triglyceride, glucose) that serve in the fulfillment of vital functions in the body, and that it generally changes the functions and compositions of various body systems such as the brain, skeleton and immune system in a beneficial way. It is reported that boron is an effective mineral on many systems in the organism, especially bone, brain and blood. Boron has an active role on cell membrane functions; It is stated that these effects are especially important in the formation of hormonal responses in cell membranes, and transmembrane signal formation and transmembrane mobility stages can occur with the effect of boron. Boron plays a role in energy production metabolism, insulin secretion, oxidation and the activity of enzymes involved in the immune system.

Keywords: Boron, element, metabolism

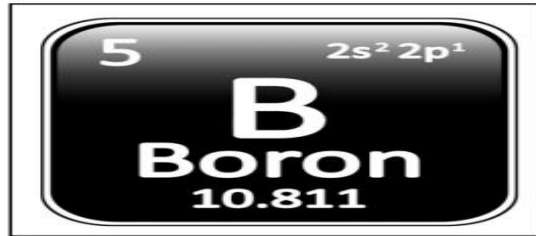


GİRİŞ

İnsan ve hayvan organizmalarının biyokimyasal ve fizyolojik fonksiyonlarının işleyişi yani homeostazisin devamlılığı açısından makro ve mikro elementlerin belirli oranlarda alınması gerekir. Bu elementler organizma üzerinde yapısal ve fonksiyonel faaliyetlerde bulunarak canlılık olaylarının meydana gelmesinde ve sürdürülmesinde önemli görevler alır (Fidan, 2006). Mikro besin elementlerinden biri olan Bor'un bitkiler için esansiyel bir element olduğu uzun zamandan beri bilinmesine rağmen insanlar ve hayvanlar için esansiyel olup olmadığı henüz kesinlik kazanmamıştır. Bor ile ilgili araştırmaların çoğunlukla endüstriyel alanda yapıldığı, hayvan besleme ve insan sağlığına etkilerini inceleyen araştırmaların son zamanlarda yoğunluk kazandığı bildirilmiştir (Eren, 2004). Yapılan çalışmaların az olmasına karşın fizyolojik miktarda diyetle alınan bordan insan ve hayvanların farklı şekillerde etkilendiği görülmüştür. (Hunt ve Idso, 1999). Bor ilk defa 1857'de *Maesa icta* tohumundan keşfedilmiştir (Deliboran, 2020). 1980'li yıllarda iz element olarak tanımlanan bor, 1996'da Dünya Sağlık Örgütü tarafından insan sağlığı açısından olası temel elementler kategorisine alınmıştır (Deliboran, 2020). Bor elementinin hayvan beslemesindeki önemi ise ilk olarak 1981'de ortaya çıkarılmıştır (Nielsen, 1988).

Bor, metabolizma için önemli roller üstlenen ve kanser dâhil birçok hastalığın mekanizmasında bulunan bir elementtir. İnsan ve hayvanlar için esansiyel bir iz element olduğu tespit edilen borun mineral metabolizması, lipit metabolizması ve enerji metabolizmasında, immün ve endokrin sistem ile birlikte beyinde önemli fonksiyonları olduğu, performansı olumlu etkilediği, osteoporoz, osteoartrit ve artrit önlenmesinde etkili olabildiği görüşleri öne çıkmaktadır (Yeşildağ, 2008; Nielsen, 1997).

BOR MİNERALİNİN KİMYASAL YAPISI



Şekil 1: Bor Mineralinin Simgesi (Mermer, 2018)

Yarı metal-yarı iletken, III A grubunun metal olmayan tek elementi B'nin atom numarası 5'tir (Nielsen, 1988). Atom ağırlığı 10.81 g/mol, kütle numaraları 11 ve 12 olan kararlı iki izotopu olan B, periyodik tabloda 5. elementtir (Power ve Woods 1997).

Doğada serbest olarak bulunmayan bor elementi oksijene bağlı halde bulunmaktadır ki; oksijene bağlı bulunan bu bileşiğe borat adı verilmektedir (EPA. 2004; Çöl ve Çöl, 2003; Murray ve Andersen, 2001). Bor doğada sodyum, kalsiyum ve magnezyum oksitlerine bağlı ve kristal suyu içeren mineraller halinde bulunmaktadır, bu minerallere bor madenleri veya bor tuzları adı verilmektedir (Duman, 2003). Doğada yaklaşık olarak 230 çeşit bor minerali bulunmakta olup bu mineraller arasında en önemlileri yapılarında Na, Ca, ve Na-Ca bulunduranlardır. Na kökenli bor minerallerine boraks (tinkal), Ca kökenli bor minerallerine kolemanit, Na -Ca kökenli bor minerallerine ise üleksit adı verilmektedir (Uçkun, 2013).



Şekil 2: Bor Minerali (Mermer, 2018)

Bor bileşiklerinin en basitleri bor oksit ve borik asittir. Bor, biyolojik sıvılarda % 96 oranında borik asit formunda bulunurken çok az bir kısmı borat anyonu olarak bulunmaktadır (Bolanos ve ark., 2004).

BOR MİNERALİNİN TARİHÇESİ

Ölüm sonrası yaşam inançları gereği Mısırlıların mumyalamada bor kullandıkları, yine Romalıların ve eski Yunanların gösteri yaptıkları arenaların temizliğinde bor kullandığı, Çinlilerin boru porselen cilalanmasında kullandığı, Arap toplumlarında M.S. 875 yılında bor bileşiklerinin ilaç yapımında kullanıldığı tespit edilmiştir (Moseman, 1994)

Tablo 1: Borun tarihsel gelişimi (Nielsen, 1988; Kuru ve Yarat 2017).

M.Ö. 2000	Babiller, altını ilk işleyen Babiller boraksı Uzak Doğu'dan temin etmişlerdir.
875	Bor tuzlarıyla ilk kez ilacı Araplar üretmiştir.
13. yy	Bor endüstrisinin modernleşmesi başlamıştır.
1702	Boraks elde edilmiştir.
1771	Katı borikasit ilk kez üretilmiştir.
1808	Elementel bor üretilmiştir.
1852	Bor üretim tesisi açılmıştır.
1857	Bazı bitkilerin Bor içerdiği belirlenmiştir.
1865	Ülkemizde Bor madeni işlenmeye başlanmıştır.
1870	Gıda endüstrisinde ilk kez Bor gıdaları korumak amaçlı kullanılmıştır.
1909	Yüksek saflıkta Bor elde edilmiştir.
1923	Bitkilerin temel yaşam koşulları için elzem olduğu belirlenmiştir.
1935	Ülkemizde MTA (Maden Tetkik ve Arama Enstitüsü ile ETİBOR kurulmuştur.
1950	Kanser tedavisinde Bor kullanılmaya başlanmıştır.
1987	Tıbbi alanda kullanılmaya başlanmıştır.
2003	Ulusal Bor Araştırma Enstitüsü (BOREN) faaliyete başlamıştır.
2003	Food and Drug Administration (FDA) bor takviyeli ilaçlara müsaade etmiştir.
2010	Ülkemizde Bor rezerv kaynakları belirlenmiştir.
2010-2016	Bor ile ilgili ulusal ve uluslararası düzeyde bilimsel faaliyetler hız kazanmıştır.



TÜRKİYE'DE BOR MİNERALİ VARLIĞI

Yeryüzünün 51. yaygın elementi olan bor; toprak, kayalar ve suda yaygın olarak bulunur. Doğada en önemli bor kaynağı topraktır (Alan, 2013). Türkiye'nin önemli bor yatakları Bursa (Kestelek), Eskişehir (Kırka), Kütahya (Emet) ve Balıkesir (Bigadiç)'de bulunmaktadır. Türkiye'de en çok bulunan bor mineralleri tinkal ve kolemanit'dir. Kırka'da tinkal yatakları, Emet, Kestelek ve Bigadiç'de kolemanit yatakları bulunmakla beraber Bigadiç'te üleksit, Kestelek'de kolemanite ek olarak üleksit yan ürünü mevcuttur (ETİ Maden, 2016).

Geleceğin petrolü olarak nitelendirilen bor elementi, Türkiye'nin stratejik öneme sahip en önemli yer altı kaynaklarından birisidir (Deliboran, 2020). ETİ Maden'in 2016 yılı Bor Sektör Raporuna göre Türkiye'nin Dünya Bor rezervinin % 72,9'una sahip olduğu belirtilirken; Maden Mühendisleri Odasının Türkiye Bor Potansiyeli makalesinde ise Türkiye'nin payı % 63 olarak belirtilmiştir (Güyagüller, T., 2001).

Tablo 2: Dünya Bor Rezervleri (ETİ Maden, 2016).

ÜLKE	SAHİP OLDUĞU TOPLAM REZERV (B ₂ O ₃ olarak milyon TON)	YÜZDE (%)
Türkiye	952	72.9
ABD	80	6.1
Rusya	100	7.7
ÇİN	47	3.6
Peru	22	1.7
Arjantin	9	0.7
Bolivya	19	1.5
Şili	41	3.1
Kazakistan	15	1.2
Sırbistan	21	1.6
TOPLAM	1304	100

Ülkemizin elinde bulunan bor rezervlerinin en etkin şekilde kullanılabilmesi ve en yüksek oranda fayda sağlanabilmesi için bor piyasasının dinamikleri iyi tespit edilmelidir (Mermer, 2018).

ALINMASI GEREKEN BOR MİNERALİ MİKTARI

ABD'de bulunan National Academies Institute of Medicine verilerine göre yetişkin bir insanın alabileceği günlük maksimum bor miktarı 20 mg B olarak belirtilmiştir. Dünya Sağlık Örgütü (WHO) ise insanların günlük ortalama bor alımı için güvenli aralığı 1-13 mg B olarak belirlemiştir. Sağlıklı ve dengeli beslenen bir insanın gün içinde tükettiği tahıl, meyve ve sebzelerden 1-3 mg/gün miktarında bor aldığı tespit edilmiş, vücuduna düşük bor diyeti (0,3-0,4 mg/gün) uygulanan insanlarda bor alımı günlük 3 mg değerine çıkarıldığında biyolojik fonksiyonlarında görülen olumsuzlukların giderildiği görülmüştür (TMMOB, 2016). Aydın ve



ark. (2018), hem hayvan hem de insan çalışmalarında, günde 1,0 mg'dan az bor alımıyla borun sağlığa yararlı etkilerinin ortaya çıkmadığını göstermişlerdir.

BOR MİNERALİNİN FİZYOLOJİYE ETKİLERİ

Bor, sodyum borat ve borik asit formunda besinler deri, solunum ve diyet yoluyla alınıp, az bir kısmı gastro-intestinal sistemde emildikten sonra % 90–95'i ilk 24 saatte değişikliğe uğramadan idrarla dışarı atılmaktadır. Çok az bir kısım ise kemik, tırnak, saç, diş, kıl, karaciğer ve dalak gibi organlarda birikmektedir (Saylı, 2000). Eseceli ve ark. (2018) bor alımı arttıkça borun konsantrasyonunun da arttığını ancak bor alımı azaldığında konsantrasyonun bir süre korunduğunu bunun ise borun kemik içinde birikmesinin neden olduğunu bildirmişlerdir. Bor vücutta metabolize edilmez. Borik asitin metabolize edilememesinin muhtemel nedeni, bileşikteki bor ile oksijen arasındaki bağın kırılması için çok yüksek enerjiye (523 kJ/mol) gereksinim duyulmasından ileri geldiği öne sürülmüştür. Borun plazma yarılanma ömrü yaklaşık 21 saat kadardır (Murray, 1998).

İlk kez 1981 yılında yapılan bir çalışmayla kolekalsiferol (vitamin D₃) bakımından yetersiz rasyonlarla beslenen civcivlerde bor ilavesinin faydalı olabileceği kanaatine varılmıştır (Bintaş, 2013). Hayvanlarda embriyolojik gelişme esnasında borun gerekli olduğu ise ilk olarak zebra balığı ve alabalık embriyolarında gözlemlenmiştir (Rowe ve ark., 1998; Rowe 1999). Bor elementinin, vücutta hayati fonksiyonların yerine getirilmesinde görev yapan enerji sübstratlarının (makro elementler, trigliserid, glukoz gibi) kullanım ve metabolizmalarını etkilediği, beyin, iskelet ve bağışıklık sistemi gibi çeşitli vücut sistemlerinin fonksiyonlarını ve kompozisyonlarını faydalı yönde değiştirdiği sonucu birçok araştırmacı tarafından bildirilmiştir (Hunt, 1989; Hunt ve Herbel, 1991-1992; Wilson ve Ruszler, 1998; Eren ve ark., 2004).

Hücre zarı fonksiyonları üzerinde borun etkin bir rolü olduğunu; bu etkilerin özellikle hücre zarlarında hormonal yanıtların oluşumunda önem taşıdığını, bor etkisiyle transmembran sinyal oluşumu ve transmembran hareketlilik aşamalarının gerçekleşebildiği belirtilmektedir (Nielsen vd., 1988a). Bor yetersizliğinden en çok plazma ve organ Ca ve Mg düzeyleri ile plazma alkali fosfataz ve kemik kalsifikasyon parametrelerinin etkilendiği gözlenmiştir. Bu da büyümede gerileme, verim performansında azalma, özellikle steroid hormon konsantrasyonlarında düşme ile kendini göstermektedir (Bintaş, 2013). Bor ile ilgili çalışmaların çoğunluğunun, kanatlıların Ca ve P metabolizmasına etkileri üzerinde yapıldığı görülmüştür. Kanatlı rasyonlarının büyük çoğunluğunun tahıllardan oluşturulması ve tahıl tanelerinin B bakımından yetersiz oluşu, kanatlıları B elementi bakımından yetersiz besleme ile karşı karşıya bırakmaktadır (Hunt, 2006). Kanatlıların gereksinim duyduğu miktarlar düşüktür, normal şartlarda noksanlık belirtileri görülmemekle birlikte; kalsiyum, fosfor, kolekalsiferol veya magnezyum yetersizliği gibi stres faktörlerinde bor yetersizliği daha belirgin bir şekilde hissedilmektedir (Nielsen, 1998).

Serum parametreleri üzerine etkisi

Buzağı beslemede süte katılan borun serum glikoz, total protein, trigliserit, kolesterol, fosfor ve klor konsantrasyonlarına ve ALT ve AST enzim aktivitelerine etkisi bulunamamıştır (Doğan 2016). Bir başka çalışmada Kurtoğlu ve ark (2012), 8 ay yaşta kısırlaştırılmış koç rasyonlarına 56 gün süreyle ilave ettikleri 15, 30 ve 45 ppm sodyum boratın serum P, glikoz, total protein, trigliserit ve total kolesterol konsantrasyonlarını etkilemediğini bildirmişlerdir. Armstrong ve Spears (2001), domuzları 0, 5 ve 15 mg/kg seviyelerinde B içeren; Mızrak ve Ceylan (2009), yumurtacı tavukları 25, 50 ve 75 mg/kg B sağlayacak şekilde B içeren; Şimşek (2011), etlik piliçleri 0, 100, 200 ve 400 mg/kg seviyelerinde B içeren rasyonlarla besledikleri çalışmalarda,



ilave B'nin serum total kolesterol ve trigliserid düzeyleri üzerine etkili olmadığını belirlemişlerdir.

Olgun (2011), 0, 60, 120 ve 240 mg/kg B içeren rasyonlarla besledikleri yumurtacı tavuklarda B ilavesinin deneme ortası (56. gün) ve sonu (112. gün) serum trigliserid ve total kolesterol düzeylerini azalttığını tespit etmiştir. Eren ve ark. (2006), bıldırcın rasyonlarına borik asit ilavesinin serum trigliserit ve total kolesterol miktarını önemli düzeyde düşürdüğünü ancak serum HDL ve LDL konsantrasyonu değerlerinde değişikliğe neden olmadığını bildirmişlerdir. Eren ve Uyanık (2007), yumurtacı tavuk rasyonlarına B ilavesinin (0, 5, 10, 50, 100, 200 ve 400 mg/kg) bazı serum parametrelerine etkilerini inceledikleri çalışmada, total kolesterol düzeylerinin ilave B seviyelerinin tamamında, serum trigliserid düzeylerinin ise 5 mg/kg B ilave edilen grup hariç diğer tüm gruplarda azaldığını tespit etmişlerdir.

Kurtoğlu ve ark. (2005) etlik piliç rasyonlarına 0, 5 ve 15 mg/kg seviyelerinde B ilavesinin serum total kolesterol ile serum trigliseridi artışa yol açtığını gözlemlemişlerdir. Bor mineralinin; Ca, P ve Mg metabolizmasını doğrudan, vitamin D metabolizmasını ise dolaylı olarak etkilediği (Hunt ve Nielsen, 1981-1986), kolekalsiferol ve Mg'ce yetersiz civciv rasyonlarına 3 mg/kg B ilavesinin plazma Ca ve Mg düzeylerini artırdığı (Hunt, 1989), rasyonda yüksek B seviyesinin Ca atılımını azaltıp, plazma Ca düzeyini artırarak, B'nin Ca metabolizmasında önemli rol üstlendiği bildirilmiştir (Nielsen, 1990).

Şimşek (2011), yaşlı yumurtacı tavukları farklı seviyelerde B içeren rasyonlarla besledikleri çalışmasında, B'nin serum Ca düzeylerinde değişiklik olmadığını ifade etmiştir. Doğan (2016), bor içeren sütle beslenen buzağuların kan serumunda bor konsantrasyonunun yüksek olduğunu gözlemlemiştir. Bu buzağularda serum Ca konsantrasyonları sabit kalırken, serum Mg konsantrasyonunda ise düşüş görülmüştür. Öte yandan Kurtoğlu ve ark. (2002) ve Yeşilbağ ve Eren (2008) ise farklı seviye ve formlardaki B'nin serum Ca düzeyini artırdığını bildirmişlerdir. Kurtoğlu ve ark. (2002) ve Olgun (2011), rasyona farklı seviye ve formlarda ilave edilen B'nin serum Ca düzeylerini azalttığını tespit etmişlerdir. Protein kısıtlaması yapılmış ve bor ilave edilmiş yemle beslenen ördeklerde, kan hemoglobin düzeyi ve hematokrit değerinin azaldığı görülmüştür (Hoffman ve ark. 1991).

Kemik gelişimi üzerine çalışmalar

Borun mineral metabolizması üzerinde regülatör etkisinin olduğu Ca, P ve Mg mineralleri ile olan etkileşimlerine bağlı olarak kemik gelişimi ve mineralizasyonunu etkilediği bildirilmiştir (Nielsen ve ark., 1988; Chapin ve ark., 1998; Armstrong ve ark., 2000). Yapılan çalışmalar bor mineralinin, en çok kalsiyum metabolizmasını, kemikleri ve immün sistemi etkilediğini göstermiştir. Bor yetersizliğinde kemik iliğinde bükülme ve kırık dokunun kalsifikasyonunda gecikme görülmektedir (Hunt, 1989). Yapılan diğer çalışmalara göre bor, broylerde makro mineral metabolizması üzerinde de önemli rol oynamaktadır (Rossi ve ark., 1993; Elliot ve Edwards, 1992; Yeşildağ, 2008). D vitamini eksikliği olan ratlara, düşük konsantrasyonlarda bor diyet olarak verildiğinde kalça kemiği Mg içeriği artmış, P ve Ca tutulması artmıştır (Hunt, 2003). Bintaş ve Özdoğan (2017), 65 haftalık Super Nick ırkı yumurtacı tavuk rasyonlarına 15 hafta boyunca B, zeolit ve B-zeolit karışımı içeren yemlerle besledikleri çalışmada; rasyona 100 mg/kg B ilavesinin tibia ham kül ve P yüzdelerinde değişikliğe yol açmadığını, tibia Ca ve B yüzdelerini ise artırdığını bildirilmiştir. Yapılan bir başka araştırmada 27 yumurtacı tavuk rasyonlarına farklı düzeylerde (50, 100, 150, 200, 250 ppm) bor katkısı yapılmış ve tibia bor konsantrasyonları arasındaki farkın istatistiksel açıdan önemli bulunduğu tespit edilmiştir (Kurtoğlu ve ark., 2007). Kaya ve Macit (2018), 62 haftalık, Lohman yumurtacı ticari hibrit tavuk rasyonlarına farklı seviyelerde B (0, 50, 75 ve 150 mg/kg) ilavesinin yumurta kabuk kalitesi üzerine etkilerini belirlemek amacıyla yaptıkları çalışmada,



rasyona ilave edilen B'nin 12 hafta sonunda tibia kemiği biyomekanik özelliklerinin tamamına etkisinde kayda değer bir değişiklik olmazken, tibia kemik B mineral konsantrasyonunda artış; Ca, Zn, Mg, P ve Mn mineral konsantrasyonlarında azalma olduğunu bildirmişlerdir. Yumurtacı tavuk rasyonlarına farklı seviyelerde ilave edilen B'nin kemiğin biyomekanik özelliklerinin tümüne etkisi önemsiz olmuştur (Arslan Kaya ve Macit, 2018). Buzağuların iskelet (kemik) gelişiminin araştırıldığı çalışmada, bor takviyesinin literatürde belirtildiği üzere kemik gelişimine olumlu etki edeceği ve cidago, kalça ve göğüs ölçülerini artıracığı tahmin edilmekteydi ancak çalışma sonucunda amaçlanan değişiklikler elde edilememiştir (Doğan, 2016).

Kemik kırılma mukavemeti

Çiftlik hayvanları için esansiyel olup olmadığı tartışılan bir mineral olan bor (B), kemiğin yapısında etkili olan Ca, Mg ve vitamin D gibi besin maddelerinin yetersizliğinde kemiğin sağlığını devam ettirmede önemli rol oynar (Nielsen, 1990). Yapılan araştırmalar, rasyona B ilavesinin kanatlılarda mineral yararlanımını ve kemik kırılma kuvvetini arttırdığını göstermektedir (Wilson ve Ruszler, 1998; Olgun ve ark., 2012). Uygun miktarda tüketilen bor mineralinin eklem bozukluklarını azalttığı ve osteoporozisi önlediği rapor edilmiştir (Baysal A., 2012). Yumurtacı tavuklarla yapılan çalışmalarda, rasyona 25 ve 75 ppm bor ilavesi ile kemik kırılma mukavemetinin arttığı, eklem bozukluklarının engellendiği ve kırık çatlak yumurta oranını azalttığı ortaya çıkmıştır (Mızrak, 2008; Wilson ve Ruszler, 1998; Demirörs, 2007). Wilson ve Ruszler (1996), Mızrak ve Ceylan (2009), Mızrak ve ark. (2010), Sızmaz ve Yıldız (2014) ve Demirörs (2007) de yumurtacı tavuk ve piliç rasyonlarına farklı seviyelerde ilave B'nin kemik çapı, kemik duvarı kalınlığı, kemik stres, kesme kuvveti ve kesme enerjisine herhangi bir etkisi olmadığını bildirmişlerdir. Olgun ve ark. (2012), 26 haftalık 320 adet yumurtacı tavuk rasyonuna 0, 60, 120 ve 240 mg/kg B ilavesinin, kemiğin biyomekanik özelliklerinden kemik çapı ve kesit alanını etkilemediğini ancak kemik duvar kalınlığı, kesme kuvveti, kemik stresi ve kesme enerjisini artırarak kemik direncinin iyileşmesine neden olduğunu bulmuşlardır. Leghorn tipi piliçlerin 0, 50, 100, 200 ve 400 mg/kg seviyelerinde B içeren rasyonlarla beslendikleri çalışmada, 50 ve 100 mg/kg B ilavesinin tibia kemiğinin kesme kuvveti, kemik stres ve kesme enerjisini femurun ise kesme kuvvetini önemli derecede artırdığı bulunmuştur. Rasyona ilave edilen B'nin hiçbir seviyesi tibia, femur, humerus ve radiusun kemik çapı, kesit alanı veya kemik et kalınlığını etkilemezken kemik B düzeylerini artırmıştır. Kemik yoğunluğunun bir ölçüsü olan kemik kül yüzdesi, 400 mg/kg B ilavesi hariç diğer tüm seviyelerde artmış olup maksimum değer 50 mg/kg bor ile elde edildiğini rapor etmişlerdir (Wilson ve Ruszler 1997). Wilson ve Ruszler (1998) yumurta tavuğu rasyonlarına B ilavesinin (50-400mg/kg) kesme kuvveti, kesme gerilmesi ve kesme enerjisini arttırdığını belirtmişlerdir. Benzer şekilde, Mızrak ve Ceylan (2009) damızlık yumurtacı rasyonlarına B ilavesinin (25-75 mg/kg) femur kırılma kuvvetini arttırdığını bildirmişlerdir. Mızrak ve ark., (2010) yumurta tavuklarında B ilavesinin tibia kırılma kuvvetine etkisinin olmadığını, 25 mg/kg ve 50 mg/kg B ilavesinde femur kırılma kuvvetinin daha yüksek olduğunu bildirmişlerdir. Olgun ve ark., (2012) yumurta tavuklarında kemiğin biyomekanik özelliklerini iyileştirmesi bakımından rasyona 60 mg/kg B ilavesinin yeterli olduğunu bildirmişlerdir. Aynı araştırmacılar B ilavesinin plazma Ca seviyesinin düşmesine ve kemik Ca seviyesinin B tarafından belirgin bir şekilde değiştirilmemesine rağmen B ilavesinin kemiğin biyomekanik özelliklerini iyileştirdiğini belirtmişlerdir. McCoy ve ark. (1990), karma yeme bor ilavesinin, düşük kalsiyum içeren yemlerle beslenen erkek farelerin kemikleri üzerindeki etkilerini inceledikleri çalışmalarında, bor ilavesiyle femurdaki dayanma gücünün etkilenmediğini tespit etmişlerdir. Nielsen (2004), 170- 200g ağırlığındaki erkek ve dişi ratlarla yapmış olduğu araştırmada farklı iki yağ



kaynağı içeren rasyonlara 3 mg/kg düzeyindeki bor ilavesiyle femur direncinin, tibial kalsiyum ve fosfor içeriğinin ve kemik organik matriksiyle ilişkili minerallerin (çinko ve potasyum) düzeyinin arttığını bildirmiştir. Son yıllarda borun kalsiyum metabolizmasına etki ederek kemik mukavemetini artırdığının bulunmasının ardından, fosfor metabolizması üzerindeki etkileri de araştırmalara konu olmuştur (Bintaş, 2013).

Yumurta kabuk kalınlığı

Çetin ve ark. (2006), yıllık üretilen yumurtalar içinde, kabuk kırıkları nedeniyle satışı sunulamayan yumurta oranının % 6-20 arasında olduğunu rapor etmişlerdir. Düşük yumurta kabuk kalitesi, yumurta üreticileri için önemli gelir kaybına neden olan faktörlerden birisidir. Yumurta tavuklarında kabuk kalitesinin artırılmasına ilişkin çok sayıda çalışmalar yapılmıştır. Yumurtacı tavuk rasyonlarına D vitamini, propiyonik asit, çinko, bakır, mangan, bor ve zeolit gibi bazı minerallerin ilave edilmesi ile kabuk kalınlığında artış sağlanabilmesi mümkündür. Qin ve Klandorf (1991), karma yemdeki bor mineralinin yumurta verimi ile yumurta kabuk kalitesi ve Ca metabolizması üzerine etkilerini incelemiş, bor katkısı ile yumurta veriminin azaldığı, yumurta kabuk kalitesinin etkilemediğini, tibia kemik külünün arttığını gözlemlemiştir. Başka bir çalışmada, yeme bor ilavesiyle yumurta kabuğu bor içeriğinin önemli düzeyde arttığı bildirilmiştir (Yenice ve ark., 2008). Rasyona katılan B'nin kabuk kırılma mukavemeti, kabuk ağırlığı (g) ve kabuk kalınlığı (mm) üzerine etkileri önemsiz olduğu fakat başta 50 mg/kg seviyesi olmak üzere, bütün gruplarda söz konusu parametrelerde rakamsal artış gözlenmiştir (Arslan Kaya ve Macit, 2018) B'nin yumurtacı tavuklarda kabuk kalınlığına etkisi üzerinde yapılan bir çalışmada, kabuk kalınlığının B'den etkilenmediği tespit edilmiştir (Eren ve ark., 2004; Olgun ve ark., 2009; Sızmaç ve ark., 2014). Yeşilbağ ve Eren (2008), yaşlı yumurtacı tavukların rasyonuna B ilavesinin kabuk kalınlığını olumsuz yönde etkilediğini belirtmişlerdir. Yemlere ilave edilen bor, zeolit ve bor-zeolit karışımının yaşlı yumurtacıların yumurta kabuk kalitesi özelliklerinden yalnızca kabuk kalınlığını istatistiksel olarak etkileyerek, bor-zeolit karışımıyla beslemede kabuk kalınlığı artmıştır (Bintaş ve Özdoğan, 2017). Yeşilbağ ve Eren (2008), çalışmalarında B ilavesinin tüm seviyelerinin yumurta ağırlığı, hasarlı yumurta oranı ve yumurta kabuk kalite parametrelerinin (yumurta kabuk kalınlığı, yumurta kabuğu kırılma mukavemeti) kontrol grubundan daha üstün olduğunu tespit etmişlerdir. Araştırmacılar sonuç olarak rasyon B ilavesinin mineral dengesini pozitif yönde etkileyerek hasarlı yumurta oranını azalttığı, yumurta kabuk kalınlığı ve kabuk kırılma mukavemetini iyileştirdiği sonucuna varmışlardır.



Tablo 5: Yumurta kabuk kalınlığı üzerine çalışmalar (Altun ve Aktaş, 2020)

Yem Katkı Maddesi	Doz	Tavuk Irkı	Etki
Bor	100 mg/kg bor	Süper Nick ırkı yumurtacı tavuk	bor ve zeolit ilavesi; yumurta ağırlığı ve miktarını azaltmıştır. bor-zeolit karışımı olan grupta; kabuk kalınlığı artmıştır. bor ilavesi, serum bor yoğunluğunu artırmış kalsiyum (Ca) ve fosfor (P) miktarını etkilememiş gübre Ca, P ve bor (B) düzeyleri etkilenmiştir. Zeolit ve Bor içerikli yemler, tibia Ca ve B yoğunluğunu arttırmıştır (Bintaş ve Özdoğan, 2017)
Zeolit	8 g/kg zeolit		
Bor-Zeolit Karışımı	100 mg/kg bor+ 8 g/kg zeolit ilaveli		
Organik	25, 50 ve 75 ppm organik	Barred Rock I yumurtacı tavuk	Rasyona 25 ppm organik ve 75 ppm inorganik bor ilavesi ak yüksekliğini artırmış, 25 ve 75 ppm organik bor ilavesi kırık-çatlak yumurta oranı düşürmüştür. yeme bor ilavesi tibia ve femur kemiklerinin fosfor oranını, yumurta kabuğu kalsiyumu ve fosfor oranını, kan, kemik, yumurta ve yumurta kabuğu bor içeriklerini önemli düzeyde artırmıştır (Mızrak, 2008).
İnorganik Bor	25, 50 ve 75 ppm inorganik bor ilavesi		

Kaya ve Macit (2018), yumurtlamanın son dönemindeki yumurtacı tavukların rasyonlarına 50 mg/kg B ilavesinin mineral dengesini pozitif yönde etkileyerek yumurta kabuk kırılma mukavemetini iyileştirip, hasarlı yumurta oranını azalttığını rapor etmişlerdir. Yeterli ve yetersiz Ca-P içeren rasyonlara B ilavesi yumurta ağırlığını azaltıp, kabuk ağırlığını artırıp, şekil endeksini etkilememiştir. Yeterli Ca-P içeren rasyona 150 mg/kg B ilavesi ile kırık-çatlak ve kabuksuz yumurta oranında azalma gözlenmiştir. Yeterli Ca-P içeren rasyonların tüm B seviyelerinde kabuk kırılma mukavemeti olumsuz etkilenirken, kabuk kalınlığı etkilenmemiş; yetersiz Ca-P içeren rasyonlara B ilavesi ise kabuk kırılma mukavemeti ve kabuk kalınlığını artırmıştır. Araştırmacılar B'nin Ca, P ve Mg ile etkileşerek mineral metabolizmasında önemli rol oynayan bir iz element olabileceğini rapor etmişlerdir (Küçükyılmaz ve ark., 2014). Yumurtacı tavuk rasyonlarına farklı seviyelerde B ilavesinin yumurta kabuk mineral elementlerinden Zn, Mg, Na, Mn ve S üzerine etkisi önemsiz; B, Ca, Fe ve P ile Pb'ye ise önemli bulunmuştur. Rasyona B ilavesi yumurta kabuğu B ve Ca miktarını artırmış, Fe miktarını ise azaltmıştır (Arslan Kaya ve Macit, 2018).

Yumurta sarısı üzerine etkiler

Duca ve ark., (2004), yumurtacı tavuklarda yumurta sarısı kolesterolünün ilave B ile azaldığını tespit etmişlerdir. B içeren rasyonlarla beslenen 60-66 haftalık yumurtacı tavuklarla yapılan bir başka araştırmada da yumurta sarısı kolesterol miktarının rasyona ilave edilen farklı seviyelerdeki B ile önemli miktarda azaldığı bildirilmiştir (Grossu ve ark., 2005). Olgun (2011), yumurtacı tavuk rasyonlarına B ilave ederek yürüttüğü çalışmada farklı seviyelerde B ilavesinin yumurta sarısı total kolesterol miktarını arttırdığını bildirmiştir. Yumurtlamanın son dönemindeki tavukların rasyonlarına değişik miktarlarda B ilavesi yumurta sarısı lipid bileşenlerinden polarlipid, hidrokarbon+kolesterol esteri ve serbest yağ asidi oranlarında değişikliğe neden olmazken, triaçilgliserol oranında azalma, total kolesterol ve diaçilgliserol oranlarında artışla sonuçlanmıştır (Kaya ve Macit, 2018).

Yumurta ağırlığı üzerine etkisi

Yeme karıştırılan bor, zeolit ve bor-zeolit katkıları canlı ağırlık ve yem değerlendirme ile ilgili parametrelerde değişikliğe neden olmazken, sadece yumurta ağırlığı ve kütesini azaltması istatistiksel olarak önemli bulunmuştur (Bintaş ve Özdoğan, 2017). Bor tüketimine ilişkin önceki çalışmalarda yeme katılan bor miktarındaki artışla yumurta ağırlığının olumsuz etkilendiği bildirilmektedir (Eren ve ark., 2004; Wilson ve Ruzsler, 1998). Arslan Kaya ve Macit (2018) çalışmalarında yumurta ağırlığının B ilavesinden etkilendiğini ve en yüksek yumurta



ağırlığını 150 mg/kg B içeren rasyonla beslenen grupta bulunduğunu belirtmişlerdir. Olgun ve Bahtiyarca (2015), 21 haftalık Super Nick ırkı yumurtacı tavuk rasyonlarına 60 ve 120 mg/kg B ilavesinin yumurta ağırlığı ve kabuk ağırlığına etkisinin olmadığını ancak 120 mg/kg Bor ilavesinin kabuk kalınlığını artırdığını bildirmişlerdir.

Üreme üzerine etkisi

Deney hayvanları üzerinde yüksek dozda borik asit beslemesi ile yapılan çalışmalar sonucunda üreme ve gelişmeye olumsuz etkiler gözlenmesiyle, bor ürünleri Kategori 2. Reprotoxic olarak sınıflandırılmışlardır (TMMOB., 2016). Weir ve Fisher (1972), ratlarda yaptıkları deneysel çalışmada 3 farklı dozda (170, 350 ve 1170 ppm/gün) borik asit ilave edilmiş yemlerin 3 nesil boyunca uygulanması sonucunda, 1170 ppm/gün borik asit uygulanan erkek ratlarda kısırılığa yol açtığını bildirmişlerdir. Bu araştırmacılar çalışmalarında borik asitin üreme sistemine yönelik toksik etkilerini ilk kez ortaya koyarak, bor içeren bileşiklerin üreme sağlığı üzerine olan olumsuz etkilerine dikkat çekmişlerdir (Aktaş, 2017).

Ku ve ark (1993) erkek ratlarda 9 hafta süreyle yemlere farklı dozlarda (3000, 4500, 6000 ve 9000 ppm/gün) borik asit uygulamış ve daha sonraki haftalarda normal diyete dönülerek sonuçları değerlendirmişlerdir. Araştırma sonucunda düşük miktarlarda borik asit (3000 ve 4500 ppm/gün) uygulanan grupta sperm üretiminde azalma, yüksek doz alan gruplarda (6000 ve 9000 ppm) ise testis dokusunda atrofi rapor edilmiştir. El-Dakdokhy ve ark (2013) yaptığı başka bir çalışmada, erkek ratlara 3 farklı dozda (125, 250 ve 500 mg/kg) borik asiti 60 gün süreyle uygulamıştır. Çalışma sonucunda 125 mg/kg verilen grupta anlamlı bir değişikliğe rastlanılmazken, 250 ve 500 mg/kg borik asit uygulanan gruplarda testiküler atrofi, epididimiste küçülme, spermiyasyonda bozulmalar ve testis dokusunda Mg ve Zn düzeyinde azalma tespit edilmiştir. Krishnan ve ark. (2019) çalışmalarında erkek keçilere diyet bor takviyesinin (40 ppm) sperm hareketliliğini ve bağışıklık ve antioksidan savunma kapasitesini arttırdığını gözlemlemişlerdir. Şu ana kadar borun insan üreme sağlığına etkilerini belirlemeye yönelik olarak bora maruz kalan bor maden ve fabrikalarında çalışan işçiler ve maden yörelerinde yaşayan insanlar üzerinde yapılan çalışmalar bor ve bileşiklerinin insanların üreme sağlığı üzerinde herhangi bir olumsuz etkisi olmadığını göstermiştir (Şaylı, 2000).

Yemden yararlanma ve performans

Eren ve Uyanık (2007) çalışmalarında yumurta tavuğu rasyonlarına 0, 5, 10, 50, 100, 200 ve 400 ppm borik asit ilavesinde 400 ppm bor ilavesinin canlı ağırlık, yem tüketimi ve yumurta verimi üzerine olumsuz etki yaptığı görülmüştür. Konuyla ilgili olarak broylerlerde yürütülen bir çalışmada rasyona farklı (0, 20,80 ve 320 mg/kg) düzeylerde bor ilave edilmiş, 21 günlük süre sonunda rasyona 320 mg/kg bor katkısı ile yem tüketimi, canlı ağırlık ve ölüm oranının azaldığı, yemden yararlanma oranının ise arttığı tespit edilmiştir (Rossi ve ark., 1990). Yapılan bir başka çalışmada ise rasyona sırasıyla; 0, 5, 10 ve 20 mg/kg düzeylerinde bor ilavesinin canlı ağırlık artışı ve yemden yararlanma üzerine etkili olmadığı saptanmıştır (Eliot ve Edwards, 1992). Rossi ve ark. (1993), yaptıkları bir çalışmada ise, broyler rasyonlarında 0, 5, 40, 80, 120 mg/kg bor ilavesi ile 21 gün sonunda canlı ağırlık ve yemden yararlanmanın değişmediği belirlenmiştir. Fry ve ark. (2010) büyümekte olan besi sığırları rasyonlarına ilave ettikleri 5 ve 50 ppm sodyum boratın immun sisteme çok az etki ettiğini, sığırların performansı üzerinde ise etkili olmadığını bildirmişlerdir. Kurtoglu ve ark (2012) 8 ay yaşta kısırlandırılmış koç rasyonlarına 56 gün süreyle ilave ettikleri 15, 30 ve 45 ppm sodyum boratın canlı ağırlık ve yemden yararlanmayı artırdığını belirtmişlerdir. Buzağı sütlerine bor ilave edilmesiyle yapılan bir başka çalışmada, buzağuların canlı ağırlık, günlük canlı ağırlık artışı, cidago yüksekliği ve göğüs çevresi ölçülerini olumsuz etkilediği görülmüştür (Doğan, 2016).



İmmunolojik fonksiyonlar ve antioksidan etki

Borik asidin oksidatif DNA hasarını önlediği gözlemlenmiştir (Yılmaz ve ark. 2016). Bai ve Hunt (1996), bor yetersizliğinde ratların bakteriyel antijenlere karşı oluşturdukları immun cevabın baskılandığını ortaya koymuşlardır. Bir bor kaynağı olan boraksın anti-artritik etkisi olduğu yapılan çalışmalarda ortaya konulmuştur. Yisheng ve Curtiss (1998), borun ratlarda serum antikor konsantrasyonunu artırarak immun sistemi etkilediğini ortaya koymuştur. Borun antioksidant özelliği ile ateroskleroz hastalığının önlenmesinde rol aldığı bildirilmiştir (Devirian ve Volpe, 2003; Naghii ve Samman, 1997). Küçükkurt ve ark. (2017), bor bileşiklerinin gentamisininden neden olduğu oksidatif stresi azalttığını belirtmişlerdir. Farfan-Garcia ve ark. (2016) bilinen bazı ilaçların borla birlikte kullanılmasının, bu ilaçların ilgi ve duyarlılıklarını artırdığı ifade etmişlerdir. Antioksidan özelliğe sahip olduğu bildirilen (İnce ve ark. 2010, Küçükkurt ve ark., 2017, Cakir ve ark., 2017) bor mineralinin verildiği gruplarda borun uygulama dozu arttıkça, lökosit sayısında azalma olduğu görülmüştür. Durmuş ve ark. (2018), yaptıkları çalışmada hem gentamisin hem de bor uygulamalarının eritrosit sayısı ve hemoglobin düzeylerine etkisinin olmadığı, gentamisin uygulamasının ise hematokrit düzeyinde azalmaya neden olduğunu ancak bor ilavesinin bu azalmayı önlediğini rapor etmişlerdir. Bu bulgu, protein kısıtlaması yapılmış ve bor ilave edilmiş yemle beslenen ördeklerde, kan hemoglobin düzeyi ve hematokrit değerinin azaldığı bildirimi (Hoffman ve ark. 1991) ile deneysel bor toksisitesi oluşturulmuş keçilerde hemoglobin düzeyinin arttığı yönündeki bildirimle (Sisk ve ark. 1990) farklılık göstermiştir. Lipid peroksidasyon düzeyindeki artışın oksidatif stresin önemli bir işareti olduğu göz önüne alındığında (Kim ve ark., 2006), yumurtacı tavuk rasyonlarına 75 ve 150 mg/kg B ilavesinin lipid peroksidasyon seviyelerinde azalmaya neden olması, aynı zamanda kandaki oksidatif hasara karşı koruyucu olabileceğini göstermektedir.

Beyin fonksiyonları üzerine olan etkileri

Borun Mg emilimini kolaylaştırması ile bağlantılanan etkileri ise dikkat, idrak, kavrama, kısa ve uzun dönem hafızaları, el becerilerinde artış bildirilmiştir (TMMOB, 2016). Küçüklerin öğrenme, yetenek ve okul becerilerinin artmasına katkıda bulunduğu; sportif performans ve atletik yapının gelişmesi için tablet şeklinde bor alındığı bilinmektedir (Uygan ve Çetin, 2004; Şaylı, 2000). İyi kontrol edilen diyet koşulları altında yoksunluktan sonra bor ilavesinin, yaşlı kadın ve erkeklerde kısa süreli hafıza ve dikkati geliştirdiği, psikomotor yeteneklerin ve davranış eylemi ve zihinsel uyanıklığı geliştirdiği gösterilmiştir (Penland, 1998). Düşük miktarda bor alımında; el-göz koordinasyonu, algıma, dikkat, kısa ve uzun sürede olayları ve durumları hatırlama gibi performanslar, yüksek miktarda bor alımına göre daha zayıf olmaktadır (Devirian ve Volpe, 2003; Boron Monograph. 2004; Gregory ve Kell, 1997; Penland, 1994).

Steroid hormon metabolizması üzerine olan etkileri

İnsanlar üzerinde yapılan çalışmalarda ortaya çıkan önemli sonuçlardan birisi de diyetle bor ilavesinin normal 17- β östrodiol ve testosteron seviyesinde artışa (2 kat) neden olmasıdır. Steroid hormon konsantrasyonundaki bu değişiklik menopoz sonrası kadınlar için oldukça önemlidir (Yaşılbağ, 2009).

Antimikrobiyal özelliği

Mikrobiyal enfeksiyonlar önemli bir sağlık sorunudur. Antibiyotiklerin keşfiyle bu problem aşılmış olsa da günümüzde antibiyotiklerin uygunsuz, gereksiz ve bilinçsiz kullanımları sonucu gelişen direnç sebebiyle antibiyotikler etkilerini önemli ölçüde kaybetmiştir (Serpi ve ark., 2012; Öztürk, 2008). Bu durum bilim insanlarını yeni antimikrobiyal ajanların keşfine odaklamıştır. Haesebrouck ve ark. (2009), %2'lik borik asit ve %2'lik asetik asitin eşit



miktarlarda karıştırılmasıyla elde edilen solüsyonun 1/2 ve 1/4'lük sulandırmalarında, 5×10^7 cfu/ml miktarındaki *Staphylococcus pseudintermedius*'u 30 dakikada inaktive ettiğini, borik asidin söz konusu aktivitesi için asetik asitle birlikte kombine edilmesinin daha etkili sonuçlar verdiğini rapor etmişlerdir. Ülkemizde insanlarda yapılan bir çalışmada, ağıza uygulanan borik asit solüsyonunun *Enterococcus faecalis* üzerine güçlü antibakteriyel etki gösterdiği bildirilmiştir (Zan ve ark. 2013). Yılmaz (2012), borik asit ve boraksın *Staphylococcus aureus*, *Acinetobacter septicus*, *Escherichia coli* ve *Pseudomonas aeruginosa*'ya karşı MİK ve MBK değerlerini sırayla 3.80 mg/ml, 3.80 mg/ml, 7.60 mg/ml ve 7.60 mg/ml olarak saptadığını bildirmiştir. Önemli insan ve hayvan patojenleri olan *Listeria monocytogenes* ve *Staphylococcus aureus*'a karşı borik asidin antibakteriyel etkinlik bakımından önemli bir potansiyele sahip olduğu tespit edilmiştir (İlhan ve ark., 2019).

Bunların yanında son yıllarda, yeni bir ilaç sınıfı olarak da tanımlanmaya aday, "bor içeren biyoaktif bileşikler" dikkat çekicidir. Bu bileşikler, özellikle anti-mikrobiyal direncin alarm verdiği günümüzde ve yakın gelecekte, insan sağlığı açısından başvurabileceğimiz moleküler silahlardan biri olabilecek güçtedir (Dibek ve ark., 2020). Bor içeren bileşiklerin (BİB'ler) tıbbi kullanımı, uzun yıllardır antiseptiklerle sınırlı kalmıştır. Ancak son yıllarda bu bileşikler, antibiyotik veya kemoterapötik ajanlar olarak kullanılmaya başlanmıştır (Soriano-Ursua ve ark., 2014). Doğal kaynaktan elde edilen BİB'lerden aplasmomisinin antibakteriyel (Chen ve ark., 1981) boromisinin antiviral, antifungal ve antibakteriyel (Kohno ve ark., 1996; Dunitz ve ark., 1971) borofisinin antikarsinojen (Davidson, 1995) ve tartrolonun antiprotozoan ve antibakteriyel (Irschik ve ark., 1995) etkileri olduğu yapılan çalışmalar ile desteklenmiştir. Sentetik olarak kullanılan, BİB'lerden borteozomib (Garcia-Avila ve ark., 2017), tavaborole (Kerydin, 2014), vaborbaktam (Langley ve ark., 2019), vabomer (Hackel ve ark., 2018), ikazomib (Raab ve ark., 2009), krizaborol (Jarnagin ve ark., 2016) bileşikleri özellikle antibakteriyel, antifungal ve antikarsinojen olarak önemli hastalıkların tedavisi için üretilmiştir.

Bor minerali ve kanser

Bor mineralinin son zamanlarda gösterilen en yararlı etkilerinden biri de kanser hastalığının tedavisinde kullanılmasıdır. Bor mineralinin, bazı prostat (Barranco ve Eckhert, 2004; Cui ve ark., 2004) ve göğüs kanseri hücrelerinin (Carper ve ark., 2007) büyümesini ve farelerde insan prostat adenokarsinom tümörlerinin büyümesini engellediğini gösteren çalışmalar bulunmaktadır (Gallardo-Williams ve Chapin, 2004). Nükleer tıpta, borla nötron aranmasında BNCT (Boron Neutron Capture Therapy) kanser tedavisinde kullanılmaktadır. Beyin kanserinin tedavisinde hasta hücrelerinin imha edilmesinde görev alması bunu yaparken de sağlıklı hücrelere verdiği zararının en düşük seviyede olması borun önemini bir kez daha göstermiştir (Yakıncı ve Kök, 2016). Velcade® ismi ile boronik asit içeren anti-kanser ilacın ilk defa piyasaya sürülmesi ve bu ilacın klinik çalışmalarda diğer kemoterapi ilaçları ile beraber kullanılması, boronik asitlerin tedavi amaçlı kullanımını ispatlar niteliktedir. Kemoterapi ilacı Velcade®'ın aktif bileşiği olan borteozomib, ABD Gıda ve İlaç Dairesi (FDA) tarafından onaylanarak ilk tedavi edici proteazom inhibitörü olarak kabul edilmiştir (Karaağaç, 2019).

SONUÇ

Ülkemiz dünya bor varlığının %70'ine sahip olmasına karşılık bor elementinin çiftlik hayvanlarında ve insanlarda verim ve genel sağlık performansı üzerine olan etkilerini belirlemeye yönelik çalışma sayısı oldukça sınırlıdır. Bor elementinin hayvanların performans artışında, kemik yapısına ilişkin bozuklukların giderilmesinde ve lipid metabolizmasına ilişkin kolesterol ve trigliserit düzeylerinin düşürülmesinde etkili olabileceği düşünülmektedir. Bor ve bor bileşiklerinin hayvan rasyonlarındaki dozunun belirlenmesi, diğer metabolizmalar üzerine



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on FOOD, AGRICULTURE and VETERINARY
19-20 June, Izmir-TURKEY**



olan etkilerinin ortaya konulabilmesi ve biyokimyasal fonksiyonlarının kesin olarak açıklanabilmesi açısından daha fazla araştırma yapılması gerekmektedir. Bor mineraliyle ilgili bilimsel arařtırmalar arttırılmalı, bor rezervi olan ÷lkemizin bu kaynađı daha etkili kullanabilme yolları arařtırılmalıdır.



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ELAZIĞ İLİ KARAKOÇAN İLÇESİ BAŞYURT KÖYÜ MERASININ VERİM, KALİTE VE OTLATMA KAPASİTESİNİN BELİRLENMESİ

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ÖZET

Bu çalışma Elazığ ili Karakoçan ilçesi Başyurt köyü merasının ot verimi, ot kalitesi ve otlatma kapasitesini belirlemek amacıyla yürütülmüştür. Çalışmada, Başyurt köyü merasının bitki boyu, yeşil ot verimi, kuru ot verimi, otlatma kapasitesi ile mera otunun sahip olduğu ham protein, ADF (asit deterjanda çözünmeyen lif), NDF (nötral deterjanda çözünmeyen lif), Ca (kalsiyum), Mg (magnezyum), P (fosfor) ve K (potasyum) oranları belirlenmiştir. Mera alanında bitki boyu ortalama 12.6 cm, yeşil ot verimi 908 kg/da ve kuru ot verimi 187 kg/da olarak tespit edilmiştir. Mera otunun ham protein oranı %20.3, ADF oranı %29.5, NDF oranı %43.8, Ca oranı %0.94, Mg oranı %0.25, P oranı %0.41 ve K oranı %2.82 olarak belirlenmiştir. Mera alanının otlatma kapasitesi 42 HB (hayvan birimi) ve 1 HB için gerekli mera alanı 20 da olarak hesaplanmıştır. Çalışma sonucunda, Başyurt köyü merasında münavebeli otlatma sistemine geçilmesi ve gübreleme yoluyla mera otunun ve kalitesinin artırılmaya çalışması gerektiği yönünde fikir oluşmuştur.

Anahtar Kelimeler: Elazığ meraları, mera verimi, mera kalitesi, otlatma kapasitesi



DETERMINATION OF YIELD, QUALITY AND GRAZING CAPACITY OF ELAZIĞ PROVINCE KARAKOÇAN DISTRICT BAŞYURT VILLAGE PASTURE

ABSTRACT

This study was carried out to determine the forage yield, quality and grazing capacity of Elazığ province Karakoçan district Başyurt village pasture. In the study; plant height, forage yield, dry matter yield, crude protein, ADF (acid detergent fiber), NDF (neutral detergent fiber), Ca (calcium), Mg (magnesium), P (phosphorus), K (potassium) ratios and grazing capacity of Başyurt village pasture were determined. Average plant height in the pasture area was 12.6 cm, forage yield was 908 kg/da, and dry matter yield was 187 kg/da. Crude protein ratio of pasture grass was determined as 20.3%, ADF ratio 29.5%, NDF ratio 43.8%, Ca ratio 0.94%, Mg ratio 0.25%, P ratio 0.41% and K ratio 2.82%. The grazing capacity of the pasture area is 42 AU (animal unit). The required pasture area for 1 AU is calculated as 20 da. As a result of the study, an idea was formed that the alternating grazing system should be introduced in the Başyurt village pasture and the pasture grass and quality should be increased by fertilization.

Keywords: Elazığ pastures, pasture yield, pasture quality, grazing capacity



1.GİRİŞ

Ülkemizde yaklaşık olarak 11 milyon büyükbaş hayvan birimine eşdeğer hayvan varlığı bulunmakta, bunların yaşama payı gereksinimlerini karşılamak için yılda ortalama 50 milyon ton kaliteli kaba yeme gerek duyulmaktadır (Altın vd., 2009). Ülkemizde tarla tarımı içerisinde yetiştirilen yem bitkilerinden ve çayır-mera alanlarından sağlanan kaliteli kaba yem miktarı, ülke olarak ihtiyaç duyduğumuz kaba yem miktarını karşılayamamaktadır. Çeşitli kaynaklarda ülkemizin kaba yem açığının yaklaşık 15.0-30.2 milyon ton arasında olduğu bildirilmektedir (Altın vd., 2009; Çağan ve Yüksel, 2016; Özkan ve Demirbağ Şahin, 2016).

Ülkemizin kaba yem açığının karşılanacağı en ucuz kaynakların başında mera alanları gelmektedir. Mera alanlarının ne kadar hayvanın yem ihtiyacını karşıladığının belirlenebilmesi için bu alanlarda yapılan çalışmalar sonucunda verimlerinin ve otlatma kapasitelerinin belirlenmesi gerekmektedir.

Mera veriminin, ot kalitesinin ve otlatma kapasitesinin belirlenmesine yönelik birçok çalışma gerek bölgemizde gerekse de ülkemizde yürütülmüştür. Örneğin; Elazığ ili Karakoçan ilçesi Bahçeçik köyü merasında yürütülen bir çalışmada kuru madde oranı ortalama 200 kg/da, ham protein oranı %11.1, ADF oranı %35.2, NDF oranı %53.2 olarak tespit edilmiştir (Taşdemir ve Kökten, 2015). Aydın ili ekolojik koşullarında farklı eğimlere sahip mera kesimlerinde yürütülen bir çalışmada yeşil ot verimi ortalama 339.9 kg/da, kuru ot verimi 162.9 kg/da, ham protein oranı %6.05, ADF oranı %39.48 ve NDF oranı %60.28 olarak belirlenmiştir (Sürmen ve Kara, 2018). Mardin ilinde yürütülen bir çalışmada yeşil ot verimi ortalama 612 kg/da, kuru ot verimi 189 kg/da, ham protein oranı %16.6, ADF oranı %37.8, NDF oranı %47.1, Ca oranı %1.59, Mg oranı %0.36, P oranı %0.26 ve K oranı %1.87 olarak kayıt altına alınmıştır (Aydın vd., 2014). Bingöl ilinde yürütülen bir çalışmada yeşil ot verimi ortalama 546 kg/da, kuru ot verimi 143 kg/da (Çağan ve Başbağ, 2016), ham protein oranı %18.5, ADF oranı %36.4, NDF oranı %52.1, Ca oranı %1.63, Mg oranı %0.38, P oranı %0.30 ve K oranı %2.00 (Çağan ve Başbağ, 2019) olarak kayıt altına alınmıştır.

Bu çalışma Elazığ ili Karakoçan ilçesi Başyurt köyü merasının ot verimi, ot kalitesi ve otlatma kapasitesini belirlemek amacıyla yürütülmüştür.

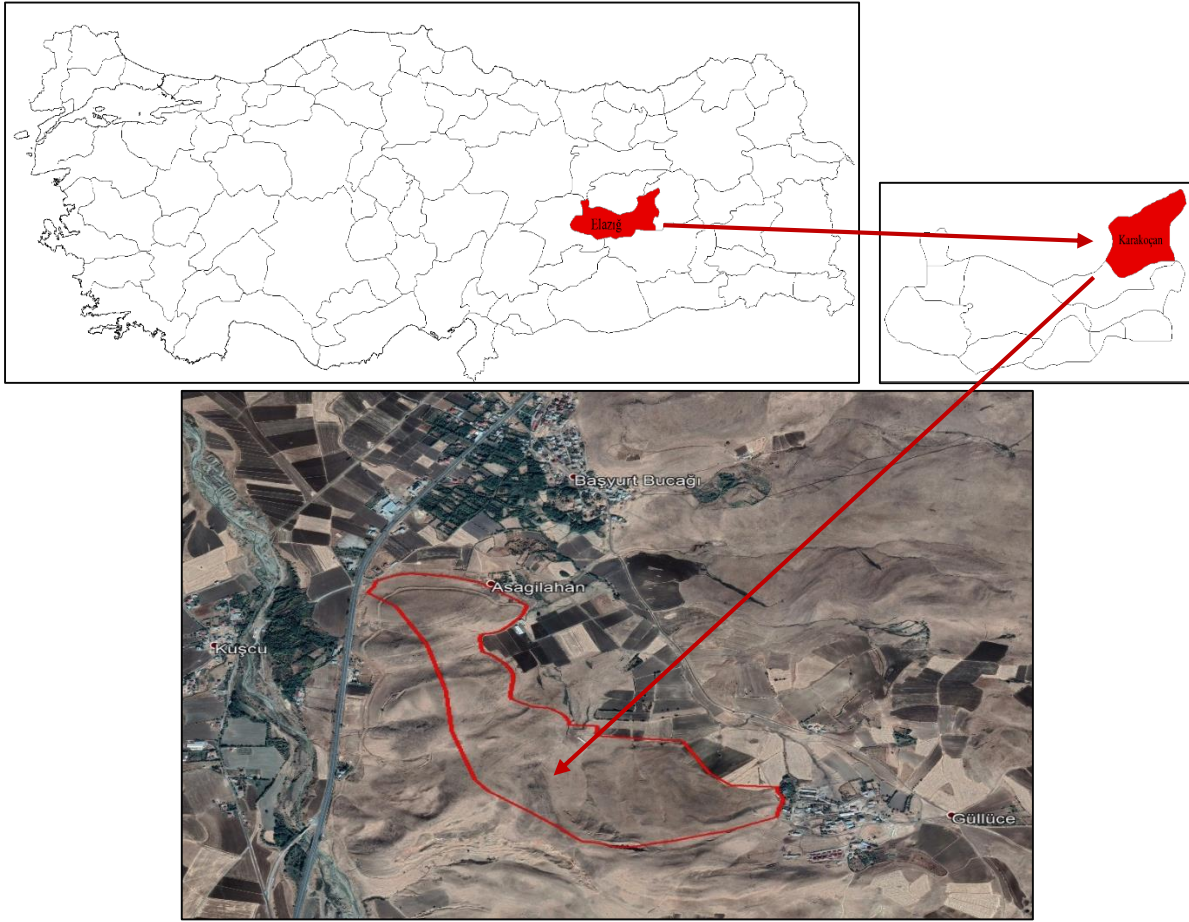
2.MATERYAL ve YÖNTEM

Materyal

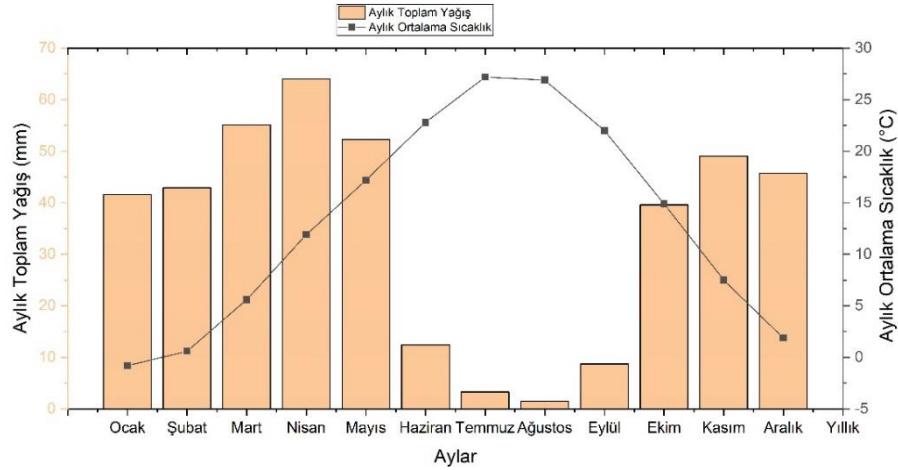
Bu araştırma ile ilgili arazi çalışması, Elazığ İli Karakoçan İlçesine bağlı Başyurt köyünde 841 da genişliğindeki merada Mayıs 2017 tarihinde yürütülmüştür. Mera alanı %15-30 eğime sahip olup, ortalama yüksekliği 1350 m'dir (Şekil 1).

Elazığ ilinin uzun yıllar (1938-2020) ortalama sıcaklık değeri 13.1 °C, aylık toplam yağış miktarı ise 416.1 mm'dir. En düşük yağışlar temmuz ve ağustos, en yüksek yağışlar mart ve nisan, en düşük sıcaklıklar aralık ve ocak, en yüksek sıcaklıklar ise temmuz ve ağustos aylarında alınmaktadır (Şekil 2).

Araştırmaya konu olan meranın yapılan toprak analizine göre arazi yapısı tınlı, organik madde miktarının orta (%2.19), orta tuzlu (%0.45), kireçli (%2.85), potasyum oranı yeterli (39.73 kg/da), fosfor oranı az (4.88 kg/da) ve pH düzeyi ise nötr (7.10) olarak belirlenmiştir.



Şekil 1. Başyurt köyü merasının lokasyonu



Şekil 2. Elazığ ilinin aylık ortalama sıcaklık ve aylık toplam yağış miktarı (MGM, 2021)

Yöntem

Meranın büyüklüğünden dolayı (841 da) çalışmaya başlamadan önce mera kendi içerisinde homojen kabul edilebilecek dört parsel ayrılmış ve mevcut çalışma A, B, C ve D şeklinde isimlendirilen bu parsellerde 2017 yılının Mayıs ayında yürütülmüştür. Meranın her parselinde,



tesadüfen seçilen dört yerinde, doğal olarak otlatılmayan alanlarda 33x33 cm²'lik çerçeve atılarak, çerçeve içerisinde kalan alan, toprak yüzeyinden biçilmiştir. Biçilen alanların arazi koşullarında yaş ot ağırlıkları alınıp, dekara verime dönüştürülecektir. Biçilen ot örnekleri 70 °C'ye ayarlı kurutma dolabında 48 saat (Anonim, 2001) kurutulduktan sonra kuru ağırlıkları alınarak kuru ot verimi hesaplanmıştır.

Kurutulan ve öğütülen kuru ot örneklerinin ham protein, ADF (asit deterjanda çözünmeyen lif), NDF (nötr deterjanda çözünmeyen lif), Ca (kalsiyum), Mg (magnezyum), P (fosfor) ve K (potasyum) içerikleri NIRS (Near Infrared Spectroscopy) cihazı yardımıyla tespit edilmiştir.

Başyurt köyü merasının otlatma kapasitesi ve bir hayvan birimi (HB) için ihtiyaç duyulan mera alanı aşağıdaki eşitliklere göre hesaplanmıştır (Tükel ve Hatipoğlu, 2005).

$$\text{Otlatma Kapasitesi} = \frac{\text{Mera alanı} \times \text{Mera Verimi} \times \text{Yararlanma Oranı}}{1 \text{ Hayvanın 1 Günlük Yem Tüketimi} \times \text{Otlatma Gün Sayısı}}$$

$$1 \text{ HB için Gerekl} \text{ Mera Alanı (da)} = \frac{\text{Otlatma Periyodu (gün)} \times \text{1 HB'nin 1 günlük Kuru Ot Gereksinimi}}{\text{Mera Verimi} \times \text{Faydalanılabilir Yem Oranı}}$$

Elde edilen verilere tesadüf blokları deneme desenine göre varyans analizi uygulanmıştır. Grupların ortalaması LSD testi ile karşılaştırılmıştır (JMP 5.0.1, 2002).

3.BULGULAR ve TARTIŞMA

Mera otunun verim özellikleri

Başyurt köyü merasındaki bitkilerin ortalama bitki boyu, yeşil ot ve kuru ot verimleri Tablo 1'de verilmiştir.

Tablo 1. Başyurt köyü merası bitkilerinin bitki boyu, yeşil ot ve kuru ot verimleri			
Mera parselleri	Bitki Boyu (cm)	Yeşil Ot Verimi (kg/da)	Kuru Ot Verimi (kg/da)
A-Parseli	12.8	884 b	184 b
B-Parseli	13.7	955 b	192 b
C-Parseli	11.2	622 c	138 c
D-Parseli	12.8	1171 a	236 a
Ortalama	12.6	908	187
Önem	--	**	**
CV (%)	18.8	6.5	11.2

Mera parselleri arasında bitki boyu açısından istatistiksel olarak bir farklılık görülmemiştir. Yeşil ot ve kuru ot verimleri ise en yüksek değerlerini D parselinde verirken, en düşük yeşil ot ve kuru ot verimleri de C parselinden elde edilmiştir. Başyurt köyü merasında bitki boyu ortalaması 12.6 cm, yeşil ot verimi ortalama 908 kg/da, kuru ot verimi ise ortalama 187 kg/da olarak tespit edilmiştir (Tablo 1).

En yüksek yeşil ot ve kuru ot verimlerinin D parselinden elde edilmesinin nedeni, bu parselin yerleşim yerlerine diğer parsellere göre nispeten uzak olmasından kaynaklanmaktadır. Yerleşim yerlerine en yakın yerler A ve B parselleridir. Bu nedenle bu parseller eşit bir şekilde otlatma baskısı altında yer almakta ve elde edilen sonuçlar açısından da istatistiksel olarak aynı grupta yer almaktadır. En düşük yeşil ve kuru ot veriminin C parselinden elde edilmesinin nedeni ise bu parselde eğimin diğer parsellere göre biraz daha fazla olmasından



kaynaklanmaktadır. Eğimin fazla olması bitki ile kaplı alan oranının daha düşük olmasına, sonuç olarak yeşil ve kuru ot verimlerinin düşük olmasına yol açmaktadır.

Mevcut çalışmadan elde edilen bulgular, Bingöl ilinde korunan bir alanda 788 kg/da yeşil ot verimi ve 203 kg/da kuru ot verimi (Çaçan vd., 2014), Mardin ilinde doğal bir mera alanında 189 kg/da kuru ot verimi (Aydın vd., 2014) ve Uşak ilinde mayıs ayı ile temmuz ayları arasında ortalama 267 kg/da olarak elde edilen kuru ot verimleri (Kabaş ve Türk, 2019) ile benzerlik göstermektedir.

Mera otunun kalite özellikleri

Başyurt köyü merasında ortalama ham protein oranı %20.3, ADF oranı %29.5 ve NDF oranı %43.8 olarak belirlenmiştir. En yüksek ham protein oranı A, B ve C parsellerinden elde edilirken, en düşük ADF ve NDF oranlarının ise B ve C parsellerinden elde edildiği görülmektedir (Tablo 2). Kalite açısından birbirine yakın olan B ve C parsellerinin kalite açısından birbirine yakın sonuçlar verdiği görülmektedir.

Tablo 2. Başyurt köyü merasının ham protein, ADF, NDF, Ca, Mg, P ve K oranları

Mera parselleri	Ham Protein (%)	ADF (%)	NDF (%)	Ca (%)	Mg (%)	P (%)	K (%)
A-Parseli	20.3 ab	32.5 a	47.9 a	0.89	0.21	0.42	2.88
B-Parseli	20.9 a	26.3 c	38.4 b	1.13	0.30	0.40	2.70
C-Parseli	21.7 a	28.2 bc	42.7 ab	0.84	0.23	0.43	3.03
D-Parseli	18.4 b	30.9 ab	46.1 a	0.90	0.25	0.40	2.66
Ortalama	20.3	29.5	43.8	0.94	0.25	0.41	2.82
Önem	*	**	*	--	--	--	--
CV (%)	6.2	6.1	7.7	17.8	19.4	10.2	13.1

Ca, Mg, P ve K oranları, Başyurt köyü merasının parselleri arasında istatistiksel olarak bir farklılık göstermemiştir. Ca oranları %0.84-1.13, Mg oranları %0.21-0.30, P oranları %0.41-0.43 ve K oranları ise %2.66-3.03 arasında değişim göstermiştir (Tablo 2).

Meralardaki otun kalitesi esasında iki faktörün etkisi altında şekillenmektedir. Birincisi meralardaki otun bileşimi, ikincisi ise mera otunun biçim zamanıdır. Birinci faktör olan otun bileşiminden kast edilen mera otunun botanik kompozisyonudur. Mera otunun kalitesi büyük oranda botanik kompozisyon ile ilgilidir. Bazı meralarda baklagiller, bazılarında buğdaygiller, bazılarında ise diğer familya bitkileri ağırlıkta olabilmektedir. Mera otunun bileşimi çok farklı olduğu için farklı meralarda yürütülen çalışmalarda farklı sonuçlar elde edilmektedir. Bu şekilde yapılan analizler haliyle farklı sonuçların elde edilmesine sebebiyet vermektedir. Bu yüzden daha önce yapılan çalışmalara bakıldığında birbirinden oldukça farklı kalite sonuçları ile karşılaşılmaktadır. Örneğin, Erzurum ilinin bazı meralarında yürütülen çalışmada ham protein oranı buğdaygillerde %11.76, baklagillerde %21.05, diğer familya bitkilerinde %15.74 ve genel ortalama olarak %16.18 (Bakoğlu vd., 1999) olarak tespit edilmiştir. Diğer bir faktör olan biçim zamanının da mera otunun kalitesi üzerine etkisi büyüktür. Örneğin Bingöl ilinde yürütülen bir çalışmada Nisan ayında biçilen mera otundaki ham protein oranı ortalama %21.1 iken, ekim ayında bu oran %10.7'ye kadar gerilemiştir (Tarhan ve Çaçan, 2020). Bu iki durum aynı şekilde ADF ve NDF oranlarına da sirayet etmektedir.

Ca, Mg, P ve K mineral madde içeriklerinin, Erzurum ilinde elde edilen %1.00 Ca, 2391 ppm Mg, 1725 ppm P ve %3.85 K oranları ile (Bakoğlu vd., 1999), Karacadağ meralarının farklı yüksekliklerinde tespit edilen ortalama %1.09 Ca, %0.31 Mg, %0.34 P ve %2.42 K (Aydın ve



Başbağ, 2017) oranları ve Mardin ilinde yürütülen bir çalışmada elde edilen %1.59 Ca, %0.36 Mg, %0.26 P ve %1.87 K (Aydın vd., 2014) oranları ile benzerlik göstermektedir.

Otlatma kapasitesi

Başyurt köyü merasının otlatma kapasitesi 42 HB olarak tespit edilmiştir ve 1 HB başına gerekli mera alanı ise 20 da olarak hesaplanmıştır.

Otlatma kapasitesi= $(841 \text{ da} \times 187 \text{ kg/da} \times 0.5) / (12.5 \times 150) = 91\ 443 / 1\ 875 = 42 \text{ HB}$

1 HB için gerekli mera alanı= $(12.5 \times 150) / (187 \times 0.5) = 1\ 875 / 93.5 = 20 \text{ da}$ 'dır.

Otlatma kapasitesini etkileyen birçok faktör vardır. Ancak en önemli faktörlerin mera alanı, mera verimi ve otlatma mevsimi olduğunu söylemek mümkündür. Örneğin Bingöl ilinde yürütülen bir çalışmada 100 da genişliğinde mera alanı üzerinde yapılan bir hesaplamada otlatma kapasitesi 1.24 HB, 1 HB için gerekli mera alanı da 80 da olarak hesap edilmiştir (Çaçan ve Kökten, 2014). Konya ilinde 36.9 HB olarak tespit edilen otlatma kapasitesi (Babalık, 2019), Antalya ilinde 179 HB olarak tespit edilmiştir (Babalık ve Matrasulov, 2020). Dolayısıyla gerek büyüklük ve gerekse verim açısından farklılık gösteren meralarda, otlatma kapasitesi açısından büyük farklılıklar ortaya çıkmaktadır.

4.SONUÇ

Elazığ ili Karakoçan ilçesi Başyurt köyü merasının verim ve kalite özelliklerine bakıldığında, verim ve kalite özellikleri açısından makul bir seviyede olduğu görülmektedir. Ancak bu meranın klimaks mera yapısında olduğunu söylemek de mümkün değildir. Bu meranın klimaks mera yapısından daha da uzaklaşmasına sebep olmamak için yani gerek mevcut durumunun muhafaza edilmesi açısından ve gerekse de verim ve kalitesinin daha da artırılması amacıyla bu merada münavebeli otlatma sistemine geçilmesi, gübreleme yoluyla verim ve kalitesinin artırılması tavsiye edilmektedir.

5.TEŞEKKÜR

Desteklerinden dolayı Elazığ İl Tarım ve Orman Müdürlüğü Çayır Mera ve Yem Bitkileri Şube Müdürlüğü çalışanlarına teşekkür ederiz.



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VAN İLİNİN TARIMDA ALET VE MAKİNA KULLANIM PROJEKSİYONU

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ÖZET

Tarımsal mekanizasyon, toprak işleme de kas gücü ile başlamış bunu hayvanların gücünden yararlanma izlemiş ardından basit aletlerden yararlanma ve onu makine kullanımı izlemiştir. Tarımsal mekanizasyon; diğer tarımsal üretim faaliyetlerinin etkinliğini artırmak, ekonomikliğini sağlamak ve çalışma koşullarını iyileştirmek açısından oldukça önemlidir. Mekanizasyonda teknik etkinliğinin artırılması için mekanizasyon işletmeciliği ve organizasyon kalitesinin artırılması gerekir. Tarımsal mekanizasyon düzeyinin planlanması; traktör ile tarım alet-makina parkının çeşitliliğinin artırılarak etkin hale getirilmesi ile sağlanabilir. Toprak işleme alet ve makinalarının işlevlerini en iyi şekilde yerine getirebilmesi, toprak işleme kalitesi ile çalışma verimini artıran önemli bir faktör olarak karşımıza çıkmaktadır. Gelişen teknolojiyle birlikte tarımsal sektörde kullanılan alet ve makinalar da gelişimini sürdürmüştür. Çalışmada kullanılan veriler TÜİK'ten elde edilmiştir. Bu çalışmada, Van ilinin 2010-2019 yılları arasındaki veriler kullanılarak tarımda teknoloji kullanım projeksiyonunun belirlenmesi amaçlanmıştır. Tarımda kullanılan teknolojinin geçmiş on yıllık üretim ve kullanım miktarları baz alınarak projeksiyon katsayısı hesaplanmıştır. Projeksiyon katsayısının artışı veya azalışı doğrultusunda Van ilinde tarımda teknoloji kullanımına ait on yıllık projeksiyonları belirlenmiştir. Bu kapsamda Van'te yaygın olarak kullanılan (toprak işleme alet ve makinaları, ekim-dikim ve gübreleme makinaları, hasat-harman ve balya makinaları, traktör ve römork, ilaçlama alet makinaları, silaj ve çayır biçme makineleri ile diğer ekipmanlar) 40 adet tarım alet makinanın kullanım projeksiyonu dikkate alınmıştır. Van tarımda teknoloji kullanım projeksiyonunun, ele alınan 35 adet tarım alet ve makinaları için belirlenen projeksiyon katsayılarının pozitif elde edilmesi doğrultusunda 2029 yılına kadar artacağı, 5 adet alet ve makine için belirlenen projeksiyon katsayısının ise negatif elde edildiği ve bu alet ve makinalarda azalma olacağı sonucuna varılmıştır.

Anahtar Kelimeler: Tarım makinaları, mekanizasyon, projeksiyon, alet, Van



PROJECTION OF AGRICULTURAL TOOLS AND MACHINERY USAGE IN AGRICULTURE IN VAN

ABSTRACT

Agricultural mechanization, tillage also started with muscle power, followed by the use of animal power, followed by the use of simple tools and the use of machinery. Agricultural mechanization is very important in order to increase the efficiency of other agricultural production activities, to ensure its economy and to improve working conditions. In order to increase the technical efficiency in mechanization. Organization quality and mechanization operation need to be increased. The quality of the soil tillage and seedbed preparation depends on how well tillage equipment is designed and its purposed function. Planning the agricultural mechanization level; It can be achieved by increasing the diversity of the tractor and the agricultural equipment-machine park and making it effective. The tillage tools and equipments used in agricultural sector have also continued their development together with improving technology. The data used in the study has obtained from Turkish Statistical Institute (TIS). This study aims to determine the projection of technology usage in agriculture by using the technology equipment data between 2010-2019 of Van province. Projection coefficient was calculated based on the past ten years production and usage amounts of the technology equipment in agriculture. In line with the increase or decrease of the projection coefficient, the projections of the future ten years belonging to the technical equipment used in agriculture have been determined in Van. Within this scope, the usage projection of 40 agricultural types of equipment (including soil cultivation equipment and machines, sowing-planting and fertilizing machines, harvest-threshing and baler machines, tractor and trailer, spraying equipment and machinery, silage and forage harvester(haylage) widely used in Van were taken into consideration. It is concluded that, in Van , the projections for 35 technology instruments and machines used in agriculture will increase up to 2029 in the direction of obtaining positive predictive coefficients. Besides, it is determined that the projection coefficient for five tools and machines will be, and accordingly, technological equipment usage will decrease in these tools and machines.

Keywords: Agricultural machinery, mechanization, projection, tools, Van



1. GİRİŞ

Tarımsal üretim artan nüfusumuzu besleyebilmek, diğer sektörlere kaynak sağlayabilmek, ulusal gelirimizi yükseltebilmek bakımından öncelikli hedeflerimizden birisi olmalıdır (Anonim 2021a). Tarımsal Mekanizasyon, tarım makinaları sektörü, tarım alanlarını daha sağlıklı hale getirmek, tarımsal üretim çeşitliliğini arttırmak ve tarımsal ürünlerin daha etkin ve çeşitli olarak kullanılmasını sağlamak ve bu doğrultuda da birçok farklı mekanik dizaynın tasarlandığı, yapıldığı, geliştirildiği ve pazarlamasının, satışının ve işletilmesinin yapıldığı, imalat sektörünün yatırım malları üreten alt sektörlerinden biri olarak tanımlanabilir (Anonim, 2021b). Mekanizasyon özellikle; sulama, toprak işleme, budama, gübreleme, hasat, hastalık ve zararlılarla mücadele gibi kültürel uygulamaların eksiksiz ve uygun zamanlarda yapılması yüksek verimin elde edilmesinde büyük önem taşımaktadır (Küçükler ve Baran, 2021). Tarımda faaliyetlerin kaliteli ve rasyonel bir şekilde yürütülebilmesi için birtakım girdilerin kullanılması kaçınılmazdır. Bu girdilerin en önemlilerinden birisi de üretimde modern tarım makinelerinin ve tekniklerinin yani tarımsal mekanizasyonun kullanılmasıdır (Korucu ve ark.,2015; Akdağ, 2019). Temel tarımsal işlerde amaca ulaşabilmek için yararlanılan mekanizasyon araçları üretim tekniği ve ürün çeşidine bağlı olarak tarımsal üretim giderlerinin % 30-60'ını oluşturmaktadır (Dilay ve Özkan, 2007).

Tarım sektörü, gelişmekte olan tüm ülkelerde olduğu gibi, ülkemizde de ulusal ekonominin temelini oluşturmaktadır. İstihdamın sektörel dağılımına bakıldığında 2017 yılı Temmuz verilerine göre toplam istihdamın yaklaşık % 20,9'unun tarım sektöründe çalıştığı görülmektedir. Böylesine büyük bir tarım sektörü neticesinde Türkiye'de güçlü bir tarımsal alet ve makina sektörü oluşmuştur (Anonim 2021 c) .

Van, sahip olduğu geniş meraları ile özellikle büyükbaş ve küçükbaş et hayvancılığı için önemli bir potansiyeli barındırmaktadır. Van'daki mera varlığı Ülkemizin mera varlığının %10'unu oluşturmaktadır. İlde kimyevi gübre ve tarımsal ilaç kullanımı düşük seviyededir. Birçok ürün doğal olarak üretilmektedir (Anonim 2021 d).

Bu çalışma ile Türkiye İstatistik Kurumu'nun 2010-2019 yıllarına ait verileri kullanılarak yoğun tarımsal faaliyetlerin yürütüldüğü Van ilinin gelecek on yıllık (2020-2029) tarımsal mekanizasyon projeksiyonunun belirlenmesi ve bu değerlerin yöredeki mekanizasyon planlamalarına yön vermesi amaçlanmıştır.

2.MATERYAL ve YÖNTEM

Çalışmanın materyalini Van ili 2010-2019 yıllarına ait Türkiye İstatistik Kurumu tarım alet ve makinaları verileri oluşturmuştur (Anonim 2021 d) .

Van dünya üzerinde 42 derece 40 dakika ve 44 derece 30 dakika Doğu boylamları ile 37 derece 43 dakika ve 39 derece 26 dakika Kuzey enlemleri arasındadır. Türkiye üzerinde ise Doğu Anadolu Bölgesinin Yukarı Murat-Van Bölümündeki Van Gölü kapalı havzasındadır. Kuzeyden Ağrı ili Doğubayazıt Diyadin ve Hamur ilçeleri; batıdan Van Gölü ile Ağrı ilinin Patnos ilçesi Bitlis' in Adilcevaz Tatvan ve Hizan ilçeleri; güneyden Siirt' in Pervari Hakkari ili Beytüşşebap ve Yüksekova ilçeleri ile komşudur. Doğusunda ise İran Devleti sınırı yer alır. İl toprakları 19.069 km kare olan yüz ölçümü ile Türkiye topraklarının %25' ini oluşturur. Van yüz ölçümü bakımından Türkiye'nin 6. büyük ilidir (Anonim 2021e).

Van ilinde kara iklimi hüküm sürer. Kışlar sert ve uzun geçer. Çok yüksek bölgelerinde, kışın daha az sert geçmesini Van Gölü temin eder. Kışın 150 güne yakını 0°C altında geçer. Yazın ise 20 gün +30°C'nin üstündedir. Toprak 80 gün karla örtülü kalır. Senelik yağış miktarı ilçelere göre 370 mm ile 570 mm arasında değişir. Yazlar az yağışlı ve çok sıcak geçer. Sıcaklık -26,9°C ile +36°C arasında seyretmektedir (Anonim 2021e).



Tarımda kullanılan teknolojinin geçmiş on yıllık üretim ve kullanım miktarları baz alınarak projeksiyon katsayısı hesaplanmıştır. Projeksiyon katsayısının artışı veya azalışı doğrultusunda Van ilinde tarımda teknoloji kullanımına ait on yıllık projeksiyonları belirlenmiştir. Bir önceki yıla ait makina sayısı ile o makina için belirlenen katsayıya bağlı olarak, Van ilinde yaygın olarak kullanılan tarım alet ve makinalarının 2029 yılına kadar olan projeksiyonlar (Demir ve Kuş 2016; Baran ve ark. 2019) çalışmalarındaki yöntem kullanılarak hesaplanmıştır. Projeksiyon katsayısının pozitif elde edilmesi, mevcut alet ve makina sayısının artmasını, negatif elde edilmesi ise azalmasını ifade etmektedir (Demir 2013; Demir ve Kuş 2016; Akbaş, 2019; Baran ve ark. 2019).

3.ARAŞTIRMA ve BULGULARI

Toprak işleme alet ve makinaları toprağın tekniğine uygun işlenmesi bitkilerin büyümesi, olgunlaşması ve meyve vermesini kolaylaştırır. Türkiye genelinde toprak işleme alet ve makinaları yaygın kullanım alanlarına sahiptirler. Van ilinde yaygın olarak kullanılan bazı toprak işleme alet ve makinalarına ait geçmiş on yıllık üretim ve kullanım miktarları, geçmiş yıl değişim oranları ve bu sayılara bağlı olarak hesaplanan projeksiyon katsayıları tablolar halinde verilmiştir. Van ilinde yaygın olarak kullanılan bazı toprak işleme alet ve makinalarına ait geçmiş on yıllık üretim ve kullanım miktarları Tablo 1, Toprak işleme alet ve makinalarının yıllara göre değişim oranları Tablo 2, toprak işleme alet ve makinalarının yıllara göre projeksiyonu Tablo 3, ekim –dikim ve gübreleme makinaları geçmiş on yıl değişim oranları ve bu sayılara bağlı olarak hesaplanan projeksiyon katsayıları Tablo 4’te, hasat-harman ve balya makinalarının geçmiş on yıl değişim oranları ve bu sayılara bağlı olarak hesaplanan projeksiyon katsayıları Tablo 5’te, yaygın olarak kullanılan ilaçlama makinalarının geçmiş on yıl değişim oranları ve bu sayılara bağlı olarak hesaplanan projeksiyon katsayıları Tablo 6’da ve traktör, Tarım arabası, silaj ve çayır biçme makinalarının geçmiş on yıl değişim oranları ve bu sayılara bağlı olarak hesaplanan projeksiyon katsayıları Tablo 7’de verilmiştir. Tablo 2’yi incelediğimizde yıllara bağlı olarak hesaplanan projeksiyon katsayılarına bakıldığında en yüksek değer, ot tırmığında % 11.3 olarak hesaplanmıştır. Bunu ise % 6.8 ile dipkazan, % 6.4 ile diskli traktör pulluğu, % 4.66 ile dişli tırmık, % 2.87 ile kültivatör, % 5.4 ile ark pulluğu, % 5.1 ile kültivatör, %4.9 ile karasaban ve karma tırmık, % 4.4 ile kulaklı traktör pulluğu, % 4.0 ile diskli tırmık, % 3.5 ile diskli anız pulluğu, %2.9 ile dişli tırmık, %2.8 ile toprak frezesi, %1.8 ile kulaklı anız pulluğu %1.6 ile merdane izlemiştir. 2010 ve 2019 yıllarında, bir önceki yıla göre artışın olması nedeniyle pozitif olarak hesaplanan geçmiş yıl değişim oranları, projeksiyon katsayısının artmasına neden olmuştur (Tablo3).



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Tablo 1. Toprak İşleme Alet ve Makinaları

YILLAR	Ot Tırmığı	Diskli amız pulluğu	Diskli tırmık (Diskarolar)	Diskli traktör pulluğu	Dişli tırmık	Ark açma pulluğu	Karasaban	Kombikürüm (Karma tırmık)	Kulaklı Amız pulluğu	Kültivatör	Kulaklı traktör pulluğu	Merdane	Toprak frezesi (Rotovatör)	Dipkazan
2010	501	71	1220	330	528	212	37	50	60	1754	3 515	75 682	33	42
2011	523	71	1243	335	543	212	37	50	60	1760	3 526	77 445	33	44
2012	543	76	1292	337	557	234	39	60	60	1843	3 606	77 294	35	46
2013	568	78	1320	346	575	236	39	62	65	1852	3 626	81 094	41	48
2014	731	86	1434	485	523	285	39	60	66	1874	4 029	82 100	32	66
2015	791	87	1476	492	535	288	39	61	66	1918	4 178	83 033	37	74
2016	889	89	1497	523	553	303	40	61	75	1941	4 260	83 487	38	87
2017	945	91	1518	588	597	309	65	67	75	2041	4 407	84 819	41	89
2018	1194	93	1531	575	591	345	65	72	60	2530	4 753	86 138	43	92
2019	1527	98	1771	625	705	355	64	80	75	2853	5 325	87 374	45	83

Tablo 2. Toprak İşleme Alet ve Makinalarının Yıllara Göre Değişim Oranları

YILLAR	Ot Tırmığı	Diskli amız pulluğu	Diskli tırmık (Diskarolar)	Diskli traktör pulluğu	Dişli tırmık	Ark açma pulluğu	Karasaban	Kombikürüm (Karma tırmık)	Kulaklı Amız pulluğu	Kültivatör	Kulaklı traktör pulluğu	Merdane	Toprak frezesi (Rotovatör)	Dipkazan
2010/ 2011	4,2	0,0	1,9	1,5	2,8	0,0	0,0	0,0	0,0	0,3	0,3	2,3	0,0	4,5
2011/ 2012	3,7	6,6	3,8	0,6	2,5	9,4	5,1	16,7	0,0	4,5	2,2	-0,2	5,7	4,3
2012/ 2013	4,4	2,6	2,1	2,6	3,1	0,8	0,0	3,2	7,7	0,5	0,6	4,7	14,6	4,2
2013/ 2014	22,3	9,3	7,9	28,7	-9,9	17,2	0,0	-3,3	1,5	1,2	10,0	1,2	-28,1	27,3
2014/ 2015	7,6	1,1	2,8	1,4	2,2	1,0	0,0	1,6	0,0	2,3	3,6	1,1	13,5	10,8
2015/ 2016	11,0	2,2	1,4	5,9	3,3	5,0	2,5	0,0	12,0	1,2	1,9	0,5	2,6	14,9
2016/ 2017	5,9	2,2	1,4	11,1	7,4	1,9	38,5	9,0	0,0	4,9	3,3	1,6	7,3	2,2
2017/ 2018	20,9	2,2	0,8	-2,3	-1,0	10,4	0,0	6,9	-25,0	19,3	7,3	1,5	4,7	3,3
2018/ 2019	21,8	5,1	13,6	8,0	16,2	2,8	-1,6	10,0	20,0	11,3	10,7	1,4	4,4	-10,8
<i>Projeksiyon Katsayısı</i>	<i>11,3</i>	<i>3,5</i>	<i>4,0</i>	<i>6,4</i>	<i>2,9</i>	<i>5,4</i>	<i>4,9</i>	<i>4,9</i>	<i>1,8</i>	<i>5,1</i>	<i>4,4</i>	<i>1,6</i>	<i>2,8</i>	<i>6,8</i>



Tablo 3. Toprak İşleme Alet ve Makinalarının Yıllara Göre Projeksiyonu

YILLAR	Ot Tırmağı	Diskli anız pulluğu (Vanvey)	Diskli trımuk (Diskarolar)	Diskli traktör pulluğu	Dişli trımuk	Ark açma pulluğu	Karasaban	Kombikürüm (Karna trımuk)	Kulaklı Anız pulluğu	Kültivatör	Kulaklı traktör pulluğu	Merdane	Toprak frezesi (Rotovator)	Dipkazan
2020	1700	101	1841	665	726	374	67	84	76	2997	5561	88750	46	89
2021	1892	105	1914	707	747	394	70	88	78	3149	5808	90148	48	95
2022	2106	109	1991	753	769	416	74	92	79	3308	6066	91568	49	101
2023	2344	112	2070	801	792	438	78	97	81	3476	6335	93010	50	108
2024	2609	116	2152	852	815	462	81	102	82	3652	6616	94475	52	115
2025	2904	120	2237	906	839	487	86	107	83	3836	6909	95964	53	123
2026	3233	124	2326	964	864	513	90	112	85	4030	7216	97475	54	131
2027	3598	129	2418	1026	889	541	94	117	87	4234	7536	99010	56	140
2028	4005	133	2515	1091	915	570	99	123	88	4448	7871	100570	57	149
2029	4458	138	2614	1161	942	601	104	129	90	4673	8220	102154	59	159

Van ilinde yaygın olarak kullanılan bazı 4 farklı çeşit ekim, 2 farklı çeşit gübreleme ve 2 çeşit dikim makinalarına ait geçmiş on yıllık üretim ve kullanım miktarları, geçmiş yıl değişim oranları ve bu sayılara bağlı olarak hesaplanan projeksiyon katsayıları ise Tablo 4'te verilmiştir. Tablo 4'ü incelediğimizde ekim makinaları çeşitlerinde; Üniversal ekim makinasında 2010 yılında 22 adet iken 2019 yılında 72 adete ulaşmıştır. Tablo'da belirtilen % 10.98 projeksiyon katsayısı ile üniversal ekim makinesi 2029 yılında 204 adete yükseleceğini, Traktörle çekilen hububat ekim makinesi'nde tablo'da belirtilen % 3.56 projeksiyon katsayısı ile traktörle çekilen hububat ekim makinesi 2029 yılında 2027 adete yükseleceğini, kombine hububat ekim makinasında % 1.85 projeksiyon katsayısı ile 2029 yılında 318 adete, pnömomatik ekim makinasında % 0.88 projeksiyon katsayısı ile 2029 yılında 27 adete yükseleceğini söylemek mümkündür. Dikim makinaları projeksiyon katsayıları fide dikim makinası %18.86 , patates dikim makinaları %7.20 , gübrelemede kullanılan makinalarda projeksiyon katsayısı kimyevi gübreleme makinasında ise %5.08 olarak pozitif artış görülmektedir. Yıllara göre işaret eden projeksiyon katsayısı oranı 2029 yılında fide dikim makinalarında 141 adet, patates dikim makinalarında 32 adet, kimyevi gübre dağıtma makinasında ise 584 adete kadar yükselebileceğini öngörmektedir.



Tablo 4. Van İlinde Yaygın Olarak Kullanılan Bazı Ekim –Dikim Gübreleme Makinaları Projeksiyonu

Ekim –Dikim ve Gübreleme Makinaları		Patates dikim makinesi	Fide dikim makinesi	Kimyevi gübre dağıtma makinesi	Kombine hububat ekim makinesi	Traktörle çekilen hububat ekim makinesi	Pnömatik ekim makinesi	Çiftlik gübresi dağıtma makinesi	Üniversal ekim makinesi
Yıllar	2010	8	1	222	204	1018	22	24	22
	2011	8	1	225	225	1064	23	25	22
	2012	10	1	234	272	1084	25	26	23
	2013	11	2	240	285	1097	30	31	27
	2014	11	18	264	205	1093	32	30	50
	2015	12	18	281	215	1113	32	30	50
	2016	12	21	290	220	1124	34	34	52
	2017	13	22	309	227	1146	34	36	54
	2018	14	25	329	262	1184	29	41	57
	2019	16	25	356	265	1429	25	27	72
Yıllara Göre Değişim Oranları	2010/ 2011	0,00	0,00	1,33	9,33	4,32	4,35	4,00	0,00
	2011/ 2012	20,00	0,00	3,85	17,28	1,85	8,00	3,85	4,35
	2012/ 2013	9,09	50,00	2,50	4,56	1,19	16,67	16,13	14,81
	2013/ 2014	0,00	88,89	9,09	-39,02	-0,37	6,25	-3,33	46,00
	2014/ 2015	8,33	0,00	6,05	4,65	1,80	0,00	0,00	0,00
	2015/ 2016	0,00	14,29	3,10	2,27	0,98	5,88	11,76	3,85
	2016/ 2017	7,69	4,55	6,15	3,08	1,92	0,00	5,56	3,70
	2017/ 2018	7,14	12,00	6,08	13,36	3,21	-17,24	12,20	5,26
2018/ 2019	12,50	0,00	7,58	1,13	17,14	-16,00	-51,85	20,83	
Projeksiyon katsayıları		7,20	18,86	5,08	1,85	3,56	0,88	-0,19	10,98
Projeksiyon	2020	17	30	374	270	1480	25	27	80
	2021	18	35	393	275	1533	25	27	89
	2022	20	42	413	280	1587	26	27	98
	2023	21	50	434	285	1644	26	27	109
	2024	23	59	456	290	1702	26	27	121
	2025	24	70	479	296	1763	26	27	135
	2026	26	84	504	301	1825	27	27	149
	2027	28	100	529	307	1890	27	27	166
	2028	30	118	556	313	1958	27	27	184
	2029	32	141	584	318	2027	27	26	204



Tablo 5. Van İlinde Yaygın Olarak Kullanılan Hasat-Harman, Saman ve Balya Makinaları Projeksiyonu

Hasat Harman, Balya ve Biçme Makinaları		Biçerdöver	Biçer bağlar makinesi	Sap döver ve harman makinesi (Batöz)	Pancar sökme makinesi	Patates sökme makinesi	Sap Toplamalı Saman Yapma Makinesi	Balya makinesi	Orak Makinesi
Yıllar	2010	2	440	2063	25	6	10	61	69
	2011	2	451	2161	30	6	10	58	74
	2012	3	513	2187	31	10	57	67	74
	2013	3	539	2227	31	12	116	77	73
	2014	3	460	2019	21	14	149	74	107
	2015	3	470	2102	21	15	154	80	107
	2016	4	482	2144	22	15	161	81	112
	2017	41	489	2175	25	17	175	85	114
	2018	31	439	2286	29	18	202	92	95
	2019	6	397	2339	32	20	195	89	90
Yıllara Göre Değişim Oranları	2010/ 2011	0,00	2,44	4,53	16,67	0,00	0,00	-5,17	6,76
	2011/ 2012	33,33	12,09	1,19	3,23	40,00	82,46	13,43	0,00
	2012/ 2013	0,00	4,82	1,80	0,00	16,67	50,86	12,99	-1,37
	2013/ 2014	0,00	-17,17	-10,30	-47,62	14,29	22,15	-4,05	31,78
	2014/ 2015	0,00	2,13	3,95	0,00	6,67	3,25	7,50	0,00
	2015/ 2016	25,00	2,49	1,96	4,55	0,00	4,35	1,23	4,46
	2016/ 2017	90,24	1,43	1,43	12,00	11,76	8,00	4,71	1,75
	2017/ 2018	-32,26	-11,39	4,86	13,79	5,56	13,37	7,61	-20,00
2018/ 2019	-416,67	-10,58	2,27	9,38	10,00	-3,59	-3,37	-5,56	
Projeksiyon katsayıları		-33,37	-1,53	1,30	1,33	11,66	20,09	3,87	1,98
Projeksiyon	2020	4	391	2369	32	22	234	92	92
	2021	3	385	2400	33	25	281	96	94
	2022	2	379	2431	33	28	338	100	95
	2023	1	373	2463	34	31	406	104	97
	2024	1	368	2495	34	35	487	108	99
	2025	1	362	2527	35	39	585	112	101
	2026	0	356	2560	35	43	703	116	103
	2027	0	351	2593	36	48	844	121	105
	2028	0	346	2627	36	54	1013	125	107
	2029	0	340	2661	37	60	1217	130	110

Çiftlik gübresi dağıtma makinalarında (% -0.19) 2010 ve 2019 yıllarında, bir önceki yıla göre azalışın olması nedeniyle negatif olarak hesaplanan geçmiş yıl değişim oranları, projeksiyon katsayısının azalmasına neden olmuştur. Van ilinde yaygın olarak kullanılan diğer hasat makinalarının projeksiyon katsayıları; biçerdöver %-33.37, biçer-bağlar makinası % -1.53, sap döver ve harman makinası (Batöz) % 1.30, orak makinası % 1.98, olarak hesaplanmıştır. Biçerdöver ve biçer-bağlar makinalarında 2010 ve 2019 yıllarında, bir önceki yıla göre azalışın



olması nedeniyle negatif olarak hesaplanan geçmiş yıl değişim oranları, projeksiyon katsayısının azalmasına neden olmuştur. Balya makinası projeksiyon katsayısı %3.87, sap toplama makinası %20.09, pancar sökme makinesi %1.33, patates sökme makinesi %11.66 hesaplanmıştır.

Tablo 6. Van İlinde Yaygın Olarak Kullanılan İlaçlama Makinaları Projeksiyonu

Alet ve Makinalar		Motorlu pulverizatör	Kuyruk milinden hareketli pulverizatör	Sedyeli, motorlu pulverizatör tozlayıcı kombine atomizör	Atomizör	Sırt pulverizatörü
Yıllar	2010	91	130	51	168	1460
	2011	101	155	51	168	1474
	2012	122	205	53	170	1482
	2013	150	228	53	180	1510
	2014	134	282	44	83	1394
	2015	141	311	44	84	1465
	2016	148	315	44	85	1483
	2017	154	336	45	87	1546
	2018	163	351	46	89	1666
	2019	149	351	43	94	1835
Yıllara Göre Değişim Oranları	2010/ 2011	9,90	16,13	0,00	0,00	0,95
	2011/ 2012	17,21	24,39	3,77	1,18	0,54
	2012/ 2013	18,67	10,09	0,00	5,56	1,85
	2013/ 2014	-11,94	19,15	-20,45	-116,87	-8,32
	2014/ 2015	4,96	9,32	0,00	1,19	4,85
	2015/ 2016	4,73	1,27	0,00	1,18	1,21
	2016/ 2017	3,90	6,25	2,22	2,30	4,08
	2017/ 2018	5,52	4,27	2,17	2,25	7,20
	2018/ 2019	-9,40	0,00	-6,98	5,32	9,21
Projeksiyon katsayısı		4,84	10,10	-2,14	-10,88	2,40
Projeksiyon	2020	156	386	42	84	1879
	2021	164	425	41	75	1924
	2022	172	468	40	67	1970
	2023	180	516	39	59	2017
	2024	189	568	39	53	2066
	2025	198	625	38	47	2115
	2026	207	688	37	42	2166
	2027	217	758	36	37	2218
	2028	228	834	35	33	2271
	2029	239	918	35	30	2325



Tablo 7. Traktör, Tarım arabası ve Silaj ve Çayır Biçme Makinaları

Alet ve Makinalar		Römork (Tarım arabası)	Traktör	Mısır silaj makinesi	Ot silaj makinesi	Traktörle çekilen çayır biçme makinesi
Yıllar	2010	4438	4 849	19	2	1347
	2011	4550	4 913	20	2	1421
	2012	4675	4 997	23	2	1457
	2013	4750	5 110	25	2	1713
	2014	4968	5 382	27	2	1849
	2015	5016	5 559	27	3	1930
	2016	5091	5 637	29	3	1963
	2017	5156	5 774	32	3	2017
	2018	5588	6 175	36	3	2531
	2019	5853	6 801	37	3	2854
Yıllara Göre Değişim Oranları	2010/ 2011	2,46	1,30	5,00	0,00	5,21
	2011/ 2012	2,67	1,68	13,04	0,00	2,47
	2012/ 2013	1,58	2,21	8,00	0,00	14,94
	2013/ 2014	4,39	5,05	7,41	0,00	7,36
	2014/ 2015	0,96	3,18	0,00	33,33	4,20
	2015/ 2016	1,47	1,38	6,90	0,00	1,68
	2016/ 2017	1,26	2,37	9,38	0,00	2,68
	2017/ 2018	7,73	6,49	11,11	0,00	20,31
	2018/ 2019	4,53	9,20	2,70	0,00	11,32
Projeksiyon katsayısı		3,01	3,65	7,06	3,70	7,80
Projeksiyon	2020	6029	7050	40	3	3076
	2021	6210	7307	42	3	3316
	2022	6397	7574	45	3	3575
	2023	6589	7851	49	3	3854
	2024	6787	8138	52	4	4154
	2025	6991	8435	56	4	4478
	2026	7201	8743	60	4	4827
	2027	7418	9063	64	4	5203
	2028	7641	9394	68	4	5609
	2029	7870	9737	73	4	6046

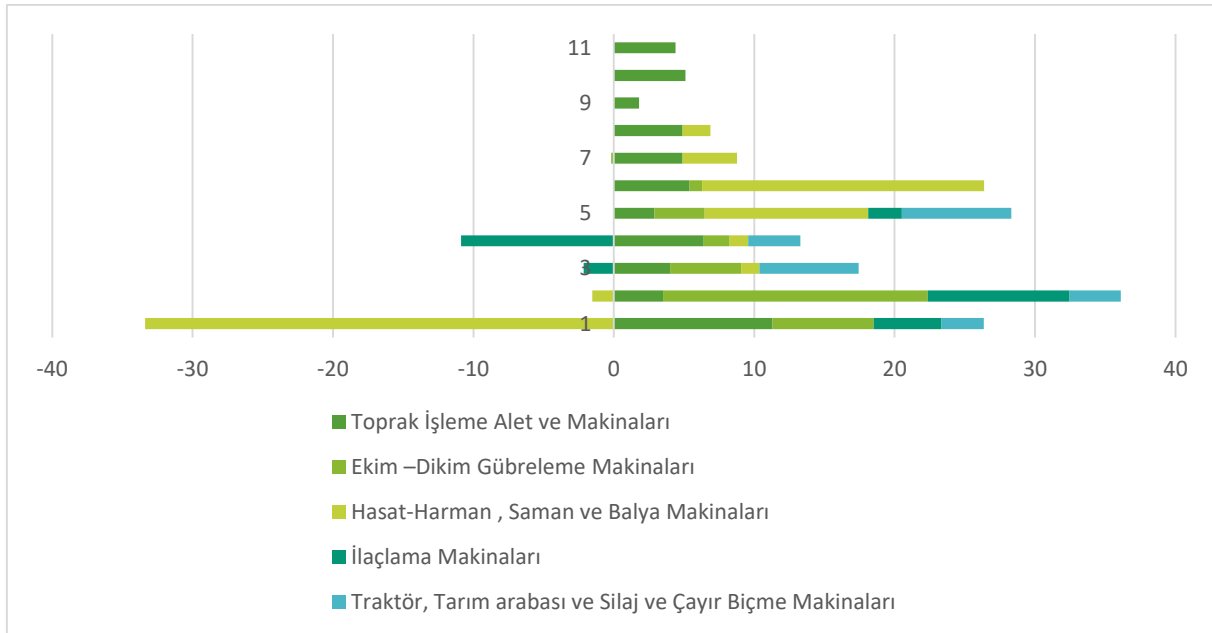
Yıllara göre işaret eden projeksiyon katsayısı oranı pozitif olan makinaların 2029 yılında balya makinasında 13 adet, orak makinasında 110 adet, sap döver ve harman makinası (Batöz) 2661 adet, sap toplamalı saman yapma makinasında 1217 adet, pancar söküm makinalarında 37 adet, patates söküm makinalarında 60 adete kadar yükselebileceğini öngörmektedir.

Tarımsal üretimde ve elde edilen ürünlerin depolanmasında hastalıklar, zararlar ve yabancı otların olumsuz etkilerinden korunmak için ilaçlama makinaları kullanılır (Solak ve ark. 2019). Tablo 6'ya bakıldığında kuyruk milinden hareketli pulverizatör sayısının 2010 yılında 130 adet iken 2019 yılında 351 adete ulaştığı görülmektedir. Tablonun bize verdiği %25 projeksiyon katsayısı ile kuyruk milinden hareketli pülverizatör sayısının 2029 yılında 918 adete



yükseleceğini söylemek mümkündür. Van ilinde yaygın olarak kullanılan diğer ilaçlama alet ve makinalarının projeksiyon katsayıları; motorlu pülverizatör % 4.84, sırt pülverizatörü ise % 2.40 olarak hesaplanmıştır. Sedyeli, motorlu pulverizatör tozlayıcı kombine atomizör ve atomizör 2010 ve 2019 yıllarında, bir önceki yıla göre azalışın olması nedeniyle negatif olarak hesaplanan geçmiş yıl değişim oranları, projeksiyon katsayısının azalmasına sebep olmuştur. Traktör tarımsal faaliyetlerde kullanılan tekerlekli, paletli veya her ikisi birlikte mevcut kendi yürür kuvvet makinesi olarak tarif edilebilir. Traktör Fransızca kökenli bir kelime olup, kelime olarak çeken manasına gelmekte ise de bugün için traktörlerde çeki işlerinin yanında kasnak, kuyruk mili, yükleme-boşaltma gibi çalışmaların yapılmasında da faydalanılmaktadır (Anonim 2021f).

Tablo 7'ye bakıldığında traktör sayısının 2010 yılında 4849 adet iken 2019 yılında 6801 adete ulaştığı görülmektedir. Tablonun bize verdiği %3.65 projeksiyon katsayısı ile Van ilinde traktör sayısının 2029 yılında traktör sayısının 9737 adete yükseleceğini söylemek mümkündür. Genelde traktör ile birlikte kullanılan römork (tarım arabası) sayısının 2010 yılında 4438 adet iken 2019 yılında ise 5853 adet olduğu görülmektedir. Tabloya göre Römork (tarım arabası) projeksiyon katsayısı % 3.01 ile Van ilinde tarım arabasının 2029 yılında 7870 adete yükseleceği söylemek mümkündür. Projeksiyon katsayılarına göre 2029 yılında mısır silaj makinası 73 adet, çayır biçme makinasının ise 6046 adete yükseleceğini söyleyebiliriz. Projeksiyon katsayıları Şekil 1'de verilmiştir.



Şekil.1 Projeksiyon Katsayıları

4.SONUÇ VE ÖNERİLER

Tarımsal mekanizasyonun 4 temel unsuru vardır. Bunlar, insan, çevre, traktör ve tarım iş makinasıdır. Tarımsal mekanizasyon planlaması, bu dört temel unsurun tarımsal mekanizasyon masraflarını minimize edecek şekilde optimizasyonu olarak tarif edilebilir (Solak ve ark. 2019). Çalışmada Van ilinin gelecek on yıllık (2020-2029) tarım alet-makina projeksiyonu; bitki bakım ve koruma, toprak işleme, ekim, dikim, gübreleme ve hayvancılıkta kullanılan tarım alet-



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makinalar şeklinde sınıflandırılarak yaygın olarak kullanılan 40 adet tarım alet makinanın kullanım projeksiyonu dikkate alınmıştır. Van İli tarımda teknoloji kullanım projeksiyonunun, ele alınan 35 adet alet ve makinaları için belirlenen projeksiyon katsayılarının pozitif elde edilmesi doğrultusunda 2029 yılına kadar artacağı, 5 adet alet ve makine için belirlenen projeksiyon katsayısının ise negatif elde edildiği ve bu alet ve makinalarda azalma olacağı sonucuna varılmıştır. Tarımda teknoloji kullanım projeksiyonu değerlerinin düşük elde edilmesi, ildeki makina kullanım etkinliğinin az olduğunu da göstermektedir. Tarımsal üretimin arttırılmasında tarım teknolojisi uygulamalarının yaygınlaştırılması ve bilinçli yapılması temel amaç olmalıdır.



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BATMAN İLİNDE BULUNAN TAHIL SAP ATIKLARININ BAZI ENERJİ DEĞERLERİNİN ANALİZİ

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ÖZET

Artan dünya nüfusu ile birlikte doğru orantılı olarak oluşan atıkların miktarı ve enerji ihtiyacı da sürekli olarak artmaktadır. Oluşan atıkların çevresel acıdan oluşturduğu olumsuz etki sebebiyle bertaraf edilme zorunluluğu ve fosil kökenli enerji kaynaklarının gün geçtikçe azalması ve enerji açığının giderek artması mevcut kaynakların daha etkin kullanımını ve yenilenebilir enerji kaynaklarına olan yönelimi gerekli kılmaktadır. Tarımsal atık, her türlü bitkisel ve hayvansal ürün elde edilirken, ürünün işlenmesi sırasında veya sonrasında ortaya çıkan atıklardır. Tarımsal atıkların ortaya çıkışında ve miktarında, üretilen ürün miktarının yanı sıra üretimin gerçekleştiği toplumun sosyoekonomik özellikleri, beslenme alışkanlıkları, gelenekler, coğrafi koşullar, iklim, sanayi tesisine olan uzaklık, eğitim gibi birçok etken mevcuttur. Ülkemiz tarımsal atık üretiminde kullanılacak ham madde kaynakları açısından önemli potansiyel değere sahiptir. Enerjideki dışa bağımlığımızı dikkate aldığımızda tarımsal atıkların daha verimli bir şekilde enerjiye dönüştürülmesinin gerekliliği ortaya çıkmaktadır. Bu çalışmada, Batman ilinin tahıl sap atık potansiyelinin belirlenmesinde, Batman, Tarım ve İl Müdürlüğü'nün 2020 yılı bitkisel üretim istatistiklerinden (İVA), yararlanılmıştır. Batman ili 2020 yılına ait kullanılabilir bazı tahıl (buğday, arpa, mercimek, nohut ve mısır) sap atık değerlerinden elde edilebilecek organik atık miktarı (ton/yıl), organik atıklardan elde edilebilecek kuru madde miktarı (ton/yıl), kuru maddeden temin edilebilecek uçucu kuru madde miktarı, toplam metan miktarı (m³/yıl) ve metan gazından elde edilebilecek enerji potansiyel değerleri belirlenmiştir. Yapılan hesaplamalar sonucunda tahıl sap atık miktarı 5318,41 ton/yıl, ortalama kuru madde miktarı 4680,20 ton/yıl, uçucu kuru madde miktarı 4627,02 ton/yıl, toplam metan üretim potansiyeli 1156,75 m³/yıl ve enerji potansiyeli 41643,15 MJ/yıl olarak belirlenmiştir.

Anahtar Kelimeler: Batman, tarımsal atık, tahıl sapı, enerji



ANALYSIS OF SOME ENERGY VALUES OF GRAIN STEM WASTES IN BATMAN PROVINCE

ABSTRACT

Through increasing world population, amount of generated waste and also energy demand increase continuously. In order to prevent use of decreasing fossil-based energy resources and reduce energy deficit as well as to dispose of waste and reduce its negative impact on the environment it is necessary to use available resources effectively and renewable energy sources. Agricultural residue is residues generated during or after the processing of the product, when all kinds of plant and animal products are obtained. In the emergence and amount of agricultural residues, there are many factors such as the socioeconomic characteristics of the production, the dietary habits, traditions, geographical conditions, climate, distance to the industrial plant, education as well as the amount of product produced. Our country has an important potential value in terms of raw material resources that can be used in agricultural waste production. Considering our external dependence on energy, it becomes necessary to convert agricultural wastes into energy more efficiently. In this study, In determining the grain stalk waste potential of Batman province, 2020 crop production statistics (IVA) of Batman Agriculture and Provincial Directorate were used. For the year 2020 according to the Batman province of used some cereals (wheat, barley, lentils, chick peas and corn) the amount of organic waste that can be obtained from the stalks waste value (tons / year), dry matter can be obtained from organic waste amount (ton / year), volatile dry matter that can be obtained from dry matter, total methane amount (m^3 / year) and energy potential values that can be obtained from methane gas were determined. As a result of the calculations, the grain straw waste amount was determined as 5318,41 tons / year, the average dry matter amount as 4680,20 tons / year, the volatile dry matter amount as 4627,02 tons / year, the total methane production potential as 1156,75 m^3 / year and the energy potential as 41643.15 MJ / year.

Keywords: Batman, agricultural waste, grain stalk, energy



1. GİRİŞ

Biyokütle genel olarak bitki veya hayvan kaynaklı hidrokarbon içeren maddelerdir ve çoğunlukla organik içeriklidir (Demirel ve Gürdil, 2018). Biyokütle enerjisi dünyada kömür ve petrolden sonra en büyük birincil enerji kaynağıdır ve dünya nüfusunun yarıdan fazlası birincil enerji kaynağı olarak biyokütle kullanmaktadır (Öztürk ve Ekinci, 2016).

Türkiye'nin biyokütle potansiyeli yıllık olarak; tek yıllık bitkilerden 55 milyon ton, orman artıklarından 18 milyon ton, çok yıllık bitkilerden 16 milyon ton, tarım endüstrisi atıklarından 10 milyon ton, odun endüstrisi atıklarından 6 milyon ton, hayvan ve diğer atıklardan 12 milyon ton ile toplam 117 milyon ton biyokütle elde edilebileceği ve bu biyokütllerden sırasıyla 14,9 milyon TEP, 5,4 milyon TEP, 4,1 milyon TEP, 3,0 milyon TEP, 1,8 milyon TEP ve 2,8 milyon TEP ile toplam 32 milyon TEP'e denk gelecek şekilde üretim potansiyele sahiptir (Demirbaş 2008; Gökçöl vd.2009; Tutar, 2021).

Bitkisel atıklar kullanılarak bölge, yöre ve işletme bazında biyogaz enerjisinin üretim potansiyeli konusunda yapılan çalışmalar incelendiğinde; Külcü (2016) tarımsal biyokütle potansiyelini incelediği bir çalışmada, Afyonkarahisar ilinde bir yılda açığa çıkan 2 838 954 ton bitkisel atıktan (%20 nem içeriğinde) 1 490 451 ton kompost üretilmesinin mümkün olduğunu belirtmiştir. Karaca (2017), Antalya' da yaptığı bir çalışmada toplamda en fazla atığın 165.3 bin ton ile domates bitkisi, bunu da 27.35 bin ton atık miktarı ile biber ve yaklaşık 10 bin ton atık miktarı ile patlıcan bitkisi üretiminden kaynaklandığını belirtmiştir. Bu üç bitkinin sera üretiminde oluşturdukları bitkisel atık miktarı ise kuru bazda toplam 202.65 bin ton olarak belirlenmiştir.

Ülkemizin önemli seviyede tarımsal atık potansiyeline sahip olması ve bu atıkların biyogaz enerjisi üretiminde kullanıldığı takdirde ülke ekonomisine büyük katkılar sağlayabileceğini gösterir (Taşova ve Naneli, 2019; Baran ve Küçükler 2021).

Sümer ve ark. (2016), Çanakkale ilinde bulunan zeytin üretimi esnasında oluşan atıklardan elde edilebilecek toplam metan gazı üretim potansiyel değerinin 8.803.909 m³/yıl olduğunu tespit etmişlerdir. Ay ve Baran (2018), Kırklareli ilinin tarımsal kaynaklardan elde edilebilecek yıllık biyokütle enerji potansiyeli 2 milyon 630 bin TEP (30.587 MW) olarak saptamışlardır. Taşova ve Polatçı(2019), Tokat ilinde yaptıkları çalışmada , tahıl sap atık miktarı 78.525.22 ton/yıl, ortalama kuru madde miktarı 68.316.87 ton/yıl, uçucu kuru madde miktarı 63.311.38 ton/yıl, toplam metan üretim potansiyeli 21.074.43 m³/yıl ve enerji potansiyeli 562.327.30 MJ/yıl olarak saptamışlardır.

Bu çalışmada, Batman ili 2020 yılına ait kullanılabilir bazı tahıl (buğday, arpa, mercimek , nohut ve mısır) sap atık değerlerinden elde edilebilecek organik atık miktarı (ton/yıl), organik atıklardan elde edilebilecek kuru madde miktarı (ton/yıl), kuru maddeden temin edilebilecek uçucu kuru madde miktarı, toplam metan miktarı (m³/yıl) ve metan gazından elde edilebilecek enerji potansiyel değerleri belirlenmiştir.

2. MATERYAL ve YÖNTEM

2.1 Çalışma alanının konumu

Batman, Dicle havzasında, batı-doğu doğrultusunda il topraklarından geçen Dicle nehri ile Batman çayı kenarındaki verimli ovalardan oluşan düz bir alan üzerine yerleşiktir. Coğrafi olarak kuzey ve kuzeydoğusu sarp, yüksek ve dağlık olup, güney tarafı ise engebeli yapıya sahiptir. Doğusunda Siirt, batısında Diyarbakır, Kuzeyinde Bitlis ve Muş, güneyinde ise Mardin illeri ile çevrili, 41° 10' ve 41° 40' doğu boylamları ile 38° 40' ve 37° 50' kuzey enlemleri arasında yer almakta olan ilin denizden yüksekliği 540-560 m arasında değişmektedir(Aydın, 2019).



2.2 Tarım Alanlarının Yapısal Özellikleri

İl yüzölçümü 470.600 ha olup ilin tarım arazisi toplamı, 97.228 ha'dır. Batman ilinin tarım arazisi, orman alanı, çayır-mera alanı ve tarım dışı alanların büyüklüğü ve toplam arazi içerisindeki payları Çizelge 1'de verilmiştir. İlimiz arazi varlığı bakımından incelendiğinde, İl yüzölçümü 470.600 ha olup ilin tarım arazisi toplamı, 156.980 ha'dır. İl yüzölçümünün % 33,36 tarım arazisi, %8,63 Mera arazisi, %14,68 Orman arazisi, %43,34 Tarıma elverişsiz arazilerden oluşmaktadır(Çizelge 1).Kullanılan 97.228 ha alanın %88.65'i kuru, geri kalan %11.34'ünde ise sulu tarım yapılmaktadır. Kayıtlı çiftçi sayısı 7889 kişidir (Anonim 2020).

Çizelge 1. Batman İli Arazisinin Niteliklerine Göre Mevcut Dağılımı (2020 yılı)

Arazinin Cinsi	Toplam (ha)	Yüzde (%)
Tarım Arazisi Toplamı	156.980	33.36
Mer'a Arazisi	40.592	8,63
Orman Arazisi	69.084	14,68
Tarıma Elverişsiz Arazi	203.944	43.40
GENEL TOPLAM	470.600	100

Kaynak: Batman İl Tarım ve Orman Müdürlüğü 2020 yılı verileri

2020 yılında, Batman iline ait yetiştirilen bazı tahıl ürünlerinin ekim alanı miktarları Çizelge 2'de verilmiştir.

Çizelge 2. Çalışma Alanında Yetiştirilen Bazı Tahıl Ürünlerinin Ekim Alanı ve Üretim Miktarları

Ürün Adı	Ekilen Alan (da)	Verim (kg/da)	Üretim (ton)
Mısır (Dane)	54,070	1.560,8	84.393
Buğday	555,134	501.27	219.068
Arpa	50,795	296	15.037
Kırmızı Mercimek	133,250	191,3	25.500
Nohut	2,813	162,1	456

Kaynak: Batman İl Tarım ve Orman Müdürlüğü 2020 yılı verileri

2.3 Atık ve Enerji Potansiyellerinin Hesaplanması

Verilen ekim alanı değerleri kullanılarak 2020 yılına ait ortalama atık potansiyeli belirlenirken, toplanabilirlik oranları dane buğday, arpa, kırmızı mercimek ve nohut için % 15, mısır için ise; % 60 olduğu ifade edilmektedir (Öztürk ve Başçetinçelik, 2006). Atıklardan elde edilebilecek kuru madde, uçucu kuru madde potansiyeli ve toplam metan potansiyel değerleri Sharma ve ark. (1988) tarafından kullanılan yöntemle göre belirlenmiştir. Uçucu kuru madde hesaplamasında gerekli parametreler literatür verileri kullanılmıştır. Bu ürünlerin atıklarından elde edilebilecek metan gazının enerji miktarı ise Aybek ve ark. (2015) tarafından kullanılan yöntemle göre belirlenmiştir. Belirtilen tahıl ürünleri tahıl atıklarından elde edilebilecek metan gazının enerji ise Aybek ve ark. (2015); Taşova ve Polatçı (2019) yöntemine göre belirlenmiştir.



Hesaplama da kullanılan eşitlikler aşağıda verilmiştir.

$$AP = ((EA \times 37 \times 15)/100)1000 \quad (1)$$

Burada;

AP: Ürün atık miktarı potansiyeli (ton/yıl);

EA: buğday ekim alanı (da).

$$KM = ((AP \times 88)/100) \quad (2)$$

Burada;

KM: Elde edilebilir kuru madde potansiyeli (ton/yıl).

$$UKM = ((AP \times 87)/100) \quad (3)$$

Burada;

UKM: Ucu kuru madde potansiyeli (ton/yıl).

$$\text{ÖMO} = UKM \times 0.25 \quad (4)$$

Burada;

ÖMO: Özgül metan oranı (CH₄ kg).

$$ME = \text{ÖMO} \times 36 \quad (5)$$

Burada;

ME: Elde edilebilir metan gazının enerji değeri (MJ).

3. ARAŞTIRMA BULGULARI

Batman ili 2020 yılına ait üretimi yapılan bazı tahıl bitkileri, sebze ve meyvelerde; atık ve kuru madde potansiyeli, uçucu kuru madde, özgül metan oranı ve metan gazı enerji eşdeğerleri hesaplanarak aşağıda çizelgelerde detaylandırılmıştır.

Çizelge 3'e göre Batman ili 2020 yılına ait toplam tahıl atık potansiyel değerinin ortalama 5318,41 ton/yıl ve bu değerden elde edilebilecek kuru madde potansiyel değerinin ise ortalama 4680,20 ton/yıl olduğu belirlenmiştir. Batman ili 2020 yılına ait toplam uçucu kuru madde potansiyel değerinin ortalama 4627,02 ton/ yıl ve elde edilebilecek toplam metan potansiyel değerinin ise ortalama 1156,75 m³/yıl olduğu belirlenmiştir. Batman ili 2020 yılına ait bazı tahıl ürünleri atıklarından elde edilebilecek toplam metan gazı enerji potansiyel değerinin ortalama 41643,15 MJ/yıl olarak saptanmıştır.

Çizelge 3. Batman İline ait bazı tahıl ürünlerinin kullanılabilir atık ve kuru madde potansiyeli, uçucu kuru madde, özgül metan oranı ve metan gazı enerji eşdeğerleri

Ürünler	Atık Potansiyeli (ton/yıl)	Kuru Madde Potansiyeli (ton/yıl)	Uçucu Kuru Madde (ton/yıl)	Özgül Metan Oranı	Metan Gazı Enerji Eşdeğeri (MJ)
D.					
Mısır	1200,354	1056,312	1044,308	261,077	9398,772
Buğday	3080,99	2711,274	2680,47	670,12	24124,19
Arpa	281,91	248,083	245,264	61,32	2207,37
Mercimek	739,54	650,793	643,398	160,85	5790,58
Nohut	15,61	13,739	13,583	3,34	122,24
Toplam	5318,41	4680,20	4627,02	1156,75	41643,15



4.SONUÇ ve ÖNERİLER

Bu çalışmada, Batman ilinde üretimi yapılan bazı tarımsal ürünlerin sap atıklarına göre, elde edilebilecek yıllık bazdaki ortalama atık, kuru madde, uçucu kuru madde, metan ve enerji potansiyelleri araştırılmıştır. Belirlenen bulgular doğrultusunda Batman ilinde ortalama 5318,41 ton/yıl tahıl sap atığının olduğu görülmüştür. Bu atıklardan elde edilebilecek ortalama enerji değeri ise 41643,15 MJ olduğu belirlenmiştir.

Ülkemizin enerji konusundaki açığı ve dışa bağımlılığı göz önüne alındığında, biyokütle, hem artan enerji ihtiyacının bir kısmının karşılanması hem de dışa bağımlılık gerektirmediği için çok önemli bir potansiyel enerji kaynağı olması açısından önemlidir. Bu enerji kaynağının kullanımında modern yöntemler tercih edilerek enerjiye dönüşümünün sağlanması için ülke olarak yatırım çalışmalarının hızlandırılması, ülke genelinde biyokütle potansiyelinin belirlenmesi ve biyokütleyi biyoenerjiye dönüştürecek tesislerin nakliye vb. maliyetlerinin optimum düzeyde olacağı şekilde uygun yerlere planlanarak bir an önce biyokütle enerji kaynağının kullanılabilir hale gelmesi Ülkemiz açısından büyük önem arz etmektedir.



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FARKLI SIRA ÜZERİ MESAFELERİN PATATESTE MİNİ YUMRU VERİMİNE ETKİSİ

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ÖZET

Çalışma 2018 yılında Ege Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü tohumluk patates üretim fideliklerinde yürütülmüştür. Çalışmada genetik materyal olarak 101 patates çeşidinin süper elit mini yumruları kullanılmıştır. Bu yumrular *in vitro*'da elde edilmiş olup virüsten aridir ve temel tohumluk sınıflarının ilk basamağını oluşturmaktadır. Bu çalışmada 10-20 mm çaplarında mini yumrular kullanılmıştır. Bu mini yumrular 5 farklı sıra üzeri mesafede denemeye alınmış ve sonuçlar değerlendirilmiştir. Fidelik denemesi Tesadüf Parselleri Deneme Desenine göre 3 tekerrürlü olarak gerçekleştirilmiştir. Farklı mesafede yetiştirilen mini yumrular yumru sayısı, tek yumru ağırlığı, yumru verimi, parsel verimi, yumru eni ve yumru boyu bakımından aralarında istatistiksel olarak fark bulunmuştur. Yumru sayısı bakımından 25 cm sıra üzeri mesafe (5.5 adet) en yüksek ortalamayı vermiştir. Tek yumru ağırlığı bakımından 10 cm mesafe 51.6 g ile en yüksek ortalamayı vermiştir. 25 cm mesafe bitki verimi (240.1 g) ve parsel verimi (1.9 kg) bakımından en yüksek ortalamayı vermiştir. Yumru eni (4.2 cm) ve yumru boyu (4.5 cm) bakımından 20 cm mesafe en yüksek ortalamayı vermiştir. Küçük ebatlardaki mini yumrular 25 cm sıra üzeri mesafe de yetiştirildiklerinde mini yumru verimi üzerine olumlu etkide bulunmuştur.

Anahtar Kelimeler: Patates, mini yumru, sıra üzeri, verim



EFFECT ON POTATO MINI TUBER YIELD OF DIFFERENT ROW DISTANCE

ABSTACT

The study was conducted in the seedbed trial of the Field Crops Department of Agricultural Faculty of the Ege University in 2018. Super-Elit mini tubers of 101 potato cultivar were used as genetic materials in the study. These mini tubers were obtained *in vitro* conditions and to be virus free. They were consisted of first class basic seed program in potato. Mini tubers of 10-20 mm diameter were used in this study, These mini tubers were grown in seedbed at 5 different row distances and the results were evaluated. The seedbed trial was arranged with the Completely Randomized Design (CRD) with 3 replications. There were significant differences between row distances for tuber number, single tuber weight, plant yield, plot yield, tuber width and tuber length. 30 cm row distance had highest means for tuber number (5.5 number). The highest mean for single tuber weight was obtained 10 cm row distance as 51.6 g. 30 cm row distance had highest means in terms of plant yield (240.1 g) and plot yield (1.9 kg). 20 cm row distance had the highest for tuber width (4.2 cm) and tuber length (4.5 cm). Small sized mini tubers had a positive effect on mini tuber yield when they were grown at the 25 cm row spacing.

Keywords: Potato, mini tuber, row distance, yield



GİRİŞ

Meristem kültürü ile elde edilen fidelerin sera koşullarında yetiştirilmesi ile patates tohumluk programının ilk kademesi olan süper-elit kademe tohumluklar elde edilmektedir (Bryan, 1988; Ranalli et al., 1990; Yıldırım, 1995). Tohumluk patates üretiminde çapları 5-25 mm ve ağırlıkları 0.1-10 g arası değişen hastalıklardan ari mini yumrular kullanılmaktadır (Struik 2007; Vinterhalter, 2008). Patateste verim üzerine bitki sıklığı ve sıra arası üzerine pek çok çalışma yapılmıştır (Creamer et al., 1999; Zebarth et al., 2006; Bussan et al., 2007). Burada optimum bitki sıklığı verim, kalite, tohumluk fiyatı üzerinde önemli etkilere sahiptir (Bussan et al., 2007). Geniş sıra arası mesafelerde yetiştirilen bitkiler özellikle topraktaki nem, ışık ve besin elementlerinden daha çok faydalanma fırsatına sahip olurlar (Rykbost and Charlton, 2004), fakat tohumluk maliyeti de bir o oranda artar. Süper elit mini yumrular tohumluk sınıfının ilk basamağını oluşturur ve çeşitli ebatlarda elde edilen yumrular tohumluk olarak değerlendirilir. Doğrudan tarla üretimine alınmayan küçük çaplı mini yumrular çeşitli sıra arası mesafelerde yetiştirilerek yüksek ekonomik geri dönüşler sağlanabilir (Hossain et al., 2015). Bu çalışmanın amacı doğrudan tarla çoğaltımlarında kullanılmayan küçük çaplardaki (10-20 mm) süper-elit mini yumruların farklı sıra üzeri mesafelerde yetiştirilerek, mini yumru performanslarının belirlenmesidir. Böylece uygun sıra üzeri mesafede ve uygun bitki sıklığı sağlanarak küçük çaplardaki mini yumruların hem ekonomik hem de verim bakımından değerlendirilmesi sağlanacaktır.

MATERYAL ve YÖNTEM

Çalışma 2018 yılında Ege Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü Tohumluk Patates Üretim fideliklerinde yürütülmüştür. Genetik materyal olarak bölümümüzde tescil edilen orta erkenci, yuvarlak oval yumru şekli, sarı et rengi yüzeysel-orta göz derinliği, %23.4 kutu madde, %16.8 nişasta içeriğine sahip Nif patates genotipi kullanılmıştır. Nif patates genotipi *in vitro*'da MS (Murashige-Skoog (1962) ortamında meristem kültürüne alınmış ve hastalıktan ari *in vitro* bitkicikler elde edilmiştir. Bu *in vitro* fideler serada saksılarda yetiştirilmiş ve hastaliksız süper-elit mini yumrular elde edilmiştir. Bu mini yumruların 10-20 mm çapında olan mini yumrular Tesadüf Parselleri Deneme Desenine göre 3 tekerrürlü olarak 24 Ağustos 2018 tarihinde fideliklerde denemeye alınmıştır. 1.5 m boyunda her sraya 5 bitki gelecek şekilde 10cm; 15cm;20cm;25cm ve 30cm olarak 5 farklı sıra üzeri mesafede denemeye alınmıştır. Sulama, çapalama ve boğaz doldurma ile yabancı ot kontrolleri yapılan bitkiler 20 Aralık 2018 tarihinde elle hasat edilmiştir.

Hasat edilen mini yumruların yumru verimi ölçümleri yapılmıştır. Bunlar yumru sayısı, tek yumru ağırlığı (g), bitki verimi (g), parsel verimi (kg), yumru eni (cm) ve yumru boyu (mm) olarak gerçekleştirilmiştir. Fidelik denemesi sonucu elde edilen mini yumru verim özelliklerine ait veriler Totemstat (Açıkgöz ve ark., 2004) paket programı kullanılarak değerlendirilmiştir. Ortalamalar Steel ve Torrie (1980)'ye göre Asgari Önemli Fark (AÖF) testi kullanılarak karşılaştırılmıştır.

ARAŞTIRMA BULGULARI ve TARTIŞMA

Meristem kültürü ile elde edilen 10-20 mm ebatlarındaki mini yumruların 5 farklı sıra üzeri mesafede elde edilen yumru özelliklerine ait ortalamalar ve F değerleri Çizelge 1'de, dağılımları ise Şekil 1;2;3;4 ve 5'de verilmiştir.



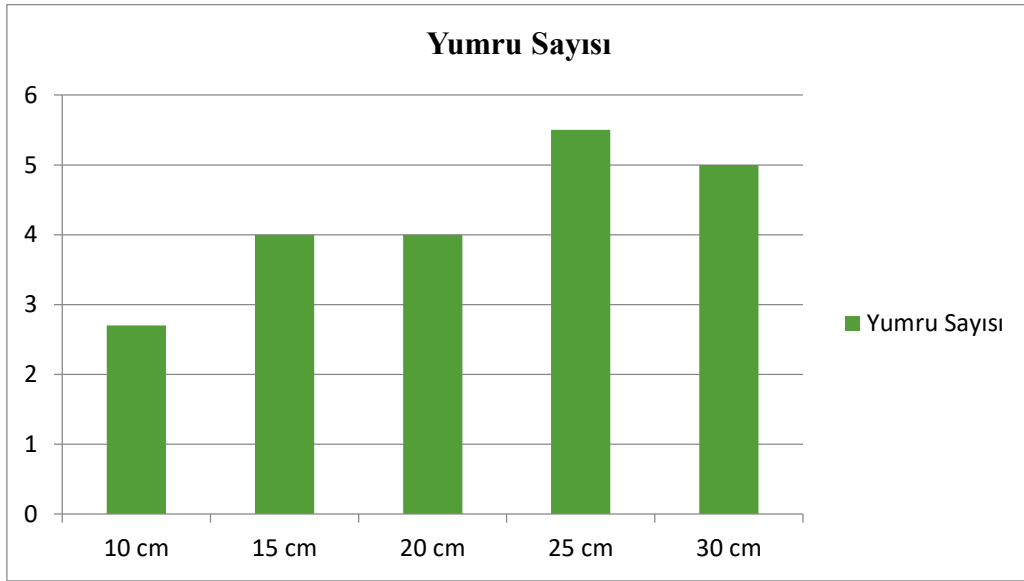
Çizelge 1. 2018 yılı fidelik denemesi mini yumru özellikleri ortalamaları ve F değerleri

Nif genotipi	Yumru sayısı	Tek yumru ağırlığı (g)	Bitki verimi (g)	Parsel verimi (kg)	Yumru eni (cm)	Yumru boyu (cm)
10 cm	2.7	51.6	129.0	1.8	3.8	4.2
15 cm	4.0	32.9	131.7	1.7	3.7	4.1
20 cm	4.0	48.8	194.6	1.8	4.2	4.5
25 cm	5.5	43.6	240.1	1.9	3.8	4.2
30 cm	5.0	32.9	164.3	1.8	3.8	4.3
(kontrol)						
LSD _(0.01)	0.470	2.747	16.670	0.054	0.215	0.225
F	53.500**	100.643**	77.456**	12.133**	9.214**	3.957*

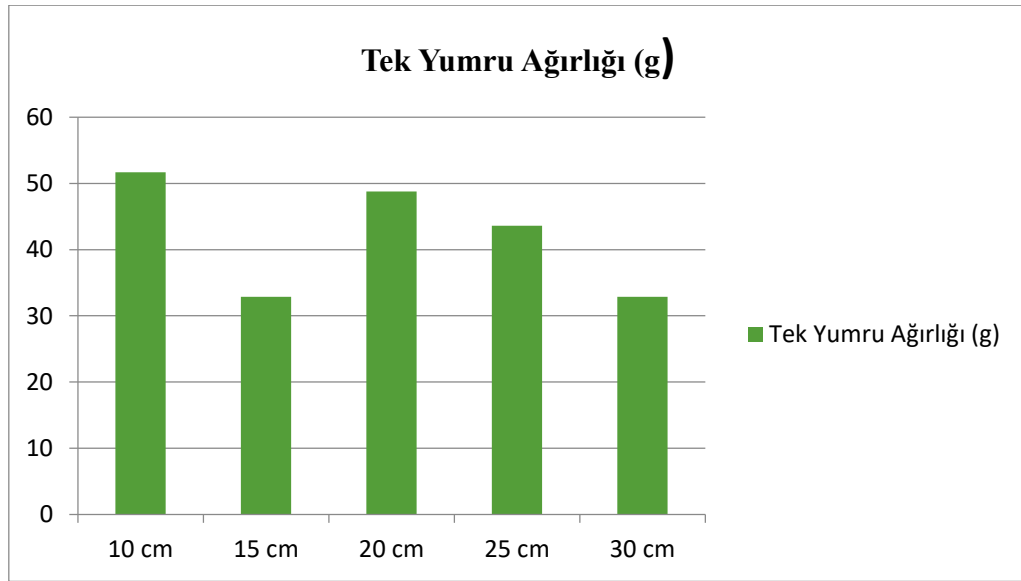
** : $\alpha=0.01$ düzeyinde önemli

* : $\alpha=0.05$ düzeyinde önemli

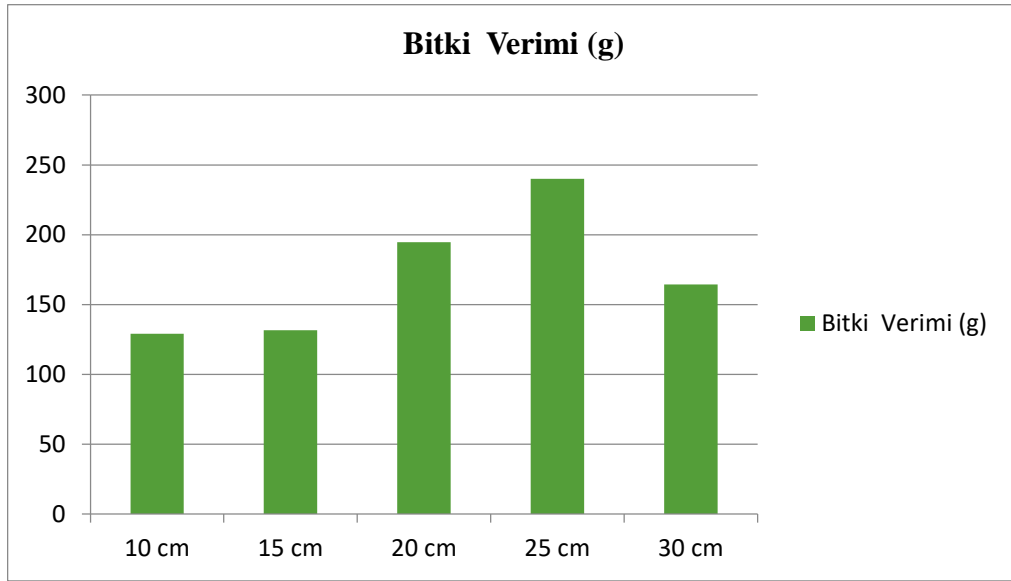
Çizelge 1’de Nif patates genotipinin mini yumrularının 10 cm, 15 cm, 20 cm, 25 cm ve 30 cm sıra üzeri mesafede yetiştirilerek elde edilen yumru verimi özelliklerine ait varyans analizi sonuçları görülmektedir. Sonuçlar değerlendirildiğinde; yumru sayısı, tek yumru ağırlığı, yumru verimi, yumru eni özellikleri bakımından $p \leq 0.01$, yumru boyu için $p \leq 0.05$ önem düzeyinde istatistiksel olarak önemli farklılıkların olduğu görülmektedir. Nif patates genotipinin sıra arası mesafeler yumru özellikleri ortalamaları karşılaştırıldığında yumru sayısı bakımından 25 cm sıra üzeri mesafede 5.5 ile en yüksek yumru sayısı elde edilmiştir. 10 cm sıra üzeri mesafe 2.7 ile en düşük yumru sayısı ortalaması elde edilmiştir. Hossain et al. (2015) farklı büyüklükteki mini yumruların 25 cm sıra mesafesinde yumru sayısı bakımından yüksek ortalama verdiğini bildirmiştir. Bu sonuçlar bizim bulgularımızla uyumludur. Tek yumru ağırlığı bakımından 10 cm sıra üzeri mesafe de 51.6 g ile en yüksek ortalama değer elde edilmiştir. 15 cm ile 30 cm sıra üzeri mesafe 32.9 g ile en düşük ortalama vermiştir. Bitki verimi bakımından en yüksek ortalama 25 cm sıra üzeri mesafede 240 gr olarak elde edilirken; 10 cm sıra üzeri mesafe 129.0 g ile en düşük ortalama vermiştir. Parsel verimi bakımından 25 cm sıra üzeri mesafede en yüksek ortalama 1.9 kg ile elde edilmiştir. Parsel verimi bakımından en düşük ortalama 15 cm sıra üzeri mesafede elde edilmiştir. Yumru eni ve yumru boyu bakımından 20 cm sıra üzeri mesafe de sırasıyla 4.2 cm ve 4.5 cm ile en yüksek ortalama elde edilmiştir. Hossain et al. (2015) yaptıkları çalışmada yumru boyutlarının 25 cm’de en düşük olduğunu bildirmiş olup, bu sonuçlar bizim çalışmamız ile kısmen uyumaktadır.



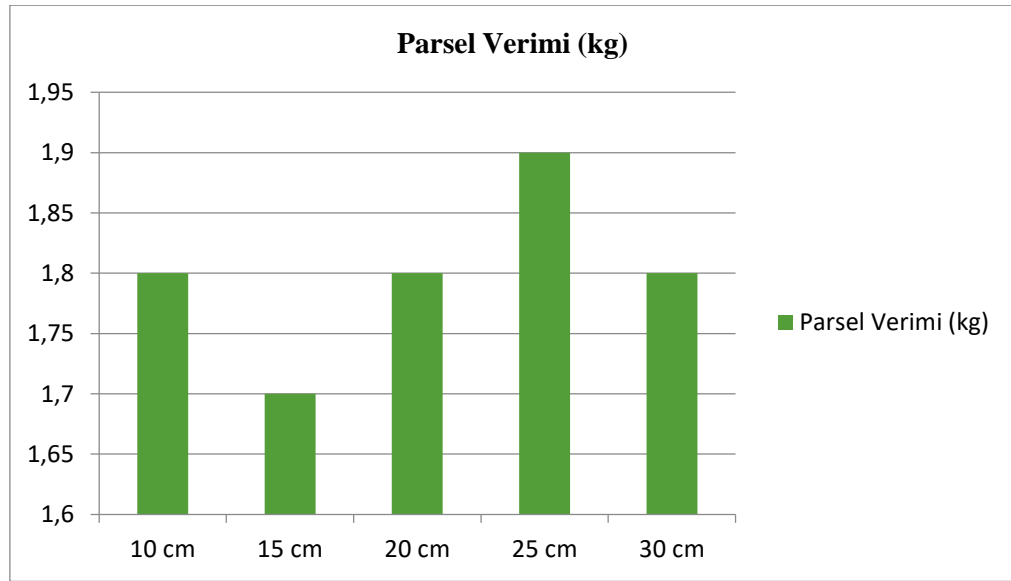
Şekil 1. Nif patates genotipinin süper-elit mini yumrularının 5 farklı sıra üzeri mesafe de yumru sayısı dağılımları



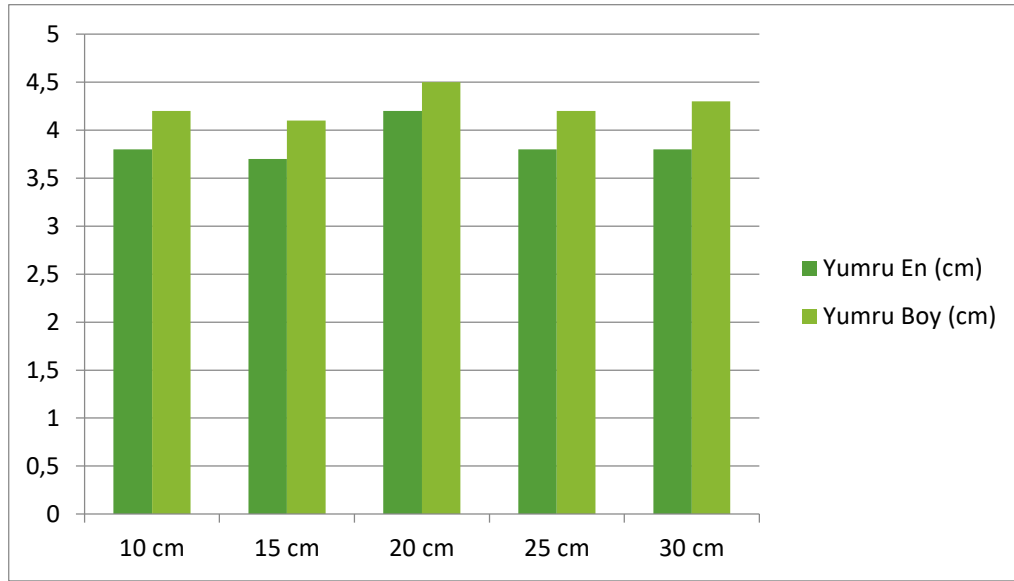
Şekil 2. Nif patates genotipinin süper-elit mini yumrularının 5 farklı sıra üzeri mesafe de tek yumru ağırlığı (g) dağılımları



Şekil 3. Nif patates genotipinin süper-elit mini yumrularının 5 farklı sıra üzeri mesafe de bitki verimi (g) dağılımları



Şekil 4. Nif patates genotipinin süper-elit mini yumrularının 5 farklı sıra üzeri mesafe de parsel verimi (kg) dağılımları



Şekil 5. Nif patates genotipinin süper-elit mini yumrularının 5 farklı sıra üzeri mesafe de yumru en (cm) ve boy (cm) dağılımları

SONUÇ ve ÖNERİLER

Patateste küçük ebatlardaki mini yumru sıra üzeri mesafelerin karşılaştırıldığı bu çalışmada 25cm sıra üzeri mesafenin yumru sayısı, bitki verimi ve parsel verimi bakımından yüksek ortalamalar vermiştir. 10 cm sıra üzeri tek yumru ağırlık bakımından yüksek ortalama vermiştir. Yumru ebatları için 20 cm mesafe yüksek ortalama vermiştir. Yaklaşık 10-20 mm ebatlarındaki mini yumrular yumru sayısı ve verimi bakımından 25 cm sıra üzeri mesafede yetiştirildiğinde iyi performans vermiş olup önerilebilir. Özellikle yumru sayısının artış göstermesi ile ocak verimi ve parsel verimi artışını da sağlamış olup, temel tohumluk üretiminde daha ileri kademelerde kullanılacak tohumluk temininde büyük oranda artış sağlanmış olacaktır. Böylece doğrudan tarla denemelerinde kullanılacak tohumluk temininde de avantaj sağlanacaktır. Tek bitki ağırlığı dikkate alındığında ise daha sık sıra üzeri mesafelerin (10 cm) kullanılması yumru doldurma bakımından önerilebilir. Büyük ebatlardaki yumrular daha çok yemeklik tüketim için uygun olup, tohumluk üretim için daha çok küçük ebatlı mini yumrular (30 cm-40 cm) kullanılmaktadır.



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F1 HİBRİT KAVUN (*Cucumis melo* L.) VE EBEVEYNLERİNİN VERİM VE MEYVE ÖZELLİKLERİ BAKIMINDAN PERFORMANSLARININ KARŞILAŞTIRILMASI

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ÖZET

Kırkağaç kavunu yaz aylarında lezzeti ve aroması ile tüketiciler tarafından çok talep gören yöresel bir kavun çeşididir. Meyve kabuğu, orta kalınlıkta üzeri pürüzlü, sarı zemin üzerinde koyu yeşil lekeler şeklinde üst renk bulunan kendine özel bir dış görünümü vardır. Taze tüketildiği gibi ocak ayı başına kadar depolarda muhafaza edilebilme özelliği vardır. Kırkağaç kavunun seleksiyon yapılan bitki materyallerinden fusarium hastalığına ve kuraklığa dayanıklı yeni bir hibrit çeşit geliştirilmiştir. Bu çalışmada yeni Kırkağaç tipi F1 hibrit kavun çeşidi ve ebeveynlerinin toplam verim ile meyvedeki bazı fiziksel ve kimyasal özellikler bakımından karşılaştırmalı incelenmesi yapılmıştır. Çalışma, Çukurova Üniversitesi Ziraat Fakültesi Bahçe Bitkileri bölümüne ait plastik bir serada 2020 ilkbahar-yaz yetiştiricilik sezonunda gerçekleştirilmiştir. Çalışma, tesadüf blokları deneme deseninde 3 tekerrürlü ve her tekerrürde 16 bitki olacak şekilde kurulmuştur. Kavun fideleri Haziran ayında sera dikilmiştir. Meyveler dikimden 110 gün sonra Ağustos ayında hasat edilmiştir. Toplam kavun verimi ve ortalama meyve ağırlığı bakımından hibrit çeşit, ana ebeveyninden %15 ve baba ebeveyninden ise %39 daha yüksek değerler oluşturmuştur. Kavun meyvesi boyu bakımından hibrit çeşit, ana ebeveyninden %31 ve baba ebeveyninden ise %7.2 daha uzun, meyve genişliği bakımından hibrit çeşit, ana ebeveyninden %5.9 ve baba ebeveyninden ise %16.7 daha geniş meyveler oluşturmuştur. Meyve eti kalınlığı bakımından ise hibrit çeşit, ana ebeveyninden %20 ve baba ebeveyninden ise %3.2 daha kalın meyve eti yapmıştır. Kavun meyvelerindeki SKMÇ (Suda Çözülebilen Kuru Madde-Brix) bakımından hibrit çeşit, ana ebeveyninden %16.3 daha yüksek ve baba ebeveyninden ise %2.1 daha düşük performans göstermiştir.

Anahtar Kelimeler: Kavun, verim, meyve özellikleri, hibrit gücü



COMPARISON OF F1 HYBRID MELON (*Cucumis melo* L.) AND ITS PARENTS IN TERMS OF YIELD AND SOME FRUIT PROPERTIES

ABSTRACT

Kırakağaç melon is a local type of melon that is highly demanded by consumers with its good taste and aroma in the summer months. It has a distinctive external appearance with rough fruit surface and upper color dark green spots on a yellow background. As it is consumed fresh, it can be stored in until the beginning of January. A new hybrid variety resistant to fusarium disease and drought has been developed from the selected plant materials of Kırakağaç melon. In this study, the new Kırakağaç type F1 hybrid melon cultivar and its parents were compared in terms of total yield and some physical and chemical properties of the fruit. The study was carried out in a plastic greenhouse belonging to Çukurova University Faculty of Agriculture, Department of Horticulture, in the spring-summer growing season of 2020. The study was established in a randomized complete block experimental design with 3 replications and 16 plants in each replication. Melon seedlings were planted in May and harvested 110 days after transplanting. In terms of total melon yield and average fruit weight, the hybrid cultivar was 15% higher than the mother parent and 39% higher than the father parent. In terms of melon fruit length, the hybrid cultivar produced 31% longer fruits than the mother parent and 7.2% longer than the father parent, while the hybrid cultivar in terms of fruit width produced fruits that were 5.9% larger than the mother parent and 16.7% wider than the father parent. In terms of flesh thickness, the hybrid cultivar produced 20% thicker flesh than the mother parent and 3.2% thicker than the father parent. In terms of TSS (Water Soluble Dry Matter-Brix), the hybrid cultivar performed 16.3% higher than the mother parent and 2.1% lower than the father parent.

Keywords: Melon, yield, fruit characteristics, hybrid vigor



1. GİRİŞ

Bitkilerde verim ve ürünlerde kalite düşüşüne sebep olan ve tüm dünyayı etkisi altına alan küresel ısınma, beraberinde iklim değişikliğini de getirmektedir. Dünya nüfusunun 2050 yılında 9 milyara ulaşmasının beklendiği ve gıda üretiminin günümüze kıyasla %38 daha fazla olması gerektiği bildirilmiştir (Dere, 2019). Üretimin artırılması için ekilebilir alanların artırılmasının imkânsız olduğu günümüzde, mevcut alanlarda da abiyotik stres kaynaklı verim kayıplarının % 50-70'e ulaştığı bildirilmiştir (Dere 2019). Bitkisel üretimde stres, abiyotik (tuzluluk, kuraklık, düşük ve yüksek sıcaklıklar, besin elementlerinin eksiklik veya fazlalıkları, ağır metaller, hava kirliliği, radyasyon vb) ve biyotik (hastalık oluşturan mantar, bakteri, virüs vb. ve zararlı böcekler) kökenli etmenler nedeniyle bitkinin büyüme ve gelişmesinde yavaşlama veya durma, buna bağlı olarak verim ve üründe kalite düşüklüğü olarak tanımlanabilir. Kuraklık stresi, su yüzyıllar boyunca uygarlıkların kaderini belirleyen temel faktörlerden biri olmuştur. Nüfusun hızla artışı ve iklim değişikliği faktörleri var olan ve giderek azalan su kaynaklarının kullanımını sınırlandırmaktadır (Türkeş ve ark., 2000). Tüm dünyada olduğu gibi Türkiye de küresel ısınmanın ve iklim değişikliğinin etkileri ile, özellikle su kaynaklarının zayıflaması, kuraklık ve çölleşme ile buna bağlı ekolojik bozulmalarla karşı karşıya olup küresel ısınmanın potansiyel etkileri açısından risk grubu ülkeler arasındadır. Dünya ülkeleriyle birlikte ülkemiz de küresel iklim değişikliğinden payını alacaktır, bundan kaçış görülmemektedir. Ancak bundan en az zararla nasıl çıkabiliriz sorusunun yanıtı ise iklim değişikliğinin etkilerine karşı uyum stratejilerinin geliştirilmesidir. İklim değişikliğine uyum güncel haliyle ekonomik bir kavram ve bir kalkınma problemi olarak karşımızda durmaktadır. Kuraklığa dayanıklı bitki çeşitlerinin geliştirilmesi, gelecek yıllarda olası kuraklık stresine karşı tarımsal üretimin tehdit edilmesini azaltabilecek en uygun çözüm olarak görülmektedir.

Su kaynaklarının azalması ve tarım arazilerinin sınırlandırılması gibi faktörlerin yanı sıra toprak kökenli patojenler bitkisel üretimde birim alandan daha fazla ürün almayı sınırlandıran en önemli faktörlerin başında gelmektedir. Bu durum, yeni yetiştirme tekniklerinin geliştirilmesini zorunlu kılmaktadır. Ülkemizde kavunda özellikle toprak kaynaklı fungal patojenlerden dolayı verim oldukça azalmıştır. Kavun yetiştiriciliğinde *Fusarium oxysporum* f.sp. *melonis* etmeninin neden olduğu *Fusarium* solgunluk hastalığı, gerek ülkemizde gerekse dünyada kavun yetiştiriciliğini sınırlandıran en önemli fungal hastalıklardan biridir (Yücel ve ark., 1994). Hastalık etmeni toprakta klamidospore formunda canlı kalmakta, buradan gelişen miselyum bitkinin genç köklerini infekte etmekte ve makro ve mikro konidileri ile iletim demetlerini tıkayarak genel bir solgunluğa neden olmaktadır. Vejetasyonun ilerleyen dönemlerinde ise, çökme ve kurumalar gözlenebilmektedir. Fom'un günümüzde ırk 0, ırk 1, ırk 2 ve ırk 1-2 olmak üzere dört ırkı rapor edilmiştir (Mas ve ark., 1981). Ülkemizde Ege Bölgesi'nde Fom'un 0, 1, 1-2 no'lu ırklarının, Güneydoğu Anadolu Bölgesi'nde 0, 1, 2, 1-2 ırklarının ve Doğu Akdeniz Bölgesi'nde 0, 1, 1-2 ırklarının yaygın olduğu rapor edilmiştir (Şensoy, 2005). *Fusarium* solgunluk hastalıklarının mücadelesinde tolerant/dayanıklı çeşit, sertifikalı tohum, uygun sulama ve gübreleme, tohum dezenfeksiyonu, ekim nöbeti, bitki artıklarının imhası ve yabancı ot kontrolü gibi kültürel önlemler sıralanabilir.

Hibrit çeşitler, üstün özellikleri nedeniyle sebze ve süs bitkilerinde tercih edilmektedir. F1 hibrit olarak da adlandırılan bu çeşitler, iki ya da daha fazla sayıdaki homojen yapı malzemenin melezlenmesinden elde edilen tohumların üretimde kullanılmasıdır. Bu çalışmada kurak stresine ve *fusarium* hastalığının 0 ve 2 nolu ırklarına dayanıklı olarak geliştirilen yeni bir F1 hibrit kavun çeşidinin, ebeveynleri ile karşılaştırmalı olarak meyve özellikleri incelenmiştir.



2. MATERYAL ve YÖNTEM

Bu çalışma Çukurova Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü deneme alanında Plastik Serada gerçekleştirilmiştir. 15 Haziran 2020 tarihinde fideler seraya dikilmiş olup, 9 Eylül 2020 tarihinde hasadı yapılmıştır.

BİTKİ MATERYALİ

Çalışmasında Kırkağaç kavun (*Cucumis melo* L. var. *inodorus*) tipi üzerine çalışma yapılmıştır. Kırkağaç kavununun 2 farklı saf hattı ebeveyn olarak kullanılmıştır. Ana ebeveyn *Ça*, *Fusarium oxysporum* hastalığının 0 ve 2 nolu ırklarına dayanıklıdır. Baba ebeveyn *Mln16* ise kuraklığa dayanıklıdır. Bu iki saf hattın F1 melezlenmesi ile geliştirilen F1 ise *Ça x Mln16* olarak hem *Fusarium* hastalığına ve hem de kuraklığa dayanıklıdır. Çalışmada ebeveynler ve F1 melez bitkileri serada yetitirilerek verim ve bazı meyve özellikleri incelenmiştir.



Şekil 1. Serada kavun bitkilerinden erken gelişme aşamasında görüntüler

YÖNTEM

Çalışma, tesadüf blokları deneme deseninde 3 tekerrürlü ve her tekerrürde 16 bitki olacak şekilde kurulmuştur. Sıra arası 100 cm ve sıra üzeri 50 cm olacak şekilde bitki yoğunluğu 2.66 bitki/m² olmuştur. Kavun fideleri Haziran ayında seraya dikilmiştir. Askıya alınan kavun bitkileri budanarak tek ana gövdeli yetiştirilmiş ve meyveler iri olduğu için her bitkide bir adet meyvenin gelişmesine izin verilmiştir. Meyveler dikimden 110 gün sonra Ağustos ayında hasat edilmiştir.



HASAT VE MEYVE ÖLÇÜMLERİ

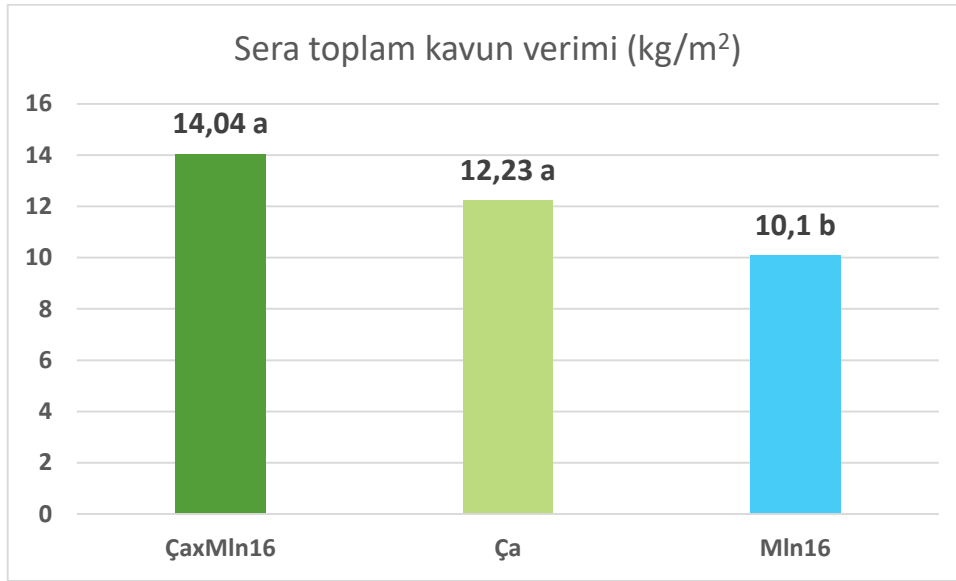
Hasat olumuna gelen kavunlar 9 Eylül 2020 tarihinde hasat edilmiş olup, ana (Ça), baba (Mln16) ve F1 melez yeni genotipin (Ça x Mln16) meyve ağırlıkları terazi ile tartılarak verim için kaydedilmiştir. Kavunlarda meyve ağırlığı, meyve etinin kalınlığı, meyvenin boyu ve eni, SÇKM, asitlik, EC ve pH özellikleri ölçülerek kaydedilmiştir.



Şekil 2. Serada askıda yetiştirilen ve hasat aşamasına gelen kavun meyvelerinden görüntüler

3. BULGULAR ve TARTIŞMA

Kavun verimi en yüksek ÇaxMln16 olarak kodlanan F1 çeşitte 14.04 kg^2 olarak elde edilmiştir. Ana olarak kullanılan Ça saf hattın verimi 12.23 kg/m^2 iken baba olarak kullanılan Mln 16 saf hattının verimi ise 10.10 kg/m^2 verim oluşturmuştur (Şekil 3). Ana ebeveyn baba ebeveyninden daha yüksek verim gösterirken, F1 çeşit her iki ebeveyninden de daha yüksek verim oluşturmuştur. Toplam kavun verimi bakımından hibrit çeşit, ana ebeveyninden %15 ve baba ebeveyninden ise %39 daha yüksek değerler oluşturmuştur. Birim alana verim bakımından F1 çeşidin ana ve babasından daha yüksek verim değeri oluşturarak heterosis etkisi gösterdiği söylenebilir.



Şekil 3. Serada ilkbahar-yaz periyodunda yetiştirilen Kırkağaç tipi kavun F1 melez ve ebeveynlerine ait toplam kavun verim değerleri (İstatistik analiz P değeri 0.0.108 ve LSD değeri 1.866)

Meyve ağırlığı, meyve boyu, meyve genişliği ve meyve eti kalınlığı Çizelge 1’de verilmektedir. Elde edilen sonuçlarda meyve ağırlığı 3.71-5.16 kg arasında, meyve boyu 26.79-20.52cm arasında, meyve genişliği 22.52-19.29cm arasında, meyve eti kalınlığı 5.43-4.52cm arasında değişmektedir. Meyve fiziksel özellikleri ile ilgili olarak melez F1 çeşidin tüm özelliklerinde hem ana ve hem de babasından rakamsal olarak daha yüksek değerler verdiği ve heterosis etkisi gösterdiği belirlenmiştir. Hibrit çeşit, ana ebeveyninden %15 daha ağır ve babadan ise %39 daha ağır meyveler oluşturmuştur. Meyve boyu bakımından hibrit çeşit, anadan %31 ve daha uzun ve babadan %7 daha uzun meyveler oluşturmuştur. Meyve genişliği bakımından hibrit çeşit, anadan %6 daha geniş ve babadan ise %17 daha geniş kavun meyveleri oluşturmuştur. Ana ebeveyn babaya göre daha kısa boylu meyveler oluştururken baba ise uzunca ve anadan biraz dar meyveler oluşturulduğu anlaşılmaktadır (Çizelge1). Meyve eti kalınlığı bakımından hibrit çeşit, anadan %20 daha kalın ve babadan ise %3 daha kalın meyve etine sahip olmuştur.

Çizelge 1. Serada ilkbahar-yaz periyodunda yetiştirilen Kırkağaç tipi kavun F1 melez ve ebeveynlerine ait bazı fiziksel meyve kalite özellikleri

	Meyve Ağırlığı (kg/adet)	Meyve Boyu (cm)	Meyve Genişliği (cm)	Meyve Eti Kalınlığı (cm)
ÇaxMln16	5.16 a	26.79 a	22.52 a	5.43 a
Ça	4.50 a	20.52 b	21.26 ab	4.52 b
Mln16	3.71 b	25.00 a	19.29 b	5.26 a
P	0.0108	0.0023	0.0365	0.0192
LSD	0.686	2.008	2.194	0.537

Kavun meyvelerinin suyu çıkarılarak bir seri kimyasal özellikleri belirlenmiştir. Bunlar SÇKM, EC, pH ve asitlik özellikleri olarak Çizelge 2’de verilmektedir. Elde edilen sonuçlarda SÇKM değeri 7.58-6.52 arasında, asitlik değeri 0.49-0.38 arasında, PH değeri 5.95-5.69 arasında, EC değeri 3.64-3.35 arasında değişmektedir. Bu özellikler bakımından hibrit meyveler sadece asitlik bakımından ebeveynlerinden yüksek bir değer gösterirken diğer özelliklerde ebeveynleri



geçmemiştir (Çizelge 2). Meyve suyundaki SÇKM bakımından hibrit kavun meyveleri, anadan %16.3 daha tatlı ve babadan ise %2 daha az tatlı meyveler oluşturmuştur. Meyvedeki asitlik bakımından hibrit kavunlar, anadan %29 daha asidik ve babadan ise %20 daha asidik meyveler oluşturmuştur. EC bakımından hibrit kavun meyveleri anadan %5 daha yüksek babadan ise %3 daha düşük EC değerleri göstermiştir.

Çizelge 2. Serada ilkbahar-yaz periyodunda yetiştirilen Kırkağaç tipi kavun F1 melez ve ebeveynlerine ait bazı kimyasal meyve kalite özellikleri

	*SÇKM (%)	Asitlik (%)	pH	EC
ÇaxMln16	7.58 a	0.49 a	5.70	3.52
Ça	6.52 b	0.38 c	5.69	3.35
Mln16	7.74 a	0.41 b	5.95	3.64
P	0.0133	0.0003	0.2809	0.6079
LSD	0.668	0.019	**Ö.D.	Ö.D.

*SÇKM: Suda Çözülebilir Kuru Madde, **Ö.D.: Önemli Değil

4. SONUÇ

Yeni geliştirilen F1 hibrit Kırkağaç tipi kavun çeşidi fusariumun 0 ve 2 nolu ırklarına ve kuraklığa dayanıklı olması yanında, bu çalışmada da görüldüğü üzere verim ve çoğu meyve özelliklerinde de heterosis etkisi göstererek ebeveynlerden daha yüksek değerler göstermiştir. Melez çeşit için 2020 yılında Sena F1 ismiyle tescil edilmek üzere başvurusu yapılmıştır.



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ARITMA ÇAMURU UYGULAMALARININ TOPRAĞIN FİZİKSEL VE KİMYASAL ÖZELLİKLERİ ÜZERİNE ETKİSİ

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ÖZET

Bu çalışma, farklı dozlarda kentsel arıtma çamuru uygulamalarının toprağın fiziksel ve kimyasal özellikleri üzerine olan etkisini belirlemek amacıyla yapılmıştır. Tesadüf blokları deneme desenine göre, 4 tekrarlamalı olarak 1) kontrol, 2) mineral gübre, 3) 1 ton/da, 4) 2 ton/da ve 5) 3 ton/da uygulamasından oluşmuştur. Denemede 2 farklı dönemde toprak örnekleme yapılmıştır. Arıtma çamuru uygulamaları ile toprak pH'sında azalmalar meydana gelmiştir. 7.75 ile en yüksek pH değeri kontrol toprağında belirlenirken, 7.34 ile en küçük pH değeri ise 3 ton/da arıtma çamuru uygulamasında elde edilmiştir. Uygulamalar sonucu toprak tuzluluğu kontrol uygulamasında 337.00 $\mu\text{S}/\text{cm}$ değeri ile en küçük, 766.37 $\mu\text{S}/\text{cm}$ değeri 3 ton/da uygulamasında en yüksek olarak belirlenmiştir. Uygulamalara göre organik madde içeriği kontrol (% 1.40), mineral gübre (% 1.41), 1 t/da (% 1.58), 2 t/da (% 1.99) ve 3 t/da (% 2.39) şeklinde belirlenmiştir. Uygulamalara göre toprağın toplam N ile alınabilir P konsantrasyonu değişimi sırasıyla 3 t/da uygulamasında en yüksek % 0.127 ve 47.55 mg/kg) ve kontrol uygulamasında en düşük (% 0.078 ve 47.55 mg/kg) olarak saptanmıştır. Uygulamaların toprakların potasyum ve kalsiyum konsantrasyonu üzerine önemli bir etkisi olmamıştır. Ekstrakte edilebilir sodyum miktarı, uygulamalara göre değişim göstermiş ve 3 ton/da uygulamasında 44.56 mg/kg ile en yüksek değeri elde etmiştir. Arıtma çamurunun uygulamasının alınabilir Fe, Cu ve Zn üzerine farklı ($p < 0.01$) düzeyde etkili olmuş en yüksek değerler sırasıyla 4.06 mg/kg, 1.74 mg/kg ve 7.62 mg/kg ile 3 ton/da uygulamasında belirlenmiştir. Alınabilir Mn ve B değerlerinde uygulamaların önemli bir etkisi olmamıştır. Toplam Cr, Cd, Pb, Ni, Hg ve As ağır metal değeri Evsel ve Kentsel Arıtma Çamurlarının Toprakta Kullanılmasına Dair Yönetmelik'e göre sınır değerleri geçmemiştir. **Anahtar Kelimeler;** Atık çamur, azot, ağır metal, organik madde



THE EFFECT OF TREATMENT SEWAGE SLUDGE APPLICATIONS ON THE PHYSICAL AND CHEMICAL PROPERTIES OF SOIL

ABSTRACT

The study was carried out to determine the effect of three different doses of municipal sewage sludge on physical and chemical properties of the soil. The random blocks consisted of 4 repetitions of 1) control, 2) mineral fertilizer, 3) 1 ton/da, 4) 2 ton/da and 5) 3 ton/da. Soil sampling was done in 2 different periods in the experiment. The soil pH decreased with treated sludge applications. The highest soil pH value with 7.75 was obtained in the control plots, while the soil pH was the lowest with 7.34 in the 3 ton/da treatment plots. As a result of the treatments, soil salinity was the smallest in the control soils 337.00 $\mu\text{S}/\text{cm}$ and the highest with 766.37 $\mu\text{S}/\text{cm}$ value in 3 ton/da treated soil. The soil organic matter content was determined as control (1.40%), mineral fertilizer (1.41 %), 1 t/da (1.58%), 2 t/da (1.99%) and 3 t/da (2.39%). In response to the treatments, soil total N and available P concentration were determined the highest in the 3 t/da treatment (0.127% and 47.55 mg/kg, respectively) and the lowest in the control plots (0.078% and 47.55 mg/kg respectively). The treatments did not have a significant effect on potassium and calcium concentration of the experimental soils. The exchangeable sodium concentration varied in response to the treatments and was the highest in the 3 ton/da treatment with the value of 44.56 mg/kg. Sewage sludge treatments had an effect on the soil available Fe, Cu and Zn amounts at different levels and the highest values were determined with 4.06 mg/kg, 1.74 mg/kg and 7.62 mg/kg, respectively in 3 ton/da soils ($p < 0.01$). Treatments did not have a significant effect on the available Mn and B values. The concentrations of total Cr, Cd, Pb, Ni, Hg and As as heavy metals did not exceed the limit values according to the Implementing Regulation on the Use of Domestic and Urban Treatment Sludge in Soil.

Keywords; Sewage sludge, nitrogen, heavy metal, organic matter



1. GİRİŞ

Arıtma çamuru, atık su arıtma tesisleri tarafından büyük miktarlarda üretilen ve organik karbon açısından zengin bir yan üründür (Eid ve Shaltout, 2016). Bitki büyümesi için önemli olan mikro besinleri ve makro besinleri içerir ve potansiyel olarak tarımsal toprakların çoğu için önemli bir organik madde kaynağıdır (Latare et al. 2014). Arıtma çamurunda yüksek düzeyde organik kirleticiler ve ağır metaller bulunabilir (Waqas et al. 2015; Rastetter ve Gerhardt, 2017). Bu nedenle, kanalizasyon çamurunun yönetimi birincil bir çevresel sorundur (Eid et al. 2017). Arıtma çamurunu arıtmak için aşağıdaki üç seçenek vardır (Kidd et al. 2007) gübre olarak depolama, yakma ve arazi uygulaması veya toprak özelliklerini iyileştirme. Düzenli depolama yer altı sularını kirletme potansiyeline sahipken, yakma hava kirliliğine neden olur. Arıtma çamurunun toprağa uygulanmasına yönelik ilgi, depolama ve yakmayla ilgili ekonomik sınırlamalar ve çevresel kaygılar nedeniyle artmaya devam etmektedir (Singh ve Agrawal, 2008). Bu tarımsal uygulama sadece bertarafı için bir yol sağlamakla kalmaz, aynı zamanda toprak verimliliğini ve fiziksel özelliklerini artırma kapasitesine sahiptir, böylece ürün verimini artırır (Antonious et al. 2012) ve besin geri dönüşümünü sağlayarak ticari gübre ihtiyacı azaltabilir (Willén et al. 2017). Çok sayıda yapılan çalışmalarda (Delibacak ve Ongun, 2016; Ongun ve Delibacak, 2017; Ongun ve Delibacak, 2018; Kayikcioglu et al., 2019) arıtma çamuru tarımda kullanılmıştır.

Bu projede, İzmir Büyükşehir Belediyesi Çiğli Atık Su Arıtma Tesisinden çıkan, anaerobik koşullarda stabilize edilmiş ve % 90 kuruluğa getirilmiş granül haldeki, farklı dozlarda arıtma çamuru uygulanarak pamuk yetiştirilen toprağın pH, EC, Organik madde, kireç, toplam N, alınabilir P, alınabilir K, alınabilir Ca, alınabilir Na, alınabilir Fe, alınabilir Cu, alınabilir Zn, alınabilir Mn, alınabilir B, toplam Cr, toplam Cd, toplam Pb, toplam Ni, toplam Hg ve toplam As değişimlerini saptamak için yapılmıştır.

2.MATERYAL ve YÖNTEM

Bu çalışmada Ege Üniversitesi Ziraat Fakültesi Uygulama ve Araştırma Çiftliğindeki arazide 2015 yılında İzmir Büyükşehir Belediyesi Çiğli Atık Su Arıtma Tesisinden çıkan ve anaerobik koşullarda stabilize edilmiş ve % 90 kuruluğa getirilmiş granül haldeki arıtma çamuru uygulanarak pamuk bitkisi yetiştirilmiştir. Denemede kullanılan arıtma çamurunun ve deneme toprağının fiziksel ve kimyasal analiz sonuçları Tablo 1 ve Tablo 2'de sunulmuştur.



Çizelge 1. Arıtma çamurunun fiziksel ve kimyasal özellikleri

pH		7.18	
EC	µS/cm	1945	
Organik madde	%	51.20	
Organik C	%	29.66	
Kireç	%	5.35	
Toplam	N	%	2.99
	P	%	0.2275
	K	%	0.34
	Ca	%	6.36
	Mg	%	2.04
	Na	mg/kg	1390.5
	Fe	mg/kg	12754.96
	Cu	mg/kg	176.5
	Zn	mg/kg	1376.59
	Mn	mg/kg	350
	Ni	mg/kg	69.73
	Pb	mg/kg	17.44
	Cr	mg/kg	112.53
	Cd	mg/kg	2.83
B	mg/kg	16.1	

Çizelge 2. Deneme toprağının analiz sonuçları

Özellik	Değer	Özellik	Değer
pH ^a	7.64	Ca ^f (mg/kg)	2162
EC ^b (dS/m)	0.44	Na ^f (mg/kg)	31.17
Bünye	Sandy-loam	Fe ^g (mg/kg)	2.65
Kum (%)	55.84	Cu ^g (mg/kg)	0.89
Mil (%)	31.44	Zn ^g (mg/kg)	2.08
Kil (%)	12.72	Mn ^g (mg/kg)	1.83
CaCO ₃ (%)	4.74	Ni ^h (mg/kg)	53.09
O. Madde ^c	1.51	Pb ^h (mg/kg)	13.34
N ^d (%)	0.081	Cr ^h (mg/kg)	25.57
P ^e (mg/kg)	14.66	Cd ^h (mg/kg)	0.75
K ^f (mg/kg)	237	B ⁱ (mg/kg)	1.07

^a:(w:v, 1:2.5 su), ^b:(EC w:v, 1:2.5 su), ^c: (Walkey-Black) ^d: (toplam kjeldahl), ^e: (almabilir Olsen),
^f: (almabilir 1N NH₄OAc), ^g: (almabilir DTPA), ^h: (toplam HCl+ HNO₃), ⁱ: (sıcak su)

Tesadüf blokları deneme desenine göre, 4 tekrarlamalı olarak parseller 3x3 m boyutlarında, aralarında 2 m boşluk olacak şekilde düzenlenmiştir. 1) Tanık, 2) Mineral gübre uygulaması, 3) 1 ton/da arıtma çamuru, 4) 2 ton /da arıtma çamuru 5) 3 ton/da arıtma çamuru uygulamasından oluşmuştur. Uygulamalar toprak yüzeyine yapıldıktan sonra rotavator ile toprağın 15 cm derinliğine kadar karıştırılmıştır (21 Nisan 2015). Pamuk ekimi ise 29 Nisan 2015 tarihinde yapılmıştır. Pamukta 50 kg/da 15.15.15 kompoze gübresi temel gübre olarak mineral gübre uygulama parseline uygulanmıştır. Denemede mineral gübre uygulaması için bu



parsellere 4 Haziran 2015 tarihinde 15 kg/da üre gübresi üst gübre olarak verilmiştir. İkinci üst gübreleme çiçeklenme döneminde yine sadece mineral gübre parsellerine 27 kg/da olarak ve CAN (kalsiyum amonyum nitrat) formunda 8 Temmuz 2016 tarihinde verilmiştir. Pamuk damla sulama sistemi tesis edilmiş ve toprağın nem durumuna göre sulama işlemleri gerçekleştirilmiştir. Denemede 2 farklı dönemde toprak örnekleme yapılmıştır. 21 Nisan 2015 tarihinde tüm deneme parsellerine arıtma çamuru uygulanmasını takiben 15 gün sonra 1. dönem toprak örnekleme ve yaklaşık 189 gün sonra 27 Ekim 2015 tarihinde 2. toprak örnekleme yapılmıştır. Analiz sonuçları 1. dönem toprak örnekleme ve 2. dönem toprak örnekleme sonuçlarının ortalaması olarak belirtilmiştir. Deneme sonrasında alınan toprak örnekleri hava kuru duruma getirilmiştir. Bu örnekler analizler için 2 mm'lik elekten elenmişlerdir. Toprak örneklerinde pH 1:2.5 toprak:su ekstraktında (Jackson, 1967), Toprak tuzluluğu (EC, dS m⁻¹), (1:2.5) (Soil Survey Staff, 1951). Kireç (CaCO₃): Scheibler kalsimetresi (Schlichting ve Blume, 1966). Organik Madde: Modifiye Walkler-Black yöntemine göre belirlenmiştir (Jackson, 1967). Toprak bünyesi hidrometre yöntemi ile (Bouyoucos, 1951), Toplam Azot (N): Modifiye Kjeldahl yöntemi (Bremner, 1965), Alınabilir Na, K, Ca, ve Mg: Toprakların alınabilir Na, K, Ca ve Mg elementleri pH değeri 7 olan 1 N amonyum asetat ekstraksiyonu NH₄OAc (pH=7) (Pratt, 1954). K, Ca ve Na, elementleri Alev (Flame) fotometrede Mg ise Atomik absorpsiyon spektrofotometresinde (Kacar ve İnal 2008) saptanmıştır. Alınabilir Fosfor Olsen Metoduna göre (Olsen ve Dean, 1965). Alınabilir Fe, Cu, Zn ve Mn: Toprak örnekleri DTPA çözeltisi ile (Lindsay ve Norvell, 1978) ekstraksiyon yapıldıktan sonra, atomik absorpsiyon spektrofotometrede belirlenmiştir (Kacar ve İnal, 2008). Bor: Sıcak su ile ekstraksiyonu sonucu spektrofotometrede saptanmıştır (Wolf, 1971). Toprakta toplam Cd, Pb, Cr, ve Ni; HCl ve HNO₃ (Kral suyu 3:1) ektrakte edilen toprak örneklerinde AAS ile belirlenmiştir (Kacar ve İnal, 2008). As: Kral suyu ekstraktında Gümüş Dietilthiokarbamat (AgDDC) yöntemiyle kolorimetrik olarak ve Hg: Toprak örnekleri asit ile işlem gördükten sonra soğuk buhar yöntemiyle atomik absorpsiyon spektrofotometrede (AAS) okunmuştur (Kacar, 2009). İstatistiki analizi; SPSS 20.0 programında tesadüf blokları deneme desenine göre yapılmıştır. Ortalama değerlerin karşılaştırılması ise "Duncan" çoklu karşılaştırma testi ile ve $\alpha=0.05$ önem düzeyine göre yapılmıştır.

3 BULGULAR ve TARTIŞMA

Arıtma çamuru uygulamaları toprak pH'sı üzerine ($p<0.01$) önemli düzeyde etkili olmuştur. Kontrol uygulamasında 7.75 ile en yüksek değer, 3 ton/da uygulamasında 7.34 ile en küçük değer elde edilmiştir (Çizelge 3). Uygulamalar EC üzerine de önemli ($p<0.01$) düzeyde etki yapmıştır. Kontrol uygulamasında 337.00 $\mu\text{S}/\text{cm}$ değeri ile en küçük, 766.37 $\mu\text{S}/\text{cm}$ değeri 3 ton /da uygulamasında en yüksek değer elde edilmiş ve uygulama dozlarının artışıyla orantılı olarak EC değeri artış göstermiştir (Delibacak ve Ongun, 2016; Evangelo et al., 2017). Toprak pH'sı ve elektrik iletkenliği ile ilgili benzer sonuçlar Tsadilas et al. 2014; Yılmaz ve Temizgül 2014; Eid et al. 2017 tarafından elde edilmiştir. Arıtma çamuru içerisindeki organik maddenin ayrışması sırasında açığa çıkan organik asitlerin ortam pH'sını düşürmesi ve çamurunun biyolojik olarak parçalanması nedeniyle ilişkili olabilir (Singh ve Agrawal 2010b; Lu et al. 2015).



Çizelge 3. Arıtma çamurunun toprağın kimi parametreleri üzerine etkisi

Uygulamalar	pH	EC (μ S/cm)	O.M (%)	Kireç (%)
Kontrol	7.75 a	337.00 c	1.40 c	4.39
Mineral Gübre	7.70 a	370.75 bc	1.41 c	4.22
1 t/da	7.58 b	429.37 b	1.58 c	4.16
2 t/da	7.47 c	717.37 a	1.99 b	4.20
3 t/da	7.34 d	766.37 a	2.39 a	4.22
	**	**	**	öd
	LSD(0.01) :0.109	LSD(0.01) :88.986	LSD(0.01) :0.293	LSD(0.01) :0.222

Bu çalışmada arıtma çamurunun uygulanması, kontrol toprağındaki organik madde içeriğı uygulamalara göre farklılık ($p<0.01$) göstermiş uygulamalara göre organik madde içeriğı Kontrol (% 1.40), mineral gübre (% 1.41), 1 t/da (% 1.58), 2 t/da (% 1.99) ve 3 t/da (% 2.39) şeklinde belirlenmiştir. Arıtma çamuru uygulamasının toprağın organik madde içeriğini arttırdığı belirtilmiştir (Delibacak ve Ongun, 2016; Bıyıklı et al. 2020). Arıtma çamuru ile toprak verimliliğinin iyileştirilmesi birçok çalışmada geniş çapta rapor edilmiştir (Delibacak et al. 2009b; Eid et al. 2017; Liu et al. 2017). Atık çamuru uygulamalarının kireç üzerine önemli etkisi olmamıştır. Kireç % 4.16-4.39 aralığında değişim göstermiştir.

Çizelge 4. Arıtma çamurunun toprağın element içeriğı üzerine etkisi

Uygulamalar	Toplam (%)	Alınabilir (mg/kg)			
	N	P	K	Ca	Na
Kontrol	0.078 c	12.55 d	243.12	2180.51	31.34 b
Mineral gübre	0.087 bc	20.11 cd	252.09	2223.59	30.19 b
1 t/da	0.092 bc	29.35 bc	266.54	2184.32	30.68 b
2 t/da	0.108 ab	37.91 ab	281.74	2238.55	37.01 ab
3 t/da	0.127 a	47.55 a	265.280	2232.94	44.56 a
	**	**	öd	öd	**
	LSD(0.01) :0.023	LSD(0.01) :4.479	LSD(0.05) :35.195	LSD(0.05) :79,970	LSD(0.05): 7.841

**; önemli ($p<0.01$), *; önemli ($p<0.05$), öd; önemli değil

Toplam N uygulamalara göre önemli ($p<0.01$) düzeyde farklılık göstermiştir. Uygulamalara N değişimi 3 t/da (% 0.127)> 2 t/da (% 0.108)> 1 t/da (% 0.092)> Mineral gübre (% 0.087) ve > kontrol (% 0.078) şeklinde sıralanmıştır (Çizelge 4). Azot ve fosfor içeriğinin atık çamur uygulamasıyla artış gösterdiği (Bozkurt ve Cimrin, 2003; Delibacak ve Ongun, 2016; Evangelo et al., 2017; Ongun ve Delibacak, 2018) belirtilmiştir. Artan atık çamur uygulama seviyelerine bağlı olarak fosfor mevcudiyeti önemli ($p<0.01$) düzeyde farklılık göstermiş en düşük ve en yüksek değerler sırasıyla kontrol ve 3 ton/da uygulamasında 12.55 mg/kg ve 47.55 mg/kg olarak P belirlenmiştir. Azot ve fosfor içeriğinin çamur uygulamasıyla artış gösterdiği (Delibacak et al 2009a; Shaheen et al.2012; Evangelo et al. 2017) belirtilmiştir. Atık çamuru uygulamalarının potasyum ve kalsiyum üzerine önemli etkisi olmamıştır. Alınabilir K değeri 243.12 mg/kg ile kontrol uygulamasında en küçük değer, 281.74 mg/kg 2 ton/da uygulamasında en büyük değer elde edilmiştir. Atık çamuru uygulamalarına göre alınabilir kalsiyum 2180.51-2238.55 mg/kg olarak saptanmıştır. Sodyum uygulamalara göre önemli ($p<0.01$) düzeyde değişim göstermiş. Mineral gübreli uygulamasında en küçük değer 30.19 mg/kg ve 3 ton/da



uygulamasında 44.56 mg/kg ile en büyük değerler elde edilmiş Bıyıklı ve ark. (2020)' göre (69.1-171.8 mg/kg) farklı bir seyir izlemiştir.

Çizelge 5. Arıtma çamurunun toprağın mikro elementler üzerine etkisi

Uygulamalar	Alınabilir (mg/kg)				
	Fe	Cu	Zn	Mn	B
Kontrol	2.19 b	0.81 c	2.55 c	1.43	0.77
Mineral gübre	2.16 b	0.86 c	2.78 c	1.47	1.02
1 t/da	2.91 bc	1.30 b	4.58 b	1.57	0.96
2 t/da	3.69 ab	1.60 ab	6.99 a	1.71	1.32
3 t/da	4.06 a	1.74 a	7.62 a	1.91	1.26
	**	**	**	öd	öd
	LSD(0.01) :0.809	LSD(0.01) :0.411	LSD(0.01) :0.862	LSD(0.05) :0.517	LSD(0.05) :0.423

**; önemli ($p<0.01$), *; önemli ($p<0.05$), öd; önemli değil

Arıtma çamurunun uygulaması Fe üzerine farklı ($p<0.01$) düzeyde etkili olmuş Fe konsantrasyonu 2.16 mg/kg gübrelili uygulamada küçük, 3 ton /da uygulamasında 4.06 mg/kg ile büyük değer elde edilmiştir (Çizelge 5). Bıyıklı ve ark. (2020)' göre (24.8-28.7 mg/kg) daha düşük düzeyde belirlenmiştir. Uygulamalarının Cu üzerine önemli ($p<0.01$) düzeyde etkili olmuştur. En küçük değer kontrol uygulamasında 0.81 mg/kg ve en yüksek değer ise 3 ton/da uygulamasında 1.74 mg/kg ile elde edilmiştir. Cu, muhtemelen organik madde artışından dolayı atık çamur uygulamasından sonra artma eğiliminde olmuştur. Organik madde içeriği ve Cu arasında pozitif bir şekilde ilişkili olduğu bildirilmiştir (Sipkova et al., 2014; Tsadilas et al., 2014). Arıtma çamuru uygulamalarının Zn konsantrasyonu üzerine etkisi önemli ($p<0.01$) bulunmuştur. Zn konsantrasyonu 2.55 mg/kg mineral gübrelili uygulamada küçük, 3 ton /da uygulamasında 7.62 mg/kg ile büyük değer elde edilmiştir. Bıyıklı ve ark. (2020)'na göre (24.8-28.7 mg/kg) daha düşük düzeyde belirlenmiştir. Delibacak ve Ongun, (2016) tarafından belirtildiği gibi arıtma çamuru uygulama dozlarına göre alınabilir Zn konsantrasyonu artış göstermiş en düşük değer kontrol (2.55 mg/kg) ve en yüksek değer 3 t/da uygulamasında (7.62 mg/kg) saptanmıştır. Atık çamuru uygulamalarının Mn ve B üzerine önemli bir etkisi olmamıştır. Kontrol uygulamasında en küçük 1.47 mg/kg Mn değeri ve en yüksek Mn değeri ise 1.91 mg/kg 3 ton/da uygulamasında saptanmıştır. Atık çamuru uygulamalarına göre B elementi 0.77-1.32 mg/kg aralığında saptanmıştır.

Uygulamaların toplam Cr üzerine önemli bir etkisi olmamıştır. En düşük Cr değeri 33.89 mg/kg ile kontrol ve en yüksek Cr değeri ise 38.55 mg/kg ile 3 t/da uygulamasında saptanmıştır. Alloway (1995)' in belirttiğine göre, topraklarda müsaade edilen krom konsantrasyonu 75-100 mg/kg olarak belirtilen değer altıda yer almıştır. Toplam kadmiyum (Cd) içeriği artan dozdaki arıtma çamuru uygulaması ile kontrole göre istatistiksel olarak ($p<0.05$) artış göstermiştir (Çizelge 6). Uygulamalara göre toplam Cd konsantrasyonu 0.82-0.93 mg/kg aralığında değişim göstermiştir. Kabata-Pendias (2011) tarafından 3 mg/kg Cd olarak belirtilmiş ola normal limitlerin altında yer almıştır. Toplam kurşun (Pb) içeriği artan dozdaki arıtma çamuru uygulaması ile kontrole göre istatistiksel ($p<0.05$) olarak artış göstermiştir. En düşük Pb konsantrasyonu 11.22 mg/kg ile kontrol, en yüksek değer ise 13.34 mg/kg ile 3 t/da uygulamasında belirlenmiştir.



Çizelge 6. Arıtma çamurunun toprağın ağır metal üzerine etkisi

Uygulamalar	Toplam (mg/kg)				Toplam (µg/kg)	
	Cr	Cd	Pb	Ni	Hg	As
Kontrol	33.89	0.82 c	11.22 b	51.71	56.05 c	18.77
Mineral gübre	34.26	0.81 c	12.04 b	51.29	60.81 bc	18.93
1 t/da	36.17	0.85 bc	12.22 ab	52.18	71.97 ab	19.21
2 t/da	36.11	0.90 ab	12.45 ab	52.14	78.10 a	19.10
3 t/da	38.55	0.93 a	13.34 a	52.00	85.23 a	18.85
	Öd	*	*	öd	**	öd
	LSD(0.05) :4.983	LSD(0.01) :0.073	LSD(0.01) :1.288	LSD(0.05) :1.620	LSD(0.01) :15.574	LSD(0.05) :2.510

**; önemli (p<0.01), *; önemli (p<0.05), öd; önemli değil

Kabata-Pendias and Pendias, (1992) tarafından belirtilen 100 mg/kg limit değerinin altında belirlenmiştir. Uygulamaların toplam Ni üzerine istatistiki olarak bir etkisi olmamıştır. En düşük Ni konsantrasyonu 51.29 mg/kg ile mineral gübre uygulamasında, en yüksek değer ise 52.18 mg/kg ile 1 t/da uygulamasında saptanmıştır. Özbek ve ark., (1995) tarafından 100 mg/kg Ni belirtilen kritik toksik değerinin altında yer almıştır. Toplam Cd, Cr, Ni ve Pb değerleri Delibacak ve Ongun (2018) tarafından belirtilen değerlere göre farklılık göstermiş bunun da uygulama dozlarına ve toprak özelliklerine göre farklılık göstermesinden kaynaklanabileceği düşünülmektedir. Toplam civa (Hg) içeriği artan dozdaki arıtma çamuru uygulaması ile kontrole göre istatistiksel (p<0.01) olarak artış göstermiştir. En düşük Hg konsantrasyonu 56.05 µg/kg ile kontrol uygulamasında, en yüksek değer ise 85.23 µg/kg ile 3 t/da uygulamasında saptanmıştır. Türkiye standart limiti olan Hg 1.5 mg/kg'ın (Anonim, 2001; Chiroma et al. 2014) altında saptanmıştır. Uygulamaların toplam As üzerine önemli bir etkisi olmamıştır. Arsenik elementine ait analiz sonuçlarına göre en yüksek değer 19.21 µg/kg, en küçük değer ise 18.77 µg/kg saptanmıştır. Arsenik elementine ait, WHO ve FAO değerleri baz alarak 20 mg/kg olarak belirtilmiştir (Chiroma et al. 2014). Arsenik değeri örneklerin tamamında standart değerinin altında kalmıştır. Anonim (2010) uyarınca belirtilen 100 mg/kg Pb, 1.5 mg/kg Cd, 100 mg/kg Cr ve 70 mg/kg Ni limit değerlerinin altında yer almıştır. Ağır metallerin mevcudiyetini ve alımını pH etkilemektedir (Kumar ve Chopra 2012; Khan et al. 2015; Eid ve Shaltout, 2016). Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb ve Zn gibi elementler asidik koşullar altında çözünürlüklerinin artış gösterdiği ifade edilmiştir (Eid et al.2017).

4. SONUÇ ve ÖNERİLER

Artan dozdaki arıtma çamuru uygulamaları toprağın organik maddesini, toplam N içeriğini, alınabilir P miktarını artırmıştır. Arıtma çamuru uygulamaları ile toprakta bitkiler için mutlak gerekli elementlerden olan Zn, Cu ve Mn miktarları artış göstermiştir. Deneme topraklarının ağır metal analiz sonuçlarına göre, hiçbir ağır metal değeri Evsel ve Kentsel Arıtma Çamurlarının Toprakta Kullanılmasına Dair Yönetmelik'e göre sınır değerleri geçmemiştir. Ancak, uygulamadaki kolaylık için organik maddesi % 1.5'den az olan topraklarda 3 ton/da, organik maddesi % 1.5'den fazla olan topraklarda 2 ton/da arıtma çamuru uygulaması önerilir.



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PATATES (*Solanum tuberosum* L.) BİTKİSİNDE FARKLI DİKİM ZAMANLARININ ETKİLERİ

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ÖZET

Patates bitkisinin çok farklı iklim bölgelerine kolaylıkla adapte olabilmesinden dolayı, ülkemizin hemen her bölgesinde patates üretimi rahatlıkla yapılabilmektedir. Dünyada 2009 yılında patates üretim miktarı 330.780.260 ton iken 2019 yılında bu miktar 370.436.581 tona yükselmiştir. Ancak, ara yıllarda üretim miktarında dalgalanmalar olmuştur. Türkiye’de 2010 yılında patates üretim miktarı 4.513.453 ton iken, 2020 yılında üretim miktarı 5.200.000 tona yükselmiştir. Patates ziraatında en iyi dikim zamanının tespit edilmesi gerekir. Bu dikim zamanı her bölgenin ekolojik şartlarına göre değişim göstermektedir.

Anahtar Kelimeler: Patates, dikim zamanı, üretim, verim



EFFECTS OF DIFFERENT PLANTING TIMES IN POTATO (*Solanum tuberosum* L.) PLANTS

ABSTRACT

Because of the potato plant can easily adapt to very different climatic regions, potato production can be done easily in almost every region of our country. While the amount of potato production in the world was 330.780.260 tons in 2009, this amount increased to 370.436.581 tons in 2019. However, there were fluctuations in the amount of production in the interim years. While the amount of potato production in Turkey was 4.513.453 tons in 2010, it increased to 5.200.000 tons in 2020. The best planting time should be determined in potato farming. This planting time varies according to the ecological conditions of each region.

Keywords: Potato, planting time, production, yield



GİRİŞ

Patates (*Solanum tuberosum* subsp.) bitkisi *Solanum* cinsine ait olup, anavatanı Güney Amerika'dır. Patatesin Türkiye'ye ne zaman ve nereden getirildiği konusunda kesin olmamakla birlikte farklı görüşler bulunmaktadır. Ancak, kesinliği bilinmemekle birlikte patatesin ülkemize Rusya ve Kafkaslar üzerinden getirilip Doğu ve Karadeniz bölgelerinin yayla ikliminde yetiştirilmeye başlandığı iddia edilmektedir (Yıldırım ve ark., 2005).

100 gr'lık patates yumrusunda; normal şartlarda bir insanın gereksinim duyduğu günlük proteinin minimum % 7'sini, demirin % 10'unu, C vitamininin % 20-50'sini, B1 vitamininin % 10'unu ve enerjinin % 3'ünü karşılayabilmektedir. Sayılan bu değerler, patatesin beslenmedeki yerini ve önemini açık olarak gözler önüne sermektedir. Patates; beslenme değerinin yüksek ve kullanım alanlarının geniş olmasından dolayı, geri kalmış ve yetersiz beslenen ülkelerde, daha da artan açlık sorununa cevap olabilecek en önemli gıda maddelerinin başında gelmektedir (Arıoğlu, 2002). Ayrıca, patates bir çapa bitkisi olduğu için ekim nöbeti içerisinde önemli bir yere sahip olmaktadır. Bu durum patates yetiştiriciliği yapılan bölgelerde birim alandan en yüksek getiriye sahip olduğundan, üretici için önemli bir gelir kaynağı konumunda olabilmektedir.

Ülkemizde patates üretiminin büyük çoğunluğu ana ürün olarak yapılmakta olup, kışları ılık geçen kıyı bölgelerimiz olan Akdeniz, Ege'de ise turfanda üretim amacıyla kışlık olarak dikim gerçekleştirilmektedir. Turfanda patates yetiştiriciliğinin en avantajlı tarafı ise, kış döneminde fazla alternatif bitkinin bulunmadığından dolayı, tarlanın yüksek gelir getirebilecek bir çapa bitkisi ile doldurulmasıdır. Turfanda patates üretimiyle hem normal üretimden daha erken bir dönemde tüketiciye patates sunulmakta hem de bu durumdan kaynaklı yüksek gelir elde edilmektedir. Ayrıca erken dönemde üretilen patatesler dış satım potansiyeline sahip olabilmektedir (Samancı ve ark., 2003).

Patates ziraatında dikim zamanı her bölgenin ekolojik şartlarına göre değişim göstermekte olup ve en iyi dikim zamanının tespit edilmesi gerekmektedir. Bu durum aynı ekolojik koşulda dahi o yılın hava şartlarına bağlı olarak farklılık gösterebilmektedir. Uzun yılların meteorolojik verileri göz önünde tutulduğunda her yıl değişimi muhtemel dikim zamanı farklılıklarının en fazla bir hafta veya on günü geçmediği tespit edilmiştir (Şenol, 1971).

Çizelge 1. Dünya patates üretim durumu (FAO, 2021)

Yıllar	Ekilen Alan (Hektar)	Üretim Miktarı (Ton)	Verim (Ton/Hektar)
2009	18581515	330780260	178016
2010	18173634	328664524	180847
2011	18699577	367985146	196788
2012	18698323	361050846	193093
2013	18507308	365206549	197331
2014	18052066	370014583	204971
2015	18068799	366137852	202635
2016	17409789	354189041	203442
2017	17443203	370104795	212177
2018	17164096	365316462	212838
2019	17340986	370436581	213619

Dünyada 2009 yılında patates üretim miktarı 330.780.260 ton iken 2019 yılında bu miktar 370.436.581 tona yükselmiştir. Ancak, ara yıllarda üretim miktarında dalgalanmalar olmuştur (Çizelge 1). Dünyada patates üretimi konusunda, Çin, Hindistan, Rusya, Ukrayna, ABD,



Almanya ve diğer ülkeler şeklinde sıralanmaktadır. Türkiye ise 18. sırada yer almaktadır (FAO, 2021).

Çizelge 2. Türkiye patates üretim Durumu (TUİK,2021)

Yıllar	Ekilen Alan (Dekar)	Üretim Miktarı (Ton)	Verim (kg/dekar)
2010	1388660	4513453	3251
2011	1429849	4613071	3260
2012	1720867	4795122	2814
2013	1250297	3948000	3160
2014	1297032	4166000	3245
2015	1538787	4760000	3095
2016	1448572	4750000	3283
2017	1428835	4800000	3360
2018	1359373	4550000	3348
2019	1408967	4979824	3538
2020	1479935	5200000	3514

Türkiye’de 2010 yılında patates üretim miktarı 4.513.453 ton iken, 2020 yılında üretim miktarı 5.200.000 tona yükselmiştir (Çizelge 2). Ara yıllarda da yükselmeler devam etmiştir. Türkiye, dünya patates üretiminin % 1.34 ‘ünü karşılamaktadır (FAO, 2021). Türkiye’de ise üretim yoğun olarak sırasıyla Niğde, Konya, Afyon, Kayseri, İzmir ve Nevşehir illerinde gerçekleştirilmekte; bu illeri sırasıyla Aksaray, Adana, Bitlis, Sivas ve Bolu izlemektedir. Toplam patates üretiminin yaklaşık %79’u bu illerde üretilmektedir. Türkiye’nin 2019 yılı ihracat miktarı 288.793 ton olup, ithalat miktarı ise 97.348 ton olmaktadır (TUİK, 2021).

Arıoğlu (1997), yapmış olduğu çalışmalar ile ülkemizde patates dikim zamanının bölgelere göre değişim gösterdiğini, yazlık patates dikimlerinin Nisan-Mayıs aylarında, turfanda patates dikim zamanlarının ise kıyı bölgelerimizde 15 Aralık- 15 Ocak tarihleri arasında yapıldığını bildirmektedir. Ayrıca, ülkemizde patates dikiminin en erken Akdeniz Bölgesinde (Aralık-Ocak) yapıldığını, burayı İzmir-Aydın (Ocak-Şubat), Bursa-İnegöl (Mart), Bolu-Adapazarı (Mart/Nisan), Niğde-Nevşehir (Nisan-Mayıs) ve Erzurum-Kars (Mayıs) bölgelerinin izlediğini bildirmektedir.

Çalışkan ve ark. (1999), yürütmüş oldukları çalışmalarında ana ürün olarak yetiştirdikleri 5 farklı patates çeşidinde (Resy, 81028/1 klonu, Sultan, Granola, Yayla kızı), 6 farklı dikim zamanının (30 Ocak, 10 Şubat, 20 Şubat, 28 Şubat, 10 Mart, 20 Mart) verim ve kalite üzerine etkilerini araştırmışlardır. Çalışma neticesinde; 30 Ocak ve 20 Mart tarihlerinden en yüksek bitki boyunu (39,9 cm), 20 Mart tarihinden en erken olum süresini (83,3 gün), 20 Şubat ve 20 Mart tarihlerinden en yüksek yumru sayısını (9,8 adet/bitki) ve 10 Şubat tarihinden ise en yüksek dekara yumru verimini (2495 kg/da) elde ettiklerini rapor etmişlerdir.

Samancı ve ark. (2005), Akdeniz Üniversitesi Ziraat Fakültesi deneme alanında yürütmüş oldukları dört farklı patates çeşidinde (Jaerla, Marabel, Marfona ve Velox) ve hasat zamanlarının (30 Mayıs, 10 Haziran ve 20 Haziran 2003 ve 2004) yumru verim öğelerine olan etkilerini incelemişlerdir. Çalışma neticesinde; hasat zamanı geciktikçe bitki başına yumru sayısı (8,04-6,66 ad/bitki), ortalama yumru ağırlığı (74,99-60,92 g), küçük ve büyük yumru oranı, bitki başına yumru ağırlığı (577,43-379,52 g) ve dekara yumru verimi (2735,91-1847,49 kg/da) azaldığını, ayrıca en uygun hasat zamanının 30 Mayıs olduğunu rapor etmişlerdir.

Ekin (2009), Bitlis-Ahlat ekolojik koşullarında farklı olum sürelerine sahip patates çeşitlerinin adaptasyon kabiliyetlerini tespit etmek amacıyla 2007 ve 2008 yıllarında yürütmüş olduğu



çalışmada, patates çeşitlerinin bu koşullarda morfolojik özellikler ile verim ve kalite özellikleri bakımından önemli ölçüde farklılıklar gösterdiklerini ifade etmiştir.

Öner ve Aytaç (2016), Bafra koşullarında turfanda patates üretim olanağının belirlenmesi amacıyla 2009-2010 yetiştirme sezonunda yürütmüş oldukları çalışmada, 2 çeşit (Marfona ve Marabel), 4 farklı dikim zamanı (24 Kasım, 2 Şubat, 1 Nisan ve 25 Nisan) ve 3 farklı uygulamayı (Ön sürgünlendirme, Gibberellik asit ve kontrol) araştırmışlardır. Çalışma sonucunda, dekara en yüksek yumru verimini (2.828,7 kg/da), üçüncü dikim zamanından, en düşük yumru verimini ise birinci dikim zamanından (880,4 kg/da) elde ettiklerini rapor etmişlerdir.

Kaplan ve Arslan (2018), Siirt Üniversitesi deneme alanında 2017 yılında farklı dikim zamanlarının (25 Ocak, 25 Şubat, 27 Mart, 21 Nisan, 12 Mayıs) bazı patates çeşitlerinde verim ve verim öğeleri üzerine etkisini incelemek amacıyla çalışma yürütmüşlerdir. Çalışma sonucunda; Soraya çeşidinin Siirt ekolojik koşullarına iyi adaptasyon sağladığını, en yüksek dekara yumru veriminin (5806,35 kg/da) Soraya çeşidinden 25 Şubat tarihinde yapılan dikimden elde edildiğini rapor etmişlerdir.

SONUÇ ve ÖNERİLER

Yüksek sıcaklık, bitkilerin büyüme-gelişme ve verimliliğini etkileyen ve kontrol edilemeyen başlıca faktördür. Dikim zamanı geciktikçe patatesin büyüme ve gelişimi yüksek sıcaklıklara maruz kaldığından (Haziran ayı) ve yumru gelişimi tamamlanmadığından dolayı verim olumsuz olarak etkilenmektedir. Ayrıca, erken olgunlaşma ile sıcaklığa tolerans arasında yakın bir ilişki olduğu ve erken olgunlaşan çeşitlerin sıcaklığa toleransının daha iyi olduğu da iddia edilmektedir. Bu yüzden, erkenci çeşitler daha kısa sürede kuru madde biriktirmekte ve stresli çevre koşullarına maruz kalma süresi geçici çeşitlere göre daha kısa olmaktadır. Bununla birlikte kısa yetiştirme periyodu ve erken olgunlaşma düşük verim potansiyeline neden olmaktadır (Marshall 1982). Patates ziraatında dikim zamanı her bölgenin ekolojik şartlarına göre değişim göstermekte ve en iyi dikim zamanının tespit edilmesi gerekmektedir.



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ROKA (*Eruca Sativa*) YETİŞTİRİCİLİĞİNDE HÜMİK ASİT, AMİNOASİT VE DENİZ YOSUNU UYGULAMALARININ ETKİLERİ

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ÖZET

Bu çalışmada roka yetiştiriciliğinde sulama suyu ile hümik asit, aminoasit ve deniz yosunu biyostimülant uygulamalarının bitki büyümesi üzerine etkileri incelenmiştir. Çalışma Kahramanmaraş Andırın ilçesinde açıkta roka yetiştiriciliği alanında gerçekleştirilmiştir. Tesadüf blokları deneme deseninde 3 tekerrürlü olarak kurulan denemede Arzuman roka tohumları 13 Ekim 2020 tarihinde ekilmiştir. Uygulamalar tohum ekiminden 10 gün sonra 24 Ekim 2020 tarihinde başlatılmıştır. İlk uygulama dozları; hümik asit ve aminoasit 10 litre sulama suyuna 100 ml, deniz Yosunu 10 litre suya 50 g olacak şekilde uygulanmıştır. Takip eden uygulamalarda dozlar iki katına çıkarılmıştır; hümik asit ve aminoasit 10 litre sulama suyuna 200 ml, deniz Yosunu ise 10 litre suya 100 g olacak şekilde uygulanmıştır. Roka bitki gelişimi üzerine hümik asit uygulaması artırıcı bir etki yaparken, aminoasit ve deniz yosunu uygulamalarının genelde kontrol bitkilerinin altında seyreden bir gelişme gösterdikleri belirlenmiştir. Buna göre roka bitkisi ağırlığı hümik asit ile kontrole göre %36 artmış, aminoasit ve deniz yosunu ile sırasıyla %10 ve %39 azalmıştır. Yaprak sayısı hümik asit ile kontrole göre %9 artmış, aminoasit ve deniz yosunu ile sırasıyla %7 ve %10 azalmıştır. Roka yaprak boyu, hümik asit ve aminoasit ile kontrole göre sırasıyla %25 ve %6 artarken, deniz yosunu ile %29 azalmıştır. Roka yaprak genişliği; hümik asit ile kontrole göre %33 artmış, aminoasit ve deniz yosunu ile sırasıyla %18 ve %36 azalmıştır. Yaprak sapı uzunluğu hümik asit ile kontrole göre %24 artmış, aminoasit ve deniz yosunu ile sırasıyla %5 ve %26 azalmıştır. Sonuç olarak, hiç mineral gübre kullanmadan sulama suyu ile sadece hümik asit kullanılarak roka yeşil yapraklı sebze yetiştiriciliğinde bitki gelişimi ve verimliliği artırılacağı belirlenmiştir. Bu sonuç konvansiyonel tarım yanında organik tarım için de önerilebilir bulunmuştur.

Anahtar Kelimeler: Roka, biyostimülant, bitki gelişimi, organik tarım



EFFECTS OF HUMIC ACID, AMINO ACID AND SEA ALGAE APPLICATION ON ARAGULA (*Eruca Sativa*) CULTURE

ABSTRACT

In this study, the effects of humic acid, amino acid and seaweed biostimulant applications on plant growth in rocket cultivation were investigated. The study was carried out in the field of arugula cultivation in the Andırın district of Kahramanmaraş. Arzuman rocket seeds were sown on 13 October 2020. The experiment was established in a randomized complete block design with 3 replications. Biostimulant applications were started on October 24, 2020, 10 days after the seed sowing. First application doses; humic acid and amino acid were applied as 100 ml to 10 liters of irrigation water and 50 g of seaweed to 10 liters of water. The doses were doubled in subsequent administrations; humic acid and amino acid were applied as 200 ml to 10 liters of irrigation water, and seaweed was applied as 100 g to 10 liters of water. While humic acid application had an increasing effect on arugula plant growth, it was determined that amino acid and seaweed applications generally showed a development below the control plants. Accordingly, the weight of arugula plant increased by 36% with humic acid compared to the control, and decreased by 10% and 39% with amino acids and seaweed, respectively. The number of leaves increased by 9% with humic acid compared to the control, and decreased by 7% and 10% with amino acids and seaweed, respectively. Arugula leaf length increased by 25% and 6% with humic acid and amino acid, respectively, compared to the control, while it decreased by 29% with seaweed. Arugula leaf width; increased by 33% with humic acid and decreased by 18% and 36% with amino acids and seaweed, respectively. Petiole length increased by 24% with humic acid compared to control, and decreased by 5% and 26% with amino acids and seaweed, respectively. As a result, it has been determined that plant growth and productivity can be increased in arugula green leafy vegetable by using only humic acid with irrigation water without using any mineral fertilizers. This result was found to be recommendable for conventional and also organic agriculture.

Keywords: Aragula, biostimulant, plant development, organic farming



GİRİŞ

Dünya genelinde oldukça fazla yetiştiriciliği yapılan birçok sebze gibi marul ve kıvırcık yapraklı baş salatanın da verim ve kalitesini arttırabilmek için uygun bir gübreleme programının yapılması ihtiyacı duyulmaktadır. Ülkemizdeki sebze alanlarında rotasyon genellikle hiç yapılmamakta ve bunun sonucu olarak da toprak yorgunluğundan dolayı verimler bir hayli düşmektedir (Tüzel ve ark., 2010; Uğur, 2014). Verimdeki bu düşüşü engelleyebilmek için üreticiler gübreleme yapmaktadır. Ancak, kullanılan aşırı miktarlardaki gübreler ülke ekonomisine zarar vermesinin yanında yer altı ve yer üstü sularının kirlenmesine de sebep olmaktadır. Buna bağlı olarak organik yapılı gübrelerin kullanılması artmaktadır. Organik yapılı gübreler topraktaki mikroorganizma faaliyetlerini arttırması ile birlikte, fiziksel ve kimyasal yapıyı iyileştirmektedir (Özer, 2016). Bu nedenle, marul yetiştiriciliğinde kimyasal olarak kullanılan gübrelerin yanında, organik yapılı gübrelerinde kullanımının yaygınlaştırılması istenmektedir.

Tarımsal biyo-uyarıcılar veya biyostimulant olarak adlandırılan bitki biyo-uyarıcıları, bir bitkinin etrafındaki ortama ilave edilmesi sonucu, bitki büyümesi ve beslenmesi üzerinde olumlu etkileri olan, aynı zamanda stres faktörlerine karşı toleransı veya ürün kalite özelliklerini arttırmak amacıyla bitkilere uygulanan her türü madde veya mikroorganizmalardır. Gelecek yıllarda tarımın, iki zorlukla karşı karşıya kalarak çözüm üretmek ile yüzleşmesi beklenmektedir; mineral sentetik gübre ve pestisit kullanımları ile tarımın insan sağlığına ve çevreye olan kümülatif olumsuz etkisini en aza indirmek için uğraşırken, büyüyen küresel nüfusu beslemenin zorunluluğunu yaşayacaktır (Searchinger, 2013). Küresel talebi karşılamak için, çeşitli çözümler arasında, daha fazla verim potansiyeline sahip yeni bitki çeşitlerinin geliştirilmesi sayılabilir ancak bu çözüm, pek çok tarımsal bitki türünün genetik potansiyelinin sınırlarına neredeyse erişilebildiği göz önüne alındığında sınırlı faydalar sağlayacaktır. Alternatif olarak kaynak kullanım verimliliğini geliştirmek, verimi sürdürülebilir bir şekilde artırmanın anahtarı olduğu varsayılmaktadır. Bu kritik zorluklarla yüzleşmek için umut verici potansiyele sahip; yenilikçi, çeşitlilikte zengin, canlı, doğa ve çevre dostu, sürdürülebilir ve çok çeşitli teknolojileri de içeren, “Biyostimülantların kullanımının” devreye girmesi gerektiği düşünülmektedir (Colla ark. 2017).

Tarımsal üretimde verim ve kalite, biyotik ve abiyotik stres etmenleri, kontrol edilemeyen olumsuz doğa koşulları nedeniyle olumsuz etkilenmektedir. Öte yandan, üretimi yapılan yeni çeşitlerin besin elementi ihtiyacındaki artış, artan gübre ve pestisit uygulamaları sonucunda üretimi yapılan tarımsal bitkilerde kalıntılar bulunmakta, bu durum kaliteyi etkilediği kadar, halk sağlığını da etkilemektedir. Biyostimülantlar, toprak verimliliğini arttırmak, mineral besinlerin bitki tarafından alınımı ve bitki gelişmesini arttırmak, biyotik ve abiyotik streslere dayanımı arttırmak, ürün verim ve kalitesini maksimuma ulaştırmak amaçları ile kullanılmaktadır. Biyostimülantlar, bitkilere yapraktan, topraktan veya tohumla uygulanan, içeriğinde organik veya inorganik bileşikler, mikroorganizmalar bulundurabilen materyallerdir. Biyostimülantların tarımda kullanımı son yıllarda önem kazanmıştır ve giderek artan bir ivme ile talep artmaktadır. Biyostimülantlarının kullanımı, sürdürülebilir tarım ve ürün kalitesini arttırmak için umut verici ve yenilikçi bir yaklaşım olarak önerilmektedir

Biyostimülantlar bitkideki biyotik ve abiyotik stresi azalttan, bitki besin maddelerinin alınımı artıran ve inorganik gübre kullanımını azaltan, verimliliği artıran, besin maddesi olmayan ürünler olarak tanımlanmışlardır (Russo ve Berlyn, 1992). Biyostimülantlar içerisinde başlıca humat ürünleri, bitki büyüme hormonları ve çeşitli metabolitler bulunmaktadır. Bu maddelerin bitkide yeşil aksam ve kök gelişimini artırdığı görülmüştür (Tan ve Nopamombodi, 1979; Russo ve Berlyn, 1992; Sanders ark.,1990; Poincelot, 1993). Biyostimülantların sınıflandırmasında



kategoriler; humik ve fulvik asitler, amino asitler ve diğer azotlu bileşikler, deniz yosunu ve bitki ekstraktları, kitin ve kitosan benzeri polimerler, inorganik bileşikler, yararlı mantarlar bakteriler ve algler şeklindedir.

HÜMİK ve FÜKVIK ASİTLER

Hümik ve fülvik asitlerin mekanizması tam olarak bilinmemekle beraber bazı araştırmacılar bu maddelerin hücre zarı geçirgenliğini, fotosentez ve solunum etkinliğini, oksijen ve mineral besin maddelerinin yararıyla ilgili, alımını ve taşınmasını artırdığını, şelatlayıcı özellikleri olduğunu, hücreler arası CO₂'i artırdığını ileri sürmektedir (Cacco ve Dell'Agnolla, 1984; Turkmen ark., 2004). Ayrıca bitkilerde antioksidanları artırarak stres toleransını geliştirdiği bildirilmektedir (Anjum ark., (2011).

DENİZ YOSUNLARI veya ALGLER

Biyostimülant ürünlerden dikkat çeken bir diğer grup deniz yosunlarıdır. Algler, fotosentez yoluyla ışığı soğurup inorganik maddeleri organik maddelere dönüştüren sucul organizmalardır. Algler küçük tek hücreli türlerden karmaşık çok hücreli yapılara kadar çeşitlilik gösterirler. Tatlı su veya deniz suyu algleri mevcuttur. İçeriğinde polisakkaritler, alginatlar, mikro ve makro besin elementleri, hormonlar, azot bileşikleri bulundurmaları, deniz yosunlarının tarımda kullanımını ön plana çıkarmıştır. Sözü edilen bu ekstraktlar bitki besin elementlerinin alımını kolaylaştırmaktadır. Fotosentez oranını, N asimilasyonunu, bazal metabolizmayı, hücre bölünmesini, patojenlere karşı korunmayı, bitkilerde kuraklık, tuzluluk, yüksek sıcaklık gibi abiyotik stres etmenlerinin etkilerini hafiflettiği bildirilmektedir.

AMİNO ASİTLER (PROTEİN HİDROLİZATLAR)

Aminoasitler, biyostimülant grubunda yer alan diğer bir ürün grubudur. Bitkisel veya hayvansal kökenli olabilir. Aminoasitler, karbon ve nitrojen metabolizmasını uyararak ve hormonal aktiviteye müdahale ederek bitkileri doğrudan etkileyebilmektedir. Dolaylı etki olarak bitkilerde besin maddelerinin alımını ve besin-kullanım verimliliğini arttırabilmektedir. Aminoasitler, tohum çimlenmesi, bitki büyümesi, verimlilik ve ürün kalitesi artırma potansiyellerinden dolayı gündemde olan biyostimülantlardır (Colla ark. 2017). Protein hidrolizatları ayrıca tuzluluk, kuraklık ve ağır metaller nedeniyle abiyotik bitki stresinin olumsuz etkilerini de hafifletebilmektedir. Amino asitler bitkilerde farklı roller oynayabilir; azot kaynağı ve hormon öncülleri olarak hareket edebilirler. Amino asitlerin mikrobisiner üzerinde şelat etkisi vardır.

ROKA

Sonbahar-kış aylarında yetiştirilen serin iklim seven, hızlı büyüyen çabuk hasata gelen yaprakları tüketilen aromatik ve taze yaş baharat olarak kullanılan bir sebzedir.15-20°C sıcaklıklarda optimum büyümektedir. Ortalama 30-40 günde hasat aşamasına gelen roka bitkileri, biçilerek yeniden üretilebilir ve bir roka plantasyonu 4-5 defa biçilebilmektedir. Yeşil yapraklı sebzeler, esas olarak yüksek lif içeriği ve aynı zamanda içerdikleri çeşitli makro ve mikro mineraller ve vitaminler nedeniyle sağlıklı beslenmenin temel bir unsuru haline gelmiştir. Modern diyetlerde roka çeşitli glukozinolatlardan ve diğer kükürt içeren bileşiklerden kaynaklanan kendine özgü tat ve aroması ile öne çıkmaktadır.

Bu çalışmada yeşil yapraklı aromatik bir sebze olan roka yetiştiriciliğinde mineral sentetik gübreler kullanılmadan biyostimülantlardan hümik asit, aminoasit ve deniz yosununun roka bitkisinde büyüme, gelişme ve verim üzerine etkileri incelenmiştir.



MATERYAL ve YÖNTEM

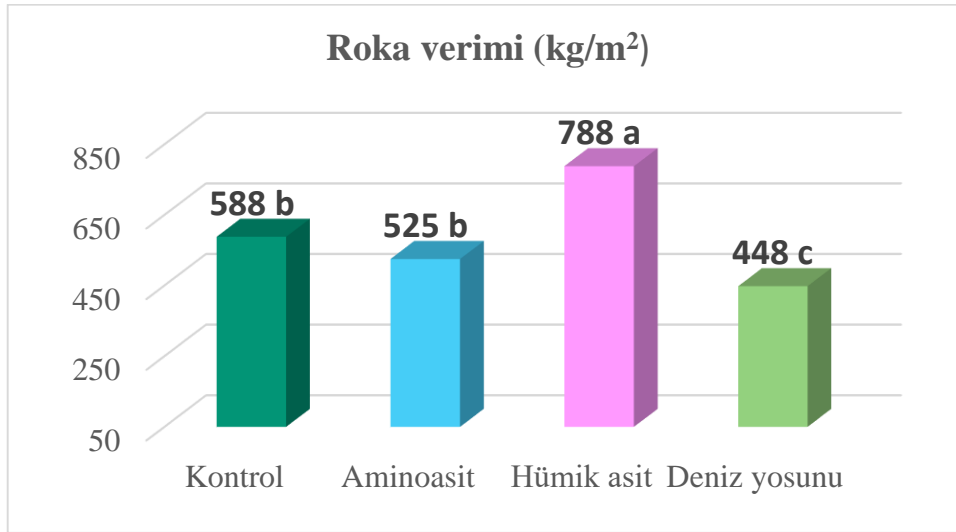
Çalışma Kahramanmaraş Andırın ilçesinde açıkta roka yetiştiriciliği alanında gerçekleştirilmiştir. Tesadüf blokları deneme deseninde 3 tekerrürlü olarak kurulan denemede Arzuman roka tohumları 13 Ekim 2020 tarihinde ekilmiştir ve 46 gün sonra 30 Kasım 2020'de hasat edilmiştir. Bitki yoğunluğu yaklaşık 2500 bitki/m² olacak şekilde, parsel büyüklüğü 1.5 m x 1.5 = 2.25 m²'dir. Biyostimulant uygulamalarına tohum ekiminden 10 gün sonra 24 Ekim 2020 tarihinde başlatılmıştır. Ticari ürünlerin kullanma kılavuzuna uyarlayarak; hümik asit ve aminoasit 10 litre sulama suyuna 100 ml, deniz Yosunu 10 litre suya 50 g olacak şekilde uygulanmıştır. Denemede aşağıdaki uygulamalar gerçekleştirilmiştir.

1. Kontrol
2. Hümik asit , Humage Leo %18 Hümik+Fulvik asit
3. Aminoasit, Amino Hyplus %12 serbest aminoasit
4. Deniz Yosunu, Maxi Crop %100 çözülebilen granül

BULGULAR ve TARTIŞMA

VERİM

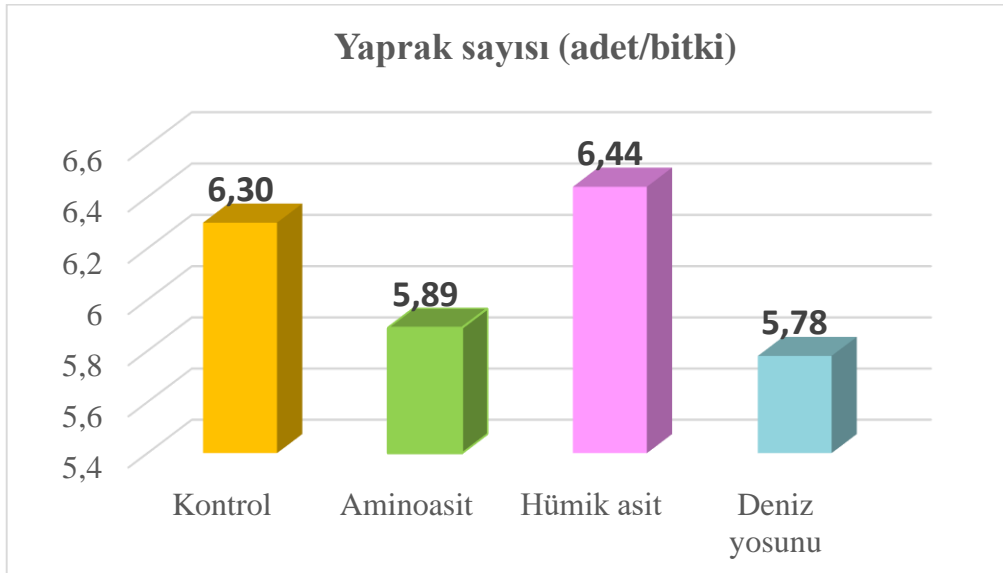
Uygulamaların birim alana m²'ye roka verimi üzerine etkisi istatistik olarak farklı olmuştur. En yüksek roka yaprak verimi 788 g/m² ile hümik asitten alınmıştır. Diğer aminoasit ve deniz yosunu uygulamaları kontrolden düşük kalmıştır (Şekil 1). Roka yaprak verimi, hümik asit ile kontrole göre %34 artmış, aminoasit ve deniz yosunu ile sırasıyla %11 ve %24 azalmıştır. Odabaş (2019), marul yetiştiriciliğinde humik asidin 0-400-800-1200 mg/kg dozlarında hümik asit uygulanmış en yüksek verim 800 mg/kg dozundan en yüksek verim elde edilmiştir. Özdemir, (2019), humik asitin 0 ve %0.2 dozları kıvırcık marul yetiştiriciliğinde kullanmıştır. Humik asit verim ve yaprak uzunluğunu artırmış, yaprak sayısı ve kök uzunluğunu azaltmıştır. Acun ve Bozokalfa (2020), mavi alg türü olan *Spirulina plantensis*'in farklı uygulama dozlarının salata ve marul çeşitlerinin verim ve kalite özellikleri üzerine etkisi incelemiştir. *S. platensis*, vejetasyon döneminde yedikule ve kıvırcık marul tiplerinde iki defa pülvenizatör yardımıyla 0.5 mg/L, 1 mg/L 1.5 mg/L, 2 mg/L dozlarında yapraktan uygulanmıştır. Mikroalg uygulamalarının salata ve marul çeşitlerinin bitki ağırlığı, bitki çapı, bitki uzunluğu, pazarlanabilir yaprak sayısı, atılan yaprak sayısı, madde miktarı ve verim değerleri üzerine etkisi istatistik düzeyde önemli bulunmuştur. Özellikle 1.5 mg/L dozunda *S. platensis* uygulamasının başta en yüksek verim olmak üzere incelenen birçok özellik üzerine en etkili doz olduğu belirlenmiştir.



Şekil 1. Roka yaprak verimi üzerine biyostimülanların etkisi (g/m²).

YAPRAK SAYISI

Roka yaprak sayısı üzerine etkileri istatistiksel olarak önemli olmamıştır bununla birlikte hümik asit ile kontrole göre %2.2 artmış, aminoasit ve deniz yosunu ile sırasıyla %6.5 ve %8.3 azalmıştır. Serada topraklı organik kıvrıcık marul yetiştiriciliğinde dört farklı bakteriyi (*Bacillus subtilis*, *Bacillus licheniformis*, *Bacillus megaterium*, *Pseudomonas putida*) içeren Medbio isimli biyo-gübre damlamadan ve yapraklardan kullanılmıştır; kontrol bitkilerinde bitki başına yaprak sayısı 41.1 adet/bitki iken bakteri uygulamasında ortalama 46.4 adet/bitki olarak bildirilmiştir (Daşgan ve ark., 2021).



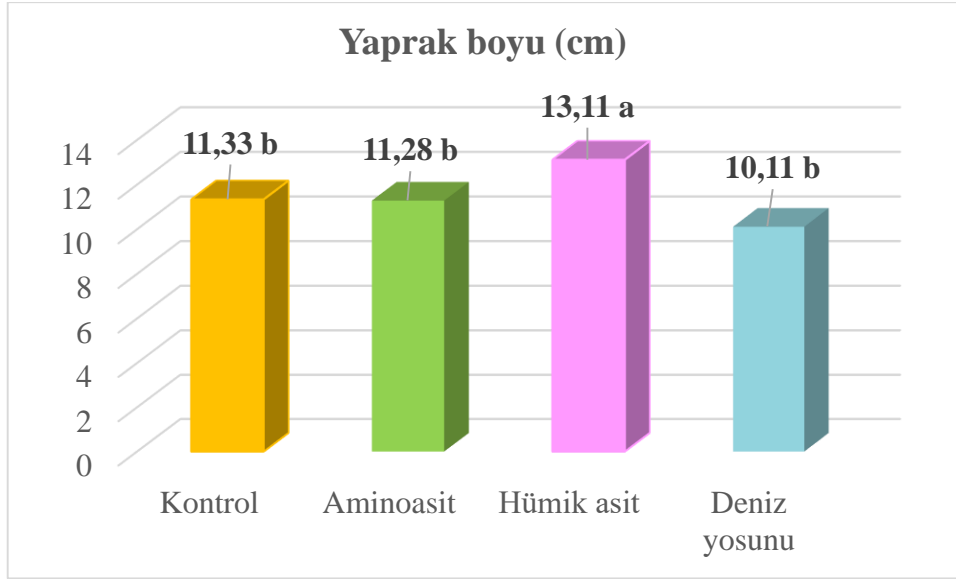
Şekil 2. Roka yaprak sayısı üzerine biyostimülanların etkisi (adet/bitki)

YAPRAK BOYU

Roka yaprak boyu, bakımından istatistiksel olarak en uzun yapraklar 13.11 cm ile hümik asit uygulamasından elde edilmiştir. En kısa boylu yapraklar ise 10.11 cm ile deniz yosunundan



alınmıştır. Yaprak boyu, hümik asit ile kontrole göre %15.7 artmış, aminoasit ile değişmemiş ve deniz yosunu ile %10.8 azalmıştır (Şekil 3). Aydöner Çoban ve ark. (2020), kokopit paketlerinde topraksız domates yetiştiriciliğinde mineral gübreleri %100 (kontrol), %80, %60 ve %40 oranlarında azaltarak kullanmış ve bitki beslemeyi ikame etmek üzere mikroalgbiyogübresi *Chlorella vulgaris*'i eklemiştir. Domates bitkisi boyu bakımından uygulamalar arasında önemli bir farklılık kaydedilmemiştir.

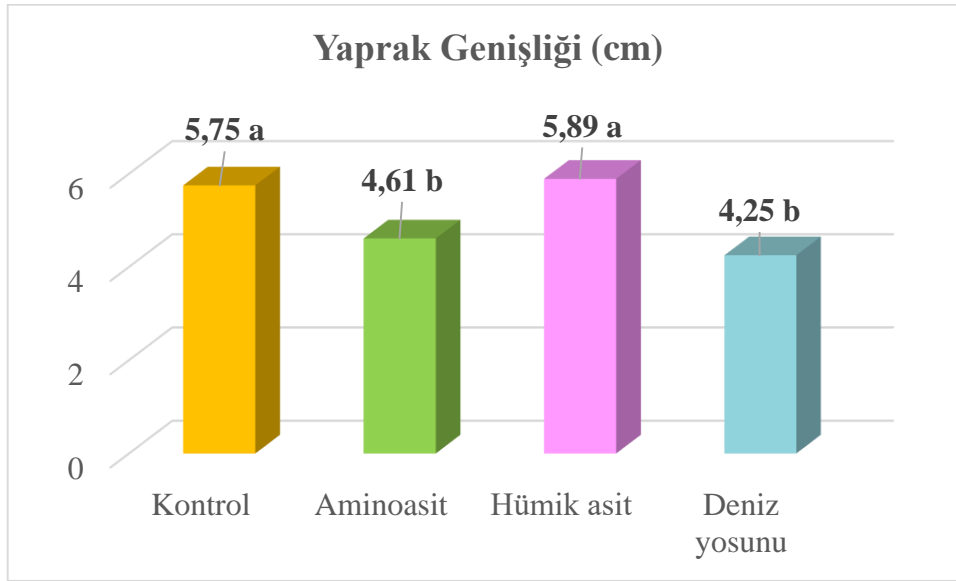


Şekil 3. Roka yaprak uzunluğu üzerine biyostimülanların etkisi (cm).

YAPRAK GENİŞLİĞİ

Roka yaprak genişliği bakımından istatistiksel olarak en geniş yapraklar 5.89 cm ile hümik asit uygulamasından elde edilmiştir. En kısa boylu yapraklar ise 4.25 cm ile deniz yosunundan alınmıştır. Roka yaprak genişliği hümik asit ile kontrole göre %2.4 artmış, aminoasit ve deniz yosunu ile sırasıyla %20 ve %26 azalmıştır (Şekil 4).

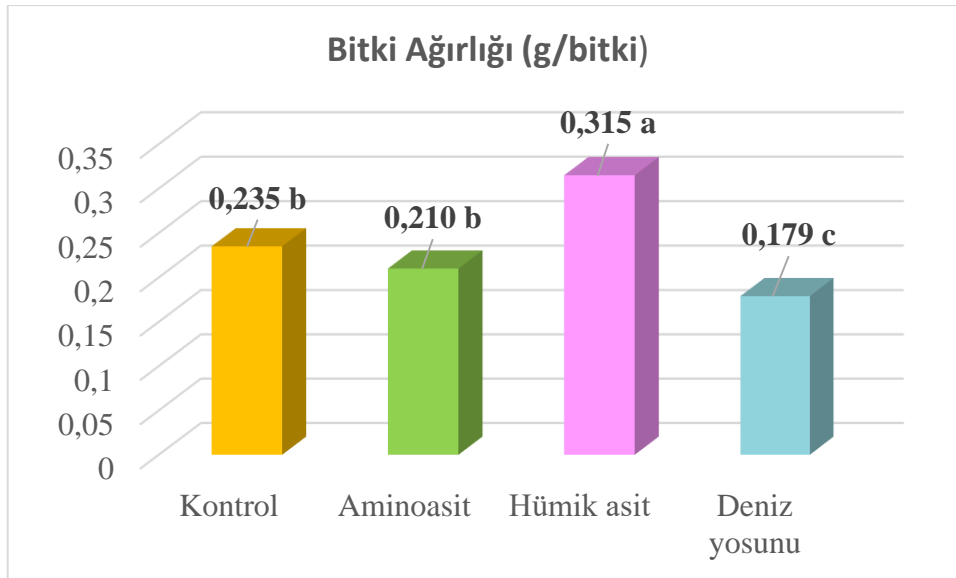
Serada topraklı organik kıvrıcık marul yetiştiriciliğinde dört farklı bakteri (*Basillus subtilis*, *Bacillus licheniformis*, *Bacillus megaterium*, *Pseudomonas sputita*) içeren Medbiobio-gübresi damlamadan ve yapraktan kullanılmıştır. Taç genişliği kontrole (40.6 cm) göre bakteri ile beslenen bitkilerde (50.4 cm) %24 istatistiksel olarak daha yüksek bildirilmiştir (Daşgan ve ark., 2021).



Şekil 4. Roka yaprak genişliği üzerine biyostimülantların etkisi (cm).

BİTKİ AĞIRLIĞI

Roka bireysel ağırlığı bakımından 0.315 g ile en iri ve ağır bitkiler hümik asit uygulamasından elde edilmiştir. En küçük ve en hafif bitkiler ise deniz yosunu uygulamasından 0.179 g olarak elde edilmiştir. Roka bitki ağırlığı, hümik asit ile kontrole göre %34 artmış, aminoasit ve deniz yosunu ile sırasıyla %11 ve %24 azalmıştır (Şekil 5).



Şekil 5. Roka bitki ağırlığı üzerine biyostimülantların etkisi (g/bitki).



YAPRAK SAPI UZUNLUĐU

Roka yaprak sapı uzunluđu bakımından uygulamaların etkisi önemli bulunmamıştır. Yaprak sapı boyu, hümik asit ile kontrole göre %14 artmış, aminoasit ve deniz yosunu ile sırasıyla %20 ve %26 azalmıştır.



Şekil 6. Roka yaprak sapı uzunluđu üzerine biyostimülanların etkisi (cm).

SONUÇ

Roka bitki ağırlığı ve m²'ye verim, hümik asit ile %34 artmıştır. Hümik asit rokada, yaprak ağırlığı, yaprak eni, yaprak boyu ve yaprak sapı uzunluğunda artışlara neden olmuştur. Hiç sentetik mineral gübre kullanmadan toprak içeriğine de bağılı olarak, sulama suyu ile sadece hümik asit kullanılarak roka yetiştiriciliğinde bitki gelişimi ve verimliliği artırılacağı belirlenmiştir. Bu sonuç konvansiyonel tarım yanında organik tarım için de önerilebilir bulunmuştur.



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**INVESTIGATION OF ANTIOXIDANT EFFECTS OF GINGER (*Zingiber officinale*)
ESSENTIAL OIL ON LUNG AND KIDNEY IN RATS**

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ABSTRACT

There have been many opinions on the use of medical herbs. Ginger, one of the most known of these herbs, is known to have antioxidant, anti-inflammatory and cytotoxic properties. In this context, determining the effectiveness of ginger on glutathione (GSH) and malondialdehyde (MDA) levels in male Wistar Albino rats was aimed. The animals were divided into three groups with seven animals in each group. While ginger oil was not given to the control group, ginger essential oil (GEO) at 100mg/kg/day and 500mg/kg/day was administered for ten days orally by gavage to GEO100 and GEO500 groups. At the end of the study, the lungs and kidneys were taken to determine GSH and MDA levels. According to the data while GEO500 had a significant effect on GSH levels in the lung and kidney ($p<0.05$), there were no differences in MDA level in the lung ($p>0.05$). Besides, GEO100 group had the lowest MDA level in the kidney ($p<0.05$). As a result, it was determined that the supplementation of ginger to the diets could provide protection against oxidative tissue damage in the rat lungs and kidneys.

Keywords: Antioxidant, ginger, glutathione, kidney, lung, malondialdehyde, rat



1. INTRODUCTION

The reactive oxygen species (ROS) describe molecules that provide an advance to reactive free radicals (FR's) like hydrogen peroxide and lipid peroxides. However, ROS produced are cleaned by the antioxidant protection policy. When the creation of ROS and/or FR's in the tissues surpasses the capacity of the antioxidant defense to defeat them, oxidative stress results (Kalam et al 2012). The lung is a vital organ from the point of its hazard to toxic elements. The alveolar epithelial surfaces of the lung are under repeated pose to great oxygen stress as well as oxidizing materials causing the lung extremely sensitive to FR's production (Pacht and Davis 1988, Fields et al 1996). The kidney, which is the place of the expulsion of reactive metabolites, is influenced by ethanol-induced alpha hydroxyethyl radical oxidants (Montoliu et al 1994).

Glutathione (GSH) acts as an antioxidant in maintaining the cell's redox nature in the detoxification system's functioning. GSH scavenges lipid peroxides and H₂O₂ with the catalytic effect of GPx. In addition, GSH regenerates some important antioxidants like Vitamin E and vitamin C (Aslan et al 1995). Free radicals affect all essential components of cells such as lipid, protein, carbohydrate and DNA (Jacob and Burri 1996). Free radicals cause lipids to be oxidized and membrane damage by the auto-catalytic effect (Stringer 1990).

Malondialdehyde (MDA) is the last product of lipid peroxidation. The existence of MDA is accepted as a determiner of the damage caused by free radicals to membrane lipids (Avcı et al 2012). GSH and MDA are the most commonly used parameters in determining oxidant/antioxidant status (Deveci and Güven 2008).

The activity of dietary supplemented antioxidants products was determined to raise the potential of the natural antioxidant defense's capacity in resisting FR's in animal nutrition research (Celi and Chauhan 2013). These products not only improve animal health but also increase performance parameters. In recent years, Phytogetic feed additives or phytobiotics are used in animal nutrition to enhance the performance of animals and affect their health and growth confidently. They are commonly administered in essential oils obtained from herbs (Roofchae et al 2011). Essential oils are natural materials, which have a complicated unit and contain several components. They have major components that establish dominance in the composition (Pichersky et al 2006, Ahmadifar et al 2020). These components have various properties including antimicrobial, antioxidants, stimulating animal gastrointestinal system. These features may increase nutrient absorption and reduce the loss of energy for advanced growth performance in animals (Herve et al 2019). Among the aromatic herbs, including essential oil, ginger (*Zingiber officinale*) is a herb that has a key role in traditional treatment with an intensive use area. Ginger root includes ginger essential oil (GEO) about 4% by the own weight. The GEO has sesquiterpene include α -zingiberene, α -phellandrene and β -sesquiphellandrene (Siripoltangman and Chickos 2019, Akshitha et al 2020). Many studies have shown that ginger has antioxidant, antimicrobial, cytotoxic, anti-inflammatory and antitumoral actions (Jeena et al 2013, Rahmani et al 2014). Supplementation of monogastric animal diets with ginger improved GSH activities and decreased MDA level (Akbarian et al 2011). Also, ginger increased performance parameters like body weight gain and feed conversion ratio (Mohamed et al 2012). By make use of these features of ginger, we aimed to investigate the supplementation of ginger oil effects on the antioxidant parameters in rat lung and kidney.

2. MATERIAL and METHODS

2.1. ANIMALS and HOUSING

In the study, 21 male Wistar Albino rats weighing 250-300 g were used. These rats were obtained from the Ataturk University Experimental Animals Application and Research Center



in Turkey, an officially authorized to produce and sell experimental animals. Rats were housed individually in cages specially designed for their species and fed as ad-libitum (Table 1). The room temperature where the rats were housed was set at 25°C, and its light pattern was adjusted to be 12 hours light/dark cycle. The rats in the groups were weighed individually to determine the initial and final weight (Table 2). The trial lasted for ten days.

Table 1. Nutritional and chemical composition of the diet

Ingredients	Ratio, %
Corn	35.00
Barley	19.20
Wheat bran	17.00
Molasses	1.00
Soybean meal (48% CP)	24.00
Brewer's yeast	0.50
Vegetable oil	0.50
Limestone	2.00
Salt	0.50
Vitamin-mineral mix ¹	0.30
Analysis of nutrient contents	
Crude protein (%)	19.40
Metabolizable energy (Kcal/kg)	2900
Starch	40.00
Calcium (%)	0.90
Available phosphorus (%)	0.58

¹Per kilogram of diet: 0.4 mg folic acid, 8.0 mg alphatocopheryl acetate, 0.02 mg cholecalciferol, 8.3 mg alphatocopheryl acetate, 25 mg biotin, 2.3 mg pyridoxine HCl; 1.8 mg menadione, 160 mg choline chloride, 18 mg Fe, 3 mg Cu, 20 mg Zn, 200 µg Co, 850 µg I, 60 µg Se.

Table 2. Body weights of rats

Parameters	Control	GO100	GO500	P
Initial Body Weight	278.50±11.25	274.75±12.32	281.00±14.44	0.676
Final Body Weight	282.25±11.82	279.05±10.78	283.88±13.60	0.347

2.2. ESSENTIAL OIL

GEO used in the trial was purchased from a commercial company. The chemical composition of GEO analyzed (GC-MS) by the manufacturer (KAÜ-HADYEK/2020-122) is presented in Table 2. GEO was stored at +4 ° C during the treatment.



Table 3. Volatile compounds in ginger essential oil identified by GC-MS

Compounds	Retention index	Concentration (%)
Camphene	943	5.94
α -Pinene	948	2.34
α -Phellandrene	964	12.00
Cineole	1059	1.27
Borneol	1138	3.91
α -Citral	1174	7.57
β -Sesquiphellandrene	1446	9.55
Farnesene	1458	4.57
Zingiberene	1451	38.10
β -Bisabolene	1500	4.39
Germacrene D	1515	1.14
α -Curcumene	1524	9.22
Total		99.99

2.3. TREATMENT GROUPS

Control: It was administered orally by gavage (1 ml of distilled water).

GEO 100: 100 mg/kg/day ginger oil (GEO 100) in 1ml distilled water was administered orally by gavage to the rats for ten days.

GEO 500: 500 mg/kg/day ginger oil (GEO500) in 1ml distilled water, which was the highest therapeutic dose, was administered orally by gavage to the rats for ten days (Prosper et al 2010). Rats fasted the last 12 hours of the trial. The lives of rats were terminated by the cervical dislocation method under anesthesia (Ketamine hydrochloride 75mg/kg and xylazine 15 mg/kg, IM). After sacrificing, lung and kidney tissues were taken from the animals.

2.4. SAMPLING

Tissue samples (1 g) were homogenized by a mechanical homogenizer with phosphate buffer (pH 7.4) and centrifuged at 3000 rpm for five minutes. The obtained supernatants were kept at -20 ° C until the day of analysis. While GSH analysis in the lung and kidney tissues was performed according to Beutler et al (1963) method, MDA analysis was performed using Yoshioka et al (1979) methods.

2.5. STATISTICAL ANALYSIS

For all analyses, the differences between groups were analyzed using one-way ANOVA analysis and evaluated using Tukey's test from GraphPad Prism 8 (Graphpad, San Diego, CA) software. The results were given as mean \pm standard deviation (SD). Any p-values lesser 0.05 were evaluated statistically significanty.

3. RESULTS

The data were presented in Figure 1. According to the results obtained, GSH in GEO500 group significantly increased in the lung ($p < 0.05$) and kidney tissue ($P < 0.001$) compared to the control group. While a significant difference in kidney tissue GSH levels between GEO groups was



detected ($P < 0.001$), there were no differences in lung tissue GSH levels between GEO groups. Moreover, both lung and kidney tissue GSH levels were not different between control and GEO100 groups. Although the difference in lung MDA value remained at the numerical level ($p > 0.05$), a reduction in the kidney MDA level was significant in the GEO100 group compared to the control and GEO500 group ($p < 0.05$). However, kidney MDA level was similar between the control and GEO500 group ($p > 0.05$).

4. DISCUSSION

Vaccine Medical herbs have been used in traditional medicine for a long time as principal ingredients. The pharmaceutical properties of herbs are attributed to their major phenolic compound. In addition, there has been considerable evidence that essential oils have improved the health status of animals. This study is based on the investigation of the ways in which ginger's impact on health.

GSH labors as a sensitive marker of oxidative stress and it acts a critical function in preserving the unity of the cell system. GSH is associated with particular body responses and is one of the most noticeable non-enzymatic antioxidants (Meister and Anderson 1983). When GEO was supplemented to the diet at the level of 500 mg, it increased the GSH level in the lung and kidney. Ginger could show antioxidant activity in rat kidney by scavenging free radicals (Krishnakantha and Lokesh 1993). Studies are similar on the ginger antioxidant efficiency via increasing GSH level (Ahmed et al 2000, Ajith et al 2007, Abdul Sani et al 2014).

The form of the lipid peroxide production, MDA, was evaluated in kidney tissue as an indication of raised lipid peroxidation (Raza et al 2000). It has been reported dietary ginger (5, 10, and 50 g/kg) lowered MDA (liver and kidney) in rat (Kota et al 2008). Also, it has been reported ginger (10 g/kg) or ginger ethanolic extract (100 mg/kg) lessened the blood MDA levels (Shanmugam et al 2010).

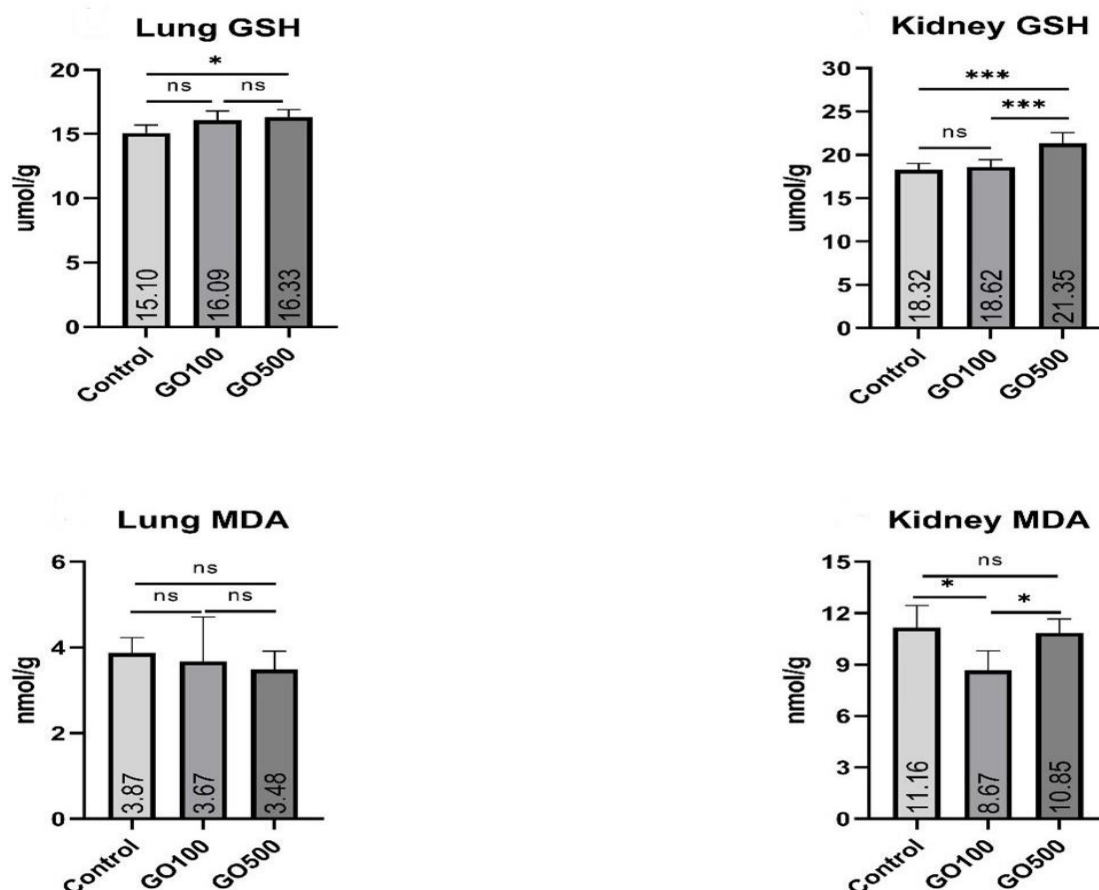


Figure 1. The Effect of ginger on ACE2, GSH and MDA levels in lung and kidney of rats (Means and Standard deviation of the groups.). ***: $P < 0.001$, *: $P < 0.05$. NS: No significant.

It was reported that trials of the animals which is diabetic with ginger supplementation the antioxidant action remarkably. Also, Ginger consumption in rats has been shown to increase the body's antioxidant clearing capacity and reduce free radical-induced damage (Ahmed et al 2000). It has been stated that ginger ethanolic extract reduces the level of TBARS by decreasing lipid peroxidation and increasing antioxidant activity in diabetic rats (Afshari et al 2007). In another study, it has been also reported that ginger keeping the normal level of antioxidants in rats (El-Sharaky et al 2009). Shanmugam et al (2010) have determined that the supplementation of ginger (10 and 20 g/kg) to diets of diabetic rats protects from kidney damage by improving antioxidant action. It has been determined that 5 g / kg of ginger supplementation to broiler diets increased antioxidant activity (Zidan et al 2016). Zhang et al (2010) also described that dietary ginger essential oil (100 mg/kg) to diets decreased the serum MDA levels in broilers. Researchers have been reported that MDA level reduced in quails administered with ginger rhizomes essential oil. Moreover, they specified that ginger increased the antioxidant activities in growing embryonic tissues, decreased their sensitivity to lipid peroxidation, and therefore lessened embryonic mortality (Surai 1999, Jiang et al 2007). Akbarian et al (2011) declared It has been reported ginger improved antioxidant activity and lowered serum MDA level in laying



hens. It has been described that essential oil hinders the 3-hydroxy-3-methylglutaryl CoA (HMG-CoA) reductase activity in rats, occurring in reducing cholesterol, and defeats lipid peroxidation via the improvement of antioxidant activities in the liver (Lee et al 2003). The differences of trials are possible owing to the animals, environmental conditions, diet forms, and the ginger origin and utilization grade (Ahmed et al 2000, Ahmad et al 2006).

GEO includes several antioxidant compounds as phenols and flavonoids contents (Oboh et al 2012). GC-MS analysis results of GEO in the current trial explain that it includes various compounds such as zingiberene, phellandrene, sesquiphellandrene and bisabolene which might perform as antioxidants (Misharina et al 2009).

5. CONCLUSION

When supplementation of ginger essential oil by orally in rats, it was observed that while kidney MDA level decreased at 100 mg/kg level, lung and kidney GSH level increased at 500 mg/kg level. Ginger can potentially contribute to protecting the health status with its antioxidant activities. However, further research should be designed for the ideal levels of ginger essential oil using as a feed additive.



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THE USE OF ACOUSTIC METHOD IN DETERMINING THE TEXTURAL PROPERTIES OF FOODS

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ABSTRACT

Sensorial properties of food products are among the main assessment criteria for consumers in terms of consumer preferences. However, since it is not always easy to perform sensorial tests on a regular basis and to reach the appropriate panelists, sensorial analyses are considered expensive and difficult. For this reason, the textural analyses are identified as alternative analysis methods used in determining the consumer preferences in food product groups and they are generally performed with instrumental devices. But, the instrumental methods are thought to not represent the criteria such as “crispiness” and “crunchiness”, which are examined also with auditory components. For this reason, in recent years, acoustic texture measurement devices are used for crispy and fried products and fruits-vegetables. In texture measurements using the acoustic method, the acoustic signal created during the deformation of products is recorded by the microphone probe or piezoelectric contact sensor and converted to meaningful data. The method was designed based on the voice recording with a microphone before. But then, the technologies thought to better represent the inside of mouth were developed and the vibration sensed by the probe inside the sample was directly perceived by a piezoelectric sensor. Hence, the freshness of foods such as fruits, vegetables, chips, and wafers and the desire to consume can be identified using the acoustic method. In the recent period, after these advancements, the textural properties of extrusion products such as chips, wafers, and cereals, various fruits-vegetables such as grape and apple, gel products obtained from sugars, and hard-skin cheeses can be determined using acoustic measurement methods. In several studies, the mechanic and acoustic methods were used together and product characteristics could be determined. Formation of acoustic measurement waves similar to the sound propagation while eating a food suggests that this method can be improved and used for a wider range of product groups. This method is thought to advance in the way involving taste parameters sensed not only through voice but also by completely simulating the inside of mouth and it is believed that a complete sensorial assessment would be possible.

Keywords: Acoustic, texture, food, crispiness, sensorial, consumer



INTRODUCTION

Besides the appearance, taste, and nutrient characteristics, the texture is one of the four major factors defining the quality of food. Furthermore, it is also one of the most important characteristics influencing the acceptability of foods by consumers (Gondek et al., 2013). Rather than being a single characteristic, the texture originates from different physical characteristics perceived through a combination of visual, kinesthetic, tactile, and auditory sensations and it depends on the reaction to the forces applied to the cellular structure (Costa et al, 2011; Gondek et al.,2013).

The textural characteristics of foods are classified as mechanical (tactile), geometric (visual), and other characteristics (texture perceived through the mouth). The mechanical characteristics are the properties characterized with the response of food to the force applied through incisor teeth of consumers to the food. Geometrical characteristics are the physical characteristics that are mainly related with the appearance of food. The characteristics in the group of other characteristics are those that support the mouth sense and cannot be distinguished as easily as in the other two categories (Drake and Delahunty, 2017; Szczesniak, 1963).

The best method in determining the textural characteristics of food products is the sensorial panels performed using the human senses while eating food. However, sensorial analyses are expensive and they are not appropriate for routine tests. In general, a qualitative comparison is performed rather than a quantitative comparison. Moreover, it is difficult to compare the results obtained from different sensorial panels (Gouyo et al., 2020). Besides that, for the food products such as chips, French fries, wafers, and crunchy bread, crispiness and crunchiness are among the textural characteristics that are important for the consumers. However, in previous studies, many researchers investigated the crispiness by using mechanical tests (penetration, compression, bending) but the results of force deformation generally showed no good correlation with the sensorial crispiness. For this reason, in recent years, it has been aimed to develop instrumental methods incorporating both mechanical and acoustic methods in expressing the textural measurements numerically (Taniwaki and Kohyama, 2012; Gondek et al., 2013; Jakubczyk et al.,2017). Among these methods, the acoustic analysis is a method investigating the emission and reflection of acoustic waves in foods and started being used by Drake in 1963 in examining the textural properties such as crispiness and crunchiness (Sakurai et al. 2020).

Consumers perceive different textures through a process starting with visual contact and hand manipulation and continuing with the emission of acoustic waves originating from the fracture of chewing force. Using microphones while eating foods, Drake performed measurements based on the intensity of sounds emitting from the mouths of individuals and it was aimed to calculate the acoustic vibrations of crispy foods by measuring the sound emission. In acoustic method, an acoustic vibration method was developed in order to determine the textural characteristics of foods by using a probe mimicking the incisor or dog teeth of humans (Iwatani et al., 2013).

Acoustic emission (AE) depends on the principle of the formation of elastic waves by making use of mechanical intervention. The sample with deteriorated structure is the source of acoustic emission that can be perceived by the sensors. With this signal obtained, information about the structure of the signal can be obtained (Chanvrier et al., 2014). The acoustic measurement in foods can generally be performed by crunching the products and recording the sound using a microphone. In this method, the food texture is examined qualitatively in terms of texture index (TI) defined as the density of energy (Taniwaki and Sakurai, 2008).



In recent studies, different instrument combinations were developed to measure the crispiness and crunchiness of products such as chips, wafers, French fries, fruits, and vegetables (Taniwaki and Kohyama, 2012; Akimoto et al., 2017). By making use of the instruments developed, the vibration arising from the fracture of sample is measured by placing a probe. The instrument consists of a piezoelectric sensor and a probe. The piezoelectric sensors have a good sensitivity to small signals and perfect responses in a wide frequency range. They are used in order to measure the vibrations originating from the penetration of the probe into the sample. These devices can measure the acoustic vibrations while breaking a food sample at very wide sound frequencies (0–25.600 Hz). Half octave multiple-filter is used in filtering the signals in order to calculate the vibration data and texture index (TI) for each frequency band (Taniwaki et al., 2006; Taniwaki et al., 2010). Besides the piezoelectric contact sensor, also the microphone probe has been used in measuring the acoustic signal during the deformation of different food products such as snacks, cornflakes, baby formulas (Iwatani et al., 2013; Jakubczyk et al., 2017).

ACOUSTIC TEXTURAL MEASUREMENT PRACTICES

Acoustic textural measurement methods differ depending on the food probe being used and the preferred sound record system. The technological advancements cause changes in the measurement devices and the food groups being investigated also differ. In studies using acoustic textural measurement instruments on the food products, acoustic measurement results are related to the mechanical measurement and sensorial analysis results and the efficiencies are investigated. The food studies implementing acoustic textural measurements are summarized in Table 1.

Table 1. Food studies implementing acoustic textural measurements

Sample	Recording Technique	References
Marcona almonds (<i>Prunus amygdalus</i> L.)	Microphone	Varela et al., 2006
Blanched bunching onions	Piezoelectric sensor	Taniwaki et al., 2006
Corn and wheat bran flakes	Piezoelectric sensor	Gondek et al., 2006
Biscuits	Microphone	Arimi et al., 2010
Cassava crackers	Microphone	Saeleaw and Schleining, 2011
Potato chips	Microphone	Taniwaki ve Kohyama, 2012
Crisp bread	Microphone	Gondek et al., 2013
Hazelnut kernels (<i>Corylus avellana</i> L.)	Microphone	Giacosa et al., 2016

In a study comparing the acoustic measurement methods to the sensorial analyses and mechanical tests, the commercially available crackers, toast, cornflakes, and granola bars were examined. It was aimed to examine the crispness by making use of a special sensorial test and to compare the results to those obtained from mechanical and acoustic textural measurements. The acoustic measurement method used in this study is illustrated in Figure 1. As a result, it was determined that the acoustic characteristics have a high linear correlation with sensorial results but sensorial results couldn't be related to any of the mechanical characteristics (Andreani et al., 2020).

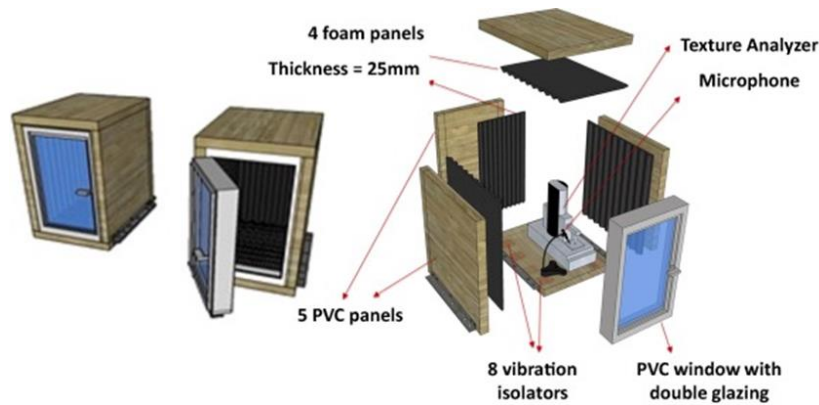


Figure 1. Schematic view of the semi-anechoic box (Murta et al., 2017; Andreani et al., 2020)

It is known that the acoustic measurements are generally used in crispy food groups. However, in a previous study, the change in the inner portion and outer surface of Manchego cheese during the maturation period was examined using acoustic and mechanical methods (Figure 2). As a result of the study, it was determined that the textural characteristics of the outer surface of cheese, especially the maximum force, in compaction experiments could be successfully estimated using the acoustic method but the estimation accuracy was not at this level for the inner surface. In conclusion, it was found in textural analysis of Manchego cheese that acoustic methods can be used in cheese classification (Benedito et al., 2006).

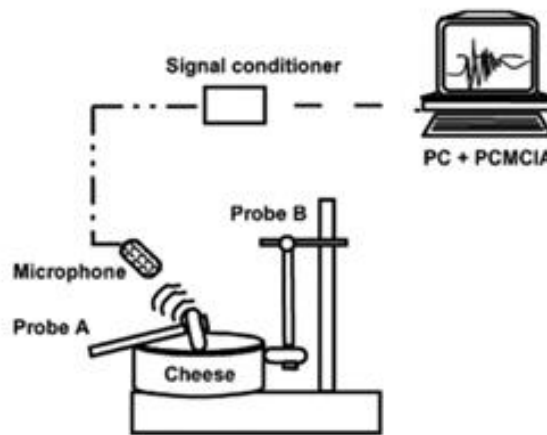


Figure 2. Acoustic measurement method used in the study for Manchego cheese (Benedito et al., 2006).

In acoustic textural measurement methods, the vibration measurements are performed using a piezoelectric sensor and the measurements are performed by mimicking the human incisor teeth and recording the vibrations in mouth. For this purpose, using a piezoelectric sensor, acoustic measurements were performed for 6 different cabbages. In this system, the first four layers of cabbage leaves were used and the vibrations were recorded using a piezoelectric sensor connected to a probe (Figure 3). In this study, the acoustic method was found to be an alternative measurement method for the leaved products because mechanical textural measurement methods do not yield accurate results due to the nervate structure leaves. Moreover, it was also emphasized that this method can be used in determining the storage period of cabbage (Taniwaki and Sakurai, 2008).

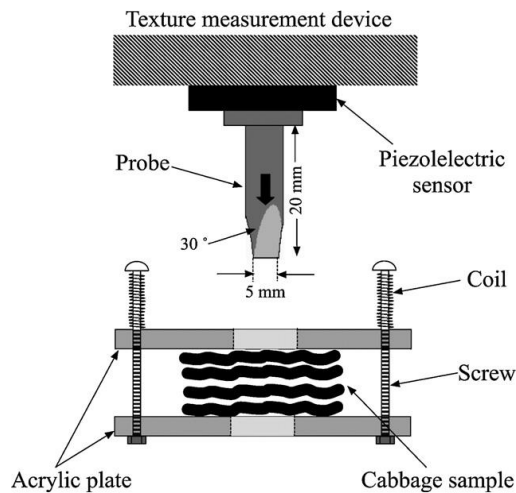


Figure 3. Acoustic measurement method used in the study for cabbage samples (Taniwaki and Sakurai, 2008)

CONCLUSION

Sensorial analyses are important for consumer preferences but, because of the difficulty of application, the mechanical textural measurement methods are used in recent periods. Among the textural measurement methods, mechanical measurement cannot meet the assessment criteria such as crispiness. For this reason, the acoustic methods are used for these criteria influencing the sensorial preferences, together with the sound in mouth. The acoustic methods differ depending on the foods that the method is applied to and the recording system that is used for sound recording. This method used for food samples such as a wafer, chips, cracker, biscuit, bread, fruits-vegetables, and even hard cheese is widely popular because it yields results in parallel with the sensorial analyses. The recent studies suggest that the textural measurements on foods can be made through acoustic, mechanic, and image recording methods and technical comparisons will be made in this parallel. Determining the appreciation and preference criteria originating from the sensorial preferences of consumers and converting them to numerical data are important research areas in this field. It is thought that the human perceptions will be analyzed in the future and the analyses will be performed by the systems to be developed in this parallel.



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FIPRONIL-INDUCED OXIDATIVE STRESS IN SPLEEN TISSUES OF RATS: THE EFFECTS OF CURCUMIN AND QUERCETIN

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ABSTRACT

Insecticides are considered one of the dangerous groups of environmental pollutants. Fipronil is a broad spectrum phenylpyrazole insecticide and is used in veterinary practice and agriculture. Fipronil is a potent environmental toxicant for humans and different animal species. Exposure to fipronil in humans can occur through food, environmental contamination, and occupational sources. It has been reported that fipronil causes hepatotoxic, neurotoxic, endocrine disrupting, carcinogenic and mutagenic effects. In addition, fipronil causes oxidative stress in various tissues such as brain, kidney and liver. Antioxidant-containing foods and antioxidant supplements can be used to help reduce oxidative stress in the human body. Curcumin and quercetin are natural polyphenolic compounds with anti-inflammatory properties and antioxidant activity. Curcumin and quercetin are known to reduce the potential toxic effects caused by environmental pollutants. In this study, the potential protective role of curcumin and quercetin, individually and in combination, on fipronil-induced oxidative stress in rat spleen tissues was investigated. This experimental study on rats was approved by Gazi University Animal Experiments Local Ethics Committee (G.U.ET-18.100). For this study, seven groups were formed with six rats in each group; 1st group: Control group, 2nd group: Curcumin (100 mg/kg b.w. day) treated group, 3rd group: Quercetin (50 mg/kg b.w. day) treated group, 4th group: Fipronil (3.88 mg/kg b.w. day) treated group, 5th group: Fipronil plus curcumin treated group, 6th group: Fipronil plus quercetin treated group, 7th group: Fipronil, plus curcumin plus quercetin treated group. Substances were given to the rats by gavage for 28 days. At the end of the 28-day experiment period, malondialdehyde (MDA) level and antioxidant enzyme activities [superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-S-transferase (GST)] in the spleen tissues of rats were compared with the control group. Statistically significant differences were not observed in all parameters examined between rats treated with control, curcumin and quercetin. In all fipronil-treated rats, SOD, CAT, GPx and GST activities were decreased while MDA levels were increased. Administration of curcumin and quercetin individually or in combination to rats exposed to fipronil significantly decreased MDA levels, while significantly increased antioxidant enzyme activities. In this study, it was determined that curcumin and quercetin partially protected against fipronil-induced oxidative stress in rat spleen tissues.

Keywords: Fipronil, curcumin, quercetin, spleen, oxidative stress



INTRODUCTION

Fipronil is a relatively new phenylpyrasole insecticide. Fipronil is commonly used in the veterinary, home applications and agricultural to control ants, flies, ticks, rootworms, wasps, beetles, termites, weevils, thrips, fleas, cockroaches, and others [1]. It has more efficacy compared to classical insecticides like carbamates, organophosphates and pyrethroids [2]. In case of long-term exposure to fipronil, it might result in serious adverse effects to humans, such as nausea, headache, weakness, and vertigo [3].

Fipronil, or its metabolites, were demonstrated to exert adverse neurotoxic effects via suppression of the inhibitory effect of gamma aminobutyric acid (GABA) by targeting GABAA-regulated chloride channels [4]. Another mechanism that plays a role in the toxicity caused by exposure to fipronil is that it causes oxidative stress [5]. Oxidative stress results from a lack of defense offered by antioxidants or increased production in reactive nitrogen species and reactive oxygen species (ROS) [6].

Curcumin is a plant-derived polyphenolic compound with strong anti-inflammatory and antioxidant activity [7]. In addition, curcumin has broad pharmacological activities such as antiproliferative, antidiabetic, antiviral, antibacterial, antitumor, immunomodulatory, proapoptotic effects and antimicrobial [8-10].

Quercetin is a well-known flavonoid and a powerful antioxidant. Quercetin is found in many foods such as apples, tea, onions, nuts, strawberries, cauliflower and cabbage [11]. It has been reported to have anti-inflammatory, antiviral, anti-ischemic, anti-carcinogenic, and antiallergenic effects, as well as protective effects in atherosclerosis and coronary heart disease [12].

In the current study, it was aimed to investigate the oxidative stress caused by fipronil in rat spleen tissue and the possible protective effects of curcumin and quercetin administration alone or in combination.

MATERIALS and METHOD

Chemicals and Animals

Fipronil (≥ 98.8 % purity), quercetin ($\geq 95\%$ purity) and curcumin (from *Curcuma longa* (Turmeric)) and were obtained from Sigma-Aldrich.

For this study, forty-two albino Wistar rats were procured from the Laboratory Animals Growing and Experimental Research Center of Gazi University. All rats were housed under standard conditions (12 h light/12 h dark period, 22 ± 3 °C) and given free access to water and food. All experimental procedure was approved by the Committee on the Ethics of Animal Experimentation of Gazi University (Protocol number: G.U.ET- 18.100).

Experimental Procedure

Rats were exposed to fipronil, quercetin and curcumin by oral gavage for 28 days. As shown in Table 1, seven experimental groups were randomly form the animals, each group containing six rat. Corn oil was used as the solvent of fipronil, curcumin and quercetin and was administered to control group rats.



Table 1. Experimental groups and administration doses of fipronil, curcumin and quercetin in different groups

Groups	Doses of substances given by gavage
Control (corn oil) group	1 ml/kg bw daily
Curcumin group	100 mg/kg bw daily
Quercetin group	50 mg/kg bw daily
Fipronil group	3.88 mg/kg bw daily
Fipronil+curcumin group	3.88 mg/kg bw +100 mg/kg bw, respectively
Fipronil+quercetin group	3.88 mg/kg bw +50 mg/kg bw, respectively
Fipronil+curcumin+quercetin group	3.88 mg/kg bw+100 mg/kg bw+50 mg/kg bw, respectively

bw: Body weight

At the end of the study (28 days), rats were sacrificed under anesthesia and the spleen tissues were taken for the determination of the activities of the enzymatic antioxidants and malondialdehyde levels.

Assessment of Antioxidant Enzyme Activities and MDA Level

The spleen samples were homogenized using homogenizer (Heidolph Silent Crusher M). The supernatants were collected by centrifuging the tissue homogenates. Antioxidant enzyme activities and MDA levels were measured from the obtained supernatants. The protein levels of the spleen tissues were analyzed according to the method of Lowry et al. using BSA as standard [13].

The malondialdehyde (MDA) level was assayed by measuring thiobarbituric acid reactive species (TBARS) as described by Ohkawa et al. [14]. Superoxide dismutase (SOD), activity was analysed as recommended by Marklund and Marklund [15]. Catalase (CAT) activity was determined by the procedure specified by Aebi's [16]. Glutathione peroxidase (GPx) activity was analysed according to the procedure specified by Paglia and Valentine's study [17]. Glutathione-S-transferase (GST) activity was evaluated by Habig et al.'s procedure [18].

Statistics

All statistical analysis were conducted by SPSS 23.0 version. One-way ANOVA and post hoc Tukey-HSD test were used to determine differences between the groups. The obtained $P < 0.05$ was accepted statistically important.

RESULTS

Oxidative stress was determined by measuring the enzymatic antioxidant activities (GST, GPx, CAT and SOD) and MDA levels in spleen tissues.

No statistically significant changes were found when the curcumin-, and quercetin- treated groups was compared with the control group for antioxidant enzymes activities and MDA level (Figure 1, Figure 2a-d).

MDA levels in the spleen tissues were a statistically significant increased in all fipronil-treated groups compared to the control group, while there were decreased in the fipronil +curcumin, fipronil+quercetin and fipronil+curcumin+quercetin treated groups compared to the only fipronil-treated group (Figure 1). Antioxidant enzymes activities (GST, GPx, CAT and SOD) significantly decreased when all the fipronil-treated groups were compared with the control group. However, activities of antioxidant enzymes were significantly increased in the fipronil+curcumin, fipronil+quercetin and fipronil+curcumin+quercetin treated rats (Figure 2a-d).

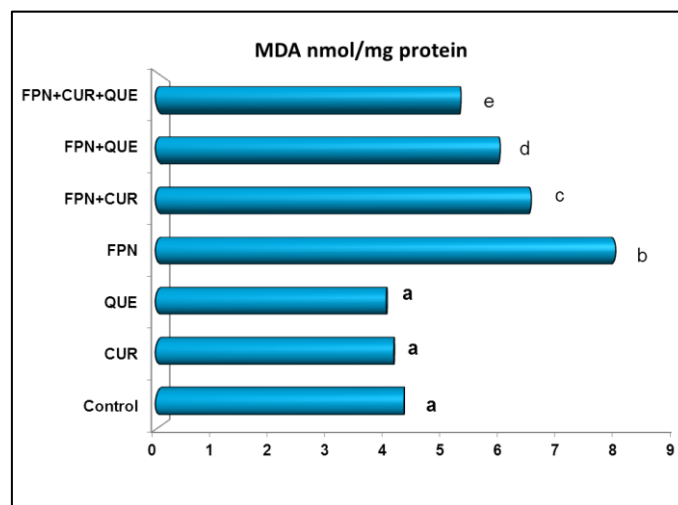


Figure 1. Effects of subacute treatment of fipronil, curcumin and quercetin on MDA level in the spleen tissues of rats. Each bar represents mean of six rats in each group. Means in a column with different superscript letters are significantly different ($P<0.05$). FPN, fipronil; CUR, curcumin; QUE, quercetin.

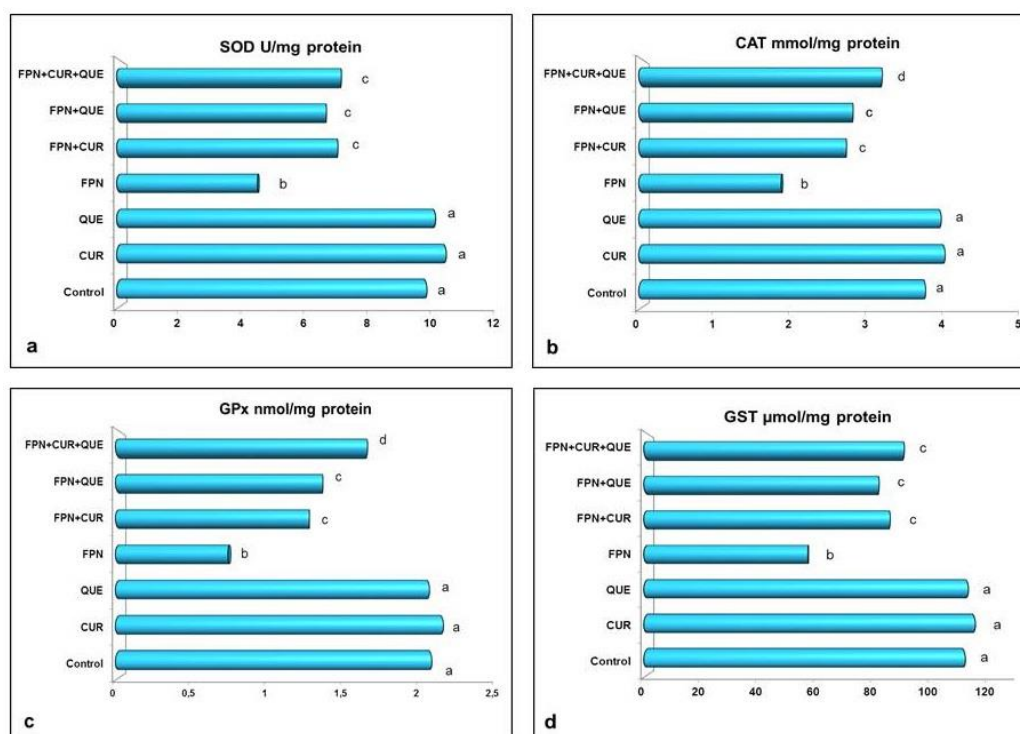


Figure 2. Effects of subacute treatment of fipronil, curcumin and quercetin on antioxidant enzyme activities in the spleen tissues of rats. (a) SOD activity, (b) CAT activity, (c) GPx activity, (d) GST activity. Each bar represents mean of six rats in each group. Means in a column with different superscript letters are significantly different ($P<0.05$). FPN, fipronil; CUR, curcumin; QUE, quercetin.

DISCUSSION

Fipronil is a potent environmental toxicant for humans and different animal species. Previous studies have shown the effect of fipronil on oxidative tissue injury by increasing the production of ROS and reducing endogenous antioxidants in tissues such as brain, kidney and liver [1, 19]. In this study, it was determined that fipronil caused a decrease in the activities of the enzymatic antioxidants and an increase in malondialdehyde levels in rat spleen tissues. MDA is the end product of lipid peroxidation in biological membranes and indirectly an important indicator of



membrane damage [20]. In this study, a statistically significant enhancement in MDA level in spleen tissues was detected in rats treated with fipronil. The rising of MDA level can be considered as an indicator of damage to biological membranes caused by excessive ROS accumulation associated with the inability of cellular non-enzymatic and/or enzymatic antioxidants to detoxify ROS in spleen tissue.

Cellular antioxidants such as GST, GPx, CAT and SOD play an important role in cellular protection against oxidative damage caused by ROS [21]. In particular, SOD and CAT are two important cellular antioxidant enzymes that scavenge free radicals produced during xenobiotic exposure [22]. SOD catalyzes free radical superoxide by converting it to less harmful hydrogen peroxide [23]. while CAT catalyzes the reduction of hydrogen peroxide to molecular oxygen and water [24]. GPx, a selenoenzyme, plays a important role in protecting cells from oxidative injury by catalyzing the reduction of hydrogen peroxide to water using glutathione [25]. GST is involved in the cellular detoxification and elimination of toxins by catalyzing attachment of the thiol of glutathione to electrophiles [25].

In this study, the decrease in antioxidant enzyme activities in the spleen tissue with exposure to fipronil may be due to the increased free radical formation due to the increase in lipid peroxidation. In previous studies, it has been reported that exposure to fipronil causes an increase in the production of reactive oxygen radicals [26]. In addition, the decrease in endogenous antioxidant enzyme activities can be attributed to their excessive use in quenching free radicals increased as a result of fipronil exposure and/or depletion of enzyme substrates. The results from the present study, the increased lipid peroxidation levels and decreased endogenous GST, GPx, CAT and SOD enzyme activities reveal that fipronil disrupts the pro-oxidant/antioxidant balance and increases the formation of ROS, thus causing oxidative stress. Quercetin and/or curcumin supplementation to rats exposed to fipronil reversed the changes in MDA levels and antioxidant enzyme activities compared to the group that were treated with only fipronil. These changes can be attributed to the antioxidant properties of curcumin and quercetin. It has been reported that curcumin prevents the formation of hydroxyl radical and superoxide anion [22], while quercetin directly scavenges free radicals such as superoxide and hydrogen peroxide and inhibits lipid peroxidation [12].

In conclusion, this study showed that fipronil caused oxidative stress in the spleen tissues of rats and the administration of curcumin and quercetin individually or in combination partially reduced the toxicity of fipronil. However, it did not provide complete protection.

ACKNOWLEDGEMENTS

We thank to Gazi University Research Fund, Dr. F.G. Apaydin and Dr. H. Bas for their helps in our study.



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INVESTIGATION OF BIOFILM FORMING CHARACTERISTICS OF *BRUCELLA* SPP. PATHOGENES

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ABSTRACT

Brucellosis is a zoonotic disease which is known as Malta fever, Mediterranean fever, or Bang's disease. It is commonly seen in developing countries such as Turkey causing economical loss and effecting food safety. Every year, 500 000 new cases are detected all over the world, and they are active in the Middle East, western Asia, Mediterranean countries, parts of Africa and Latin America and in our country. The distribution of Brucellosis cases in the world generally varies by country. In our country, it is especially common in animals and people dealing with animal husbandry in Ankara plain, Konya region, Southeastern Anatolia, Diyarbakır and Urfa regions. The spread of Brucellosis among humans to a certain region is closely related to animal husbandry in that region. Contamination of the disease occurs with cheese and butter made from raw milk, direct contact with animals or with aerosol. For Brucellosis, long-term and combined antibiotics are required to achieve a complete cure. In addition, the antibiotics given must be able to reach sufficient concentrations. Treatment of this disease is often very difficult and the treatment time is very long. It is well described that the long treatment time is a result of biofilm formation for the bacteria cause infectious diseases. Biofilms are the way of microorganisms to survive under harsh environmental conditions. This is a process, which starts with attachment to the surface, continues with the permanent attachment of the cells to the surface. Later, they develop on the surface and grow embedded in the exopolymeric structure (EPS) and become mature biofilms. Biofilms can be formed by a single type of microorganism or by multiple species of microorganisms. In this way, although some pathogens cannot form biofilms, they can continue their activities in the formed biofilm by being protected from difficult environmental factors. It is also known that the bacteria become resistant to antibiotics when biofilms are formed. The ability of biofilm formation of *Brucella* spp. and also the relationship with Brucellosis is investigated in this review.

Keywords: Biofilms, *brucella* spp., brucellosis



1. INTRODUCTION

Biofilms are defined as a collection of microorganisms attached to a surface (Toole et al. 2000; Donlan 2002). In order for microorganisms to survive under difficult environmental conditions, this process, which starts with adhesion to the surface, continues with the permanent attachment of cells to the surface. They then develop on the surface and grow embedded in the exopolymeric structure (EPS) and become a mature biofilm. Over time, some cells may leave the biofilm structure and become planktonic again (Gandhi and Chikindas 2007; Fratamico et al. 2009). These stages can be listed as attachment, growth and separation in general.

In various industries such as the food industry, many bacteria have the ability to adhere to surfaces and form biofilms, which are a permanent source of contamination. Biofilm formation is determined not only by the nature of the binding surface, but also by the characteristics of the bacterial cell and environmental factors (Van Houdt and Michiels 2010). Bacterial biofilms are defined as structural communities living in a polymeric matrix that bacterial cells produce when attached to a surface. Bacteria form biofilms to protect themselves from adverse environmental conditions and to continue their lives (Donlan 2002). Bacteria in biofilms show much less sensitivity to antibiotics and disinfectants compared to their planktonic states (Jacques et al. 2010; Schembri et al. 2002).

2. STRUCTURE OF BIOFILMS

Biofilms are a community of microorganisms living in a gel-like layer of polymeric structure that they produce by adhering to a surface (Jacques et al. 2010). The extracellular matrix, consisting of polysaccharide, protein, DNA, nucleic acid, lipophilic compounds and water, allows biofilm cells to adhere to surfaces or to each other (Kolari et al. 2003). One of the most important functions of the matrix is to protect the bacteria against many factors such as UV radiation, different pH conditions, osmotic pressure, water loss, and antibiotics (Gün and Ekinçi 2009).

Most microorganisms have the ability to form biofilms to survive under harsh conditions (Jacques et al. 2010). This feature of microorganisms is considered as an advantage and is used in wastewater treatment (Vanloosdrecht and Heijnen 1993), biological cleaning of contaminants in nature (Singh et al. 2006), and electricity generation with microbial fuel cells (Logan et al. 2006). However, biofilms can cause unwanted effects such as microbial-induced corrosion (Beech and Sunner 2004), as well as various diseases, food poisoning and dental plaque by forming on teeth (Socransky and Haffajee 2002), catheter surfaces (Donlan 2001), and food production systems. Since biofilm cells have barriers that reduce or prevent contact with antimicrobial agents, they are more resistant than planktonic bacteria (Srey et al. 2013).

Microorganisms attach to the surface and form biofilms, thus causing the antibiotic-resistant infections of infectious diseases (Donlan 2002; Kregiel 2014). All microorganisms that cause spoilage and show pathogenic characteristics have the ability to form biofilms under suitable conditions. Biofilm formation and the level of attachment of bacteria to surfaces depend on features such as bacterial species, cell density, electrostatic and physical interaction between the surface to which it is attached and the cell, cell-cell communication and signaling. Environmental conditions such as pH and temperature of the environment, contact time, nutrient content and amount, and ion concentration are also factors affecting biofilm formation (Arnold and Silvers 2000; Lindsay et al. 2002; Srey et al. 2013). Some bacteria have a high tendency to form biofilms. The most common of these are *Salmonella* (Wang et al. 2015), *Pseudomonas* (Leid 2009), *Enterobacter*, *Flavobacterium*, *Alcaligenes*, *Staphylococcus* and



Bacillus. These microorganisms can form biofilms on all surface types in many ecosystems where nutrients are abundant (Gün and Ekinçi 2009).

3. BRUCELLA SPP. IN FOOD PRODUCTS

Brucella species were first isolated and described about 134 years ago, and recently all nucleotide sequences of the genomes of well-characterized *Brucella* strains have been determined (Seleem et al. 2008). Bacteria belonging to the *Brucella* genus are in the alpha subgenus of the Proteobacteriaceae family. It is a gram negative and facultative intracellular coccobacillus. According to genetic and immunological data, all members of the genus *Brucella* have structural and antigenic properties that are very close to each other (Xavier et al. 2010; Zygmunt et al. 2006). In many food sectors, there are different microbial flora depending on the raw material of the food to be produced, and therefore, the biofilms formed in food processing systems vary according to the sector (Faille et al. 2014). Therefore, *Brucella* containing food materials are mostly dairy products especially processed from raw milk.

Buffalo milk and derived dairy products are a source of *Brucella* contamination for consumers. *Brucella* is a serious pathogen causing Brucellosis that endanger human health even at low concentrations (Amoroso et al. 2011). Even though *Brucella* spp. is a very late and slow reproducing organism, there are some methods to grow them in vitro. In the isolation of various strains, selective media are used to prevent or reduce the growth of unwanted microorganisms. *Brucella abortus* RB51 vaccine strain grows better on modified *Brucella* selective media (MBS) containing the antibiotic blend, erythritol as sole carbon source and neutral red as pH indicator. Erythritol in MBS medium promotes the growth of *B. abortus*. *Brucella* colonies are easily distinguished from other organisms by forming a pinkish color in the middle (Her et al. 2010).

Most common pathogenic bacteria in the dairy industry are *Campylobacter* spp., *Salmonella* spp., *Escherichia coli*, *Shigella* spp. and *Brucella* spp. (Quigley 2013). The diseases caused by some of these bacteria called Brucellosis, Campylobacteriosis, Salmonellosis, Yersiniosis, Listeriosis, Tuberculosis, Brucellosis, Staphylococcal enterotoxin poisoning, Streptococcal and *Escherichia coli* O157: H7 infection and the diseases occur with consumption of milk and milk products (Headrick et al. 1998). *Brucella melitensis*, *Brucella suis*, *Brucella canis* and *Brucella abortus* are transmitted by consuming unpasteurized milk of infected animals or by coming into contact. It causes flu-like symptoms with fever that lasts for months or years. Boiling milk before consumption can prevent Brucellosis. This disease can only be treated with antibiotics (Njiro 2013).

Millions of people in the world die from the disease as a result of microbial agents, biotoxins and chemical contaminants originating from food. The most common foodborne diseases are bacterial in origin, appear quickly and progress rapidly. Viruses, parasites, molds and toxic substances of animal and vegetable origin are other factors in food poisoning (Özkaya and Cömert 2008). Bacterial proteins play an important role in the emergence of pathogenicity (Han et al. 2014). Foodborne diseases are defined by the World Health Organization (WHO) as “a contagious or toxic disease caused by bacteria, viruses, parasites or chemical substances that enter the body with the consumption of food or water”. Changes in the nutritional habits of societies, mass food preparation, complex and long food production processes and poor hygiene practices are important factors in the increase of food poisoning (Ali et al. 2010). In a study conducted in Cerrahpaşa Medical Faculty Pediatric Emergency Unit, 171 people out of 1213 patients were diagnosed with food poisoning. In addition, it was reported that food poisoning with a rate of 14.1% occurred the most after drug poisoning and was most common in summer.



It was determined that the source of poisoning was 53.4% meat products, 27.3% dairy products, 5.5% mushrooms and 13.8% other foods (Aji 1998).

Brucella spp. enters the host cells during digestion or respiration by phagocytic or non-phagocytic ways and causes infection (Poester et al. 2013). Brucellosis is transmitted to humans through contact with animals or consumption of unpasteurized milk and dairy products, and it is more common in rural areas (Gkogka et al. 2011; Lusk et al. 2013). It is controlled by mass vaccination of animals and it is treated with a combination of antibiotics in humans, but requires laboratory tests because it is very difficult to diagnose (Smits and Kadri 2005).

Brucella abortus is an intracellular pathogen that causes disease in cattle and humans. Antigen-producing NK cell, CD4+ and CD8+ T cells and B cell specific for *B. abortus*. NK cells are the first line of defense against pathogens and, upon activation, kill infected target cells. NK cells play a role in the control of infected cells by secreting IFN- γ (Golding et al. 2001).

In a study conducted in Greece, the effect of diseases caused by foodborne pathogens on public health between 1996-2006 was investigated. It has been determined that approximately 370 000 patients/million people develop foodborne illness every year by consuming contaminated food. Intestinal infections and Brucellosis, echinococcosis, salmonellosis and toxoplasmosis were observed in 27% and 70% of these patients, respectively (Gkogka et al. 2011). In a study conducted in Pakistan, the incidence of contamination in retail meat was investigated. Equipment used in raw meat and meat production stages were analyzed to detect microbial contamination, and pathogenic bacteria were detected in 66% of 550 different isolates. *Klebsiella*, *Enterobacter*, *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* O157:H7, *Listeria*, *Salmonella enteritidis*, *Shigella* and four different strains of *Brucella* were isolated from meat samples. Biofilm formation was observed in 16% of 88 pathogenic bacteria, including *E. coli*, *Klebsiella*, *Enterobacter* species and *Staphylococcus aureus* (Ali et al. 2010).

4. CASES OF BRUCELLOSIS IN THE WORLD

Every year, 500 000 new cases are detected all over the world, and it is active in the Middle East, western Asia, Mediterranean countries, parts of Africa and Latin America and in our country. The distribution of Brucellosis cases in the world by country is given in Figure 1. It is especially common in the Ankara plain, Konya region, Southeastern Anatolia, Diyarbakir and Urfa regions in animals and people dealing with livestock. The spread of Brucellosis in a certain region among humans is closely related to the livestock in that region. The transmission of the disease occurs with cheese and butter made from raw milk, by direct contact with animals or by aerosol. Long-term and combined antibiotic use is necessary to achieve a complete cure in Brucellosis. In addition, the antibiotics given must be able to reach sufficient concentrations.

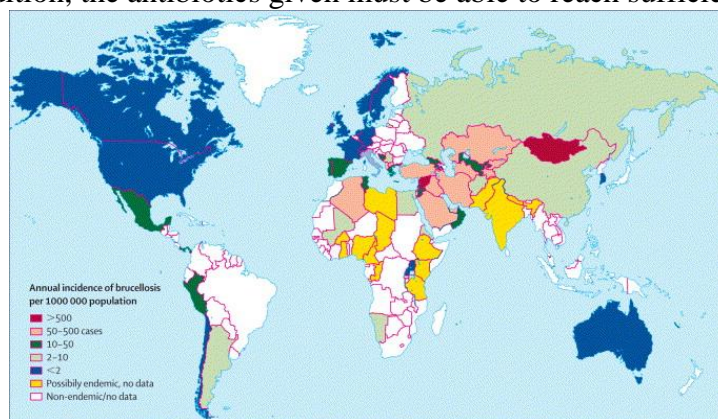


Figure 1. Distribution of Brucellosis cases in the world by country (Pappas et al. 2006)



Prevention of Brucellosis in humans depends on the control and eradication of the disease, especially in domestic animals such as sheep, goats and cattle. Prevention and control of Brucellosis depend on vaccinating lambs and kids with *B. melitensis* Rev-1 vaccine, and cattle with *B. abortus* S-19 vaccine (Young 2000). Despite this, 500 000 new cases of Brucella infections are observed every year (Pappas 2000).

In a study conducted in Bangladesh, the incidence of Brucellosis in humans varies according to occupations, but it is seen at the rate of 2.5-18.6%, and in animal species it is 3.7% in cattle, 4.0% in buffaloes, 3.6% in goats and 7.3% in sheep. It occurred in 2.6-21.6% of farmers, 18.6% of milkers, 2.5% of butchers and 5.3-11.1% of veterinarians, depending on contact with animals or their products or consumption of raw milk (Islam et al. 2013).

Brucellosis cases followed for 16 years in the Western Anatolia region of Turkey, where Brucellosis is moderately endemic, were investigated. A total of 523 Brucellosis patients followed between 1997 and 2012 were evaluated. It was observed that patients in the productive age group were most affected, and the most common mode of transmission was the consumption of unpasteurized milk and dairy products (Türker et al. 2014). In a study, it was aimed to detect Brucella in 617 pregnant women who applied to the Sorgun State Hospital obstetrics and gynecology outpatient clinic, and thus to evaluate the effectiveness of the eradication program implemented in recent years. The patients were screened for Brucellosis with Rose Bengal and Brucella standard tube agglutination tests. Titers of 1/160 and above were considered positive. While Rose Bengal test was positive in three of 617 pregnant women included in the study, a titer of 1/160 and above 1/320 was found with the standard tube agglutination test in only one of them (Yapça et al. 2009).

In a study conducted in Rwanda, the incidence of Brucellosis in women who had abortion and/or stillbirth was investigated. Serum samples were collected from a total of 60 women and the Rose Bengal plate test (RBPT) was performed on each sample. A questionnaire was administered to investigate potential contacts with this disease due to contact with animals and/or consumption of raw milk. Results were positive in 15 women (25%). Survey results also showed that Brucellosis patients were either in contact with pets (cattle, goat or sheep) or were those who consumed raw cow's milk (Rujeni and Mbanzamihiho 2014).

5. BIOFILM FORMATION OF *BRUCELLA* STRAINS

Microorganisms are involved in the food chain at every stage in food production systems and can form biofilms and pose dangers in food safety (Mossel et al. 1998; Havelaar et al. 2010; McMeekin, Hill et al. 2010). Most microorganisms have the ability to form biofilms (Jacques et al. 2010). Biofilms can cause contamination after the production of foods, shorten the shelf life of processed foods and cause food poisoning as a result of consuming the contaminated product. For this reason, it has become one of the important food safety problems. In addition to health problems, they cause corrosion of metal pipelines and tanks in food production systems, decrease in heat transfer efficiency in heat exchangers and mechanical blockages, causing great financial losses in the industry (Mittelman 1998; Chmielewski and Frank 2003). To prevent these problems, antimicrobial agents, which are mostly chemical or biochemical compounds, are used in biofilm control. In the industrial biofilm control, antimicrobials called biocides are used in surface disinfection together with chemical methods (Kumar and Anand 1998). Antimicrobials called antibiotics are used in biofilm-based infections in humans and animals (Fratamico et al. 2009). In the use of these substances, the disinfectant concentration required to destroy biofilm cells is 10-1000 times higher than planktonic cells, making bacterial



biofilm control even more difficult (Frank and Koffi 1990; Norwood and Gilmour 2000; Robbins et al. 2005).

Table 1. Biofilm formation characteristics of *Brucella* spp.

Species	Biofilm	Conclusions	Reference
<i>B. abortus</i>	Aggregates and produces biofilm, adhere and displace	Starved and grown under microaerobiosis produce extracellular matrix, autoaggregate, move, and adhere to abiotic surfaces without the involvement of VjbR, the lipopolysaccharide-O antigen, cyclic β (1,2) glucan, or flagella. Matrix-producing cells are more resistant to desiccation and promote the development of biofilms	Almiron et al. 2013
<i>B. melitensis</i> 16M	Biofilm formation	Presence of exopolysaccharide and DNA, strong clumping phenotype, increased production of outer membrane vesicles	Godefroid et al. 2010
<i>B. abortus</i>	Biofilm formation	20 differentially expressed protein spots between biofilms and planktonic cells	Tang et al. 2019
<i>B. abortus</i> A3313	Biofilm formation	There were metabolomic and proteomic differences between biofilm and planktonic cells	Tang et al. 2021
<i>B. melitensis</i>	Biofilm formation	Outer membrane proteins and overproduction of a matrix-forming exopolysaccharide	Uzuraeu et al. 2007

One of these biofilm forming bacteria is *Brucella* spp. However, even though Brucellosis is a relevant disease effecting people worldwide, there are few research about *Brucella* spp. biofilm forming characteristics (Table 1).

B. abortus, *B. melitensis*, *B. suis*, *B. canis*, *B. ovis* and *B. neotomae* species are in the genus *Brucella*. All of these species are known as human pathogens except for *B. ovis* and *B. neotomae*. These bacteria are found intracellularly in humans and animals. They are the causative agents of Brucellosis disease, which initially causes general infection and septicemia in humans and then tends to settle in various organs (Cengiz 1997). *Brucella* spp. has different effects in humans and animals. This is because the human placenta lacks erythriol. Erythritol is a nutritious carbohydrate that increases the growth of *Brucella*. It is found in sheep, goats, cattle and pigs. At the same time, there is an activity that inhibits *Brucella* bacterial species in human amniotic fluid (Sayilir 2003).

Brucella melitensis is a bacterium belonging to the alpha-2 proteobacteria class responsible for Maltese fever in humans and Brucellosis in ovines. *B. melitensis* forms clusters containing exopolysaccharide. In stacks produced by this strain, two classical components of extracellular matrices have been shown to be exopolysaccharides and DNA. Complex exopolysaccharides produced by *B. melitensis* 16M, consisting mostly of mannose, glucose and glucosamine and having a molecular weight of about 16 kDa, are purified. *B. melitensis* forms a biofilm in its



life cycle (Godefroid et al. 2010). Also, Uzureau et al. (2007) reported that *B. melitensis* can form a biofilm in their study.

Brucella abortus mostly causes Brucellosis in cattle. The disease is transmitted to humans by ingestion of infected animal products or by direct contact with material. *B. abortus* adheres to the surface and forms a biofilm under microaerobic conditions (Almirón et al. 2013).

6. CONCLUSIONS

Biofilms are a very important subject that has been studied because of their negative effects on health and in the food industry. These structures start naturally with adhesion to the surface so that microorganisms can survive in difficult environmental stresses, but they turn into a mature biofilm layer with the permanent attachment and growth of cells on the surfaces and increase their virulence by becoming resistant to antibiotics. *Brucella* species, most of which are pathogenic, have also been reported to form biofilms. Even though vaccines, immunization protocols, diagnostic tests, and removal of the infected animals applied to fight with the disease, still Brucellosis is a relevant disease worldwide. Moreover, development of biofilms may lead to important medical situations especially in chronic diseases. Revealing the biofilm formation would help people to find appropriate antimicrobials and develop methods to eradicate biofilms. More research should be carried out on *Brucella* spp. biofilms to fight disease effectively. Therefore biofilm formation of *Brucella* spp. should be investigated more to shed light on curing mechanisms.



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KOKOPİT ORTAMINDA TOPRAKSIZ MARUL YETİŞTİRİCİLİĞİNDE MİNERAL GÜBRELERİN AZALTILMASI İÇİN BİYO-GÜBRE KULLANIMI

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ÖZET

Bu çalışmada amaçlanan, serada kokopit ortamında topraksız marul yetiştiriciliğinde sentetik mineral gübre miktarını %50 azaltmaktır. Azaltılan mineral gübre yerine biyo-gübreler eklenmiştir. Çalışmada bitki materyali olarak Dragon isimli kıvrıkcık marul çeşidi ve bitki beslemede biyo-gübre uygulamaları olarak mikroalg, bakteri ve mikoriza biyo-gübreleri kullanılmıştır. Deneme cam bir serada sonbahar-kış döneminde dört tekerrürlü ve tekerrürde 12 marul bitkisi olacak şekilde tesadüf parselleri deneme planına göre kurulmuştur. Mikroalg olarak, *Chlorella vulgaris*'in canlı hücreleri kullanılmıştır. Bakteri olarak, *Basillus subtilis*, *Bacillus megaterium* ve *Pseudomonas fluorescens* olmak üzere 3 farklı tür bulunan biyo-gübre kullanılmıştır. Mikoriza olarak ise, içeriğinde *Glomus intraradices*, *Glomus aggregatum*, *Glomus mosseae*, *Glomus clarum*, *Glomus monosporus*, *Glomus deserticola*, *Glomus brasilianum*, *Glomus etunicatum*, *Gigaspora margarita* mantarlarının karışımından oluşan bir kokteyl kullanılmıştır. Topraksız yetiştirilen kıvrıkcık marul yaprak verimi, %100 mineral gübre uygulamasında 13.96 kg/m², %50 azaltılan mineral gübre uygulamasında 9.62 kg/m² bulunmuştur. Mineral gübrenin %50 azaltıldığı ve biyo-gübrelerden bakteri, mikoriza ve mikroalg eklenen uygulamalarda toplam marul verimi sırasıyla 11.05 g/m², 11.31 kg/m² ve 10.98 kg/m² olarak belirlenmiştir. Biyo-gübrelerin bu verim değerleri %50 mineral gübre uygulamasından sırası ile %14.86, %17.57 ve %14.14 daha fazla marul verimi oluşturmuştur. Biyo-gübrelerin marul ürünü fiziksel kalitesi üzerine etkilerini görmek üzere ortalama ağırlık, en, boy, çap, çevre ve SPAD metre cihazı ile klorofil ölçümleri yapılmıştır. Kokopit paketlerinde topraksız kıvrıkcık marul yetiştiriciliğinde mineral gübrelerin azaltılıp yerine biyo-gübrelerin ikame edilmesi verimi ve bitki büyümesini artırıcı etkiler yapmıştır. Söz konusu biyo-gübreler, mineral gübreler %50 azaltıldığı durumda toplam verim biraz düşmekle birlikte daha temiz bir çevre ve daha sağlıklı yeşil yapraklı sebzeler tüketmek adına için tercih edilebilir bulunmuştur.

Anahtar Kelimeler: Topraksız yetiştiricilik, *Lactuca sativa* L. var. *crispa*, mikrobiyal gübre



USE OF BIO-FERTILIZERS TO REDUCE MINERAL NUTRIENTS IN SOILLESS GROWN LETTUCE IN COCOPEAT

ABSTRACT

The aim of this study is to reduce the amount of synthetic mineral fertilizers by 50% in soilless cocopeat grown lettuce. Bio-fertilizers have been added to replace the reduced mineral fertilizers. In the study, a variety of battavia lettuce named Dragon was used as plant material. Microalgae, bacteria and mycorrhiza were used as the bio-fertilizers. The experiment was set up in a glass greenhouse in the autumn-winter growing period with four replications and 12 lettuce plants in replication, according to a randomized complete block experimental design. Living cells of *Chlorella vulgaris* were used as microalgae bio-fertilizer. Three different species were used as bacteria bio-fertilizer: *Bacillus subtilis*, *Bacillus megaterium* and *Pseudomonas fluorescens*. The cocktail consisting of *Glomus intraradices*, *Glomus aggregatum*, *Glomus mosseae*, *Glomus clarum*, *Glomus monosporus*, *Glomus deserticola*, *Glomus brasilianum*, *Glomus etunicatum*, *Gigaspora margarita* was used as mycorrhiza bio-fertilizer. The leaf yields of battavia lettuce were 13.96 kg/m² and 9.62 kg/m² in 100% and 50% synthetic mineral fertilizer applications, respectively. Bacteria, mycorrhiza and microalgae fertilizers produced 11.05 kg/m², 11.31 kg/m² and 10.98 kg/m² total lettuce yield, respectively. The bio-fertilizers created 14.86%, 17.57% and 14.14% higher lettuce yield, respectively, than that of the 50% mineral fertilizer. In order to see the effects of bio-fertilizers on some physical quality properties of lettuce crop; average weight, width, height, diameter, circumference and leaf color were measured and discussed in the manuscript. These bio-fertilizers have been found to be preferable for a cleaner environment and healthier green leafy vegetables, although the total yield decreases slightly when the mineral fertilizers are reduced by 50%.

Keywords: Soilless culture, *Lactuca sativa* L. var. *crispa*, microbial fertilizer



GİRİŞ

Ülkemizde örtüaltı yetiştiriciliği meyve ve sebze üretiminde önemli yere sahiptir. Türkiye’de 2019 yılında 31 milyon ton sebze üretimi yapılmıştır. Bunun 22 milyon tonu açıkta, 8 milyon tonu ise örtüaltında üretilmiştir. Türkiye’de toplam 772.091 dekara sahip örtüaltı alanı bulunmaktadır. Antalya ili %47’lik payla (3.8 milyon ton) örtüaltı üretiminde ülkemizde ilk sırada yer almaktadır. Bu ili sırasıyla, Mersin %20 (1.6 milyon ton), Adana %12 (970 bin ton), Muğla %8 (657 bin ton) takip etmektedir. Örtüaltı yıllık sebze üretimi 7.535.511 ton, meyve üretimi 535.515 ton ve süs bitkisi ise 1.211.202.223 adettir (TÜİK, 2019). Topraksız yetiştiricilik, çoğunlukla seralarda kullanılmakla birlikte, son yıllarda kapalı mekânlarda (indor farming), bitki fabrikalarında (plant factory) çok katlı raflı sistemlerde (vertical farming) ve açık alanda da kullanılan bir bitki yetiştiricilik teknolojisidir. Bitki yaşamı için gerekli olan su, besin elementleri ve oksijenin gereken miktarlarda kök ortamına verilmesi esasına dayalı olup su kültürü ve substrat kültürü (katı ortam kültürü) şeklinde iki farklı teknikle yapılabilmektedir. Su kültüründe bitkiler besin çözeltisi içinde yetiştirilirken (Burrage, 1999), katı ortam kültüründe bitki kökleri organik, inorganik veya sentetik ortamlar içindedir (Schwarz, 1995; Sevgican, 1999). Başka bir tanımda, “Topraksız tarım”, bitkilerin durgun veya akan besin çözeltisi içerisinde, besin çözeltisi püskürtülmesi ile ya da besin çözeltisi ile sulanarak katı yetiştirme ortamlarında yetiştirilmesidir (Daşgan, 2020).

Topraksız tarımdaki substratlar; organik, inorganik ve sentetik substratlar olarak ayrılır. Organik substratlar; torf, hindistan cevizi lifi (cocopeat), saman, çeltik kavuzu, üzüm küspesi vs. kullanılmaktadır. İnorganik substratları ise işlenmiş ve doğal olarak ikiye ayırmaktayız. Doğal olanlar; kum, çakıl, volkanik tuf. İşlenmiş olanlar; perlit, vermikulit, kaya yünü, geliştirilmiş kil vb olabilir. Yetiştiricilerin topraksız tarımı tercih etme sebepleri arasında; toprak işleme, dikim yeri hazırlama gibi işlemlerin olmaması, yabancı ot sorunundan dolayı oluşan işçilik maliyetinin ortadan kalkması, seralarda toprak yorgunluğu, ekim nöbeti, hastalık parazit popülasyonunun artması, tuzluluk, pH gibi sorunların önüne geçilmesi ve bu sistemde yapılan yetiştiricilikte kontrolün tamamen üreticide olması, bitki için en iyi ortamı sağlaması gibi durumlardan dolayı yetiştiricilerin tercih ettiği sistemdir. Bu tür avantajlara rağmen, geri dönüşümlü kapalı sistemlerde bitki besleme kontrolü için teknik bilgi ve tecrübeye sahip teknik personel ihtiyacı, hastalık riskinin kapalı sistemlerde yüksek olması ve sürekli enerji ihtiyacı gibi dezavantajları olabilir.

BİYO-GÜBRELER

Biyogübre veya mikrobiyal gübre olarak adlandırılan canlı organizmalar, havada ve topraktaki yarayışlı besin maddelerinin bitkiler tarafından faydalanılmasına yardımcı olur ve bu nedenle kimyasal gübrelerin daha az kullanılmasına olanak sağlar. Biyogübreler mineral gübrelerin bitkiye yarayışlılığını artırmakta, kullanılan mineral gübre miktarının azalmasını sağlamakta ve kök bölgesinde pH ve EC seviyelerinde iyileştirmeleri sağlamaktadır. Çeşitli funguslar, mikoriza türleri, bakteriler ve mikroalgler önemli mikroorganizma gruplarıdır.

FAYDALI BAKTERİLER

Rizosferde yaşayan bazı bakterilerin farklı etki mekanizmaları ile bitki gelişimini birçok yönden desteklediği yapılan araştırmalar sonucu ortaya konmuştur. Bu faydalı bakteriler Klopper ark.(1989) tarafından PGPR (Plant Growth Promoting Rhizobacteria) olarak adlandırılmıştır ve bitkiye sağladıkları pek çok faydadan dolayı "Probiyotik Rizobakteriler" olarak da bilinmektedir. PGPR'ler azotu bağlayabilmesi, fosforu ve ağır metalleri çözebilmesi, hormon üretmesi, su ve mineral alımını artırması, kök gelişimini desteklemesi, bitkide enzim



aktivitesini artırması, gibi etki mekanizmaları ile bitki gelişimini teşvik etmektedirler. Rizobakterilerin geniş kullanım alanlarına yönelik araştırmalar pek çok araştırmacı tarafından yapılmaktadır. Bitki büyümesini teşvik edici etkileri olan ve tarımda mikrobiyal gübre olarak bilinen bakteriler genel olarak bitki büyümesi, besin elementi alımı, kimyasal gübre kullanımına karşı talebin azalması, bitki bünyesinde IAA ve Sitokininin üretimi, bitki bünyesinde gibberelinlerin teşvik edilmesi gibi daha pek çok etkilerinin olduğu bildirilmektedir (Eşitken ark., 2006; Orhan ark., 2006).

MİKORİZA MANTARLARI

Bazı bitkilerin köklerinde yoğun bir şekilde bulunan fakat hastalık oluşturmeyen mantarlar saptanmış ve bitki kökleri ile uyumlu bir ilişki ile yaşayan bu mantarlara “mikoriza” ismi verilmiştir. Mikorizal funguslar doğada yaygındır ve bitkilerin çoğu yaşamlarını beraber sürdürürler. Mikorizal funguslar bitki köklerine besin maddelerini uzaklardan taşırlar. Köklerde fizyolojik ve morfolojik değişiklikler ile bitki gelişimine katkıda bulunur. Sürdürülebilir tarım araştırmalarının odağını bu faydalı mikroorganizmalarının işletilmesi oluşturmaktadır. Bitki kökleriyle ortak yaşam kuran mikoriza mantarları, ticari önemi olan birçok bitki türünü kolonize edebilmektedir. Bu mantarlar bitkiler için gerekli mineralleri salgıladıkları enzimler yoluyla çeşitli rezervlerden çözünür hale getirerek hifleri yoluyla bitkiye taşırlar. Tarımda sürdürülebilirlik için biyolojik gübrelemenin önemi ve enerji fiyatlarındaki artışa bağlı olarak kimyasal gübrelemenin maliyetinin artması yanında çevreye olan zararlı etkilerinin anlaşılması, sentetik gübrelere karşı biyolojik alternatiflerin kullanımını gündeme getirmiştir.

MİKROALGLER

Mikroalgler, fotosentez yoluyla ışığı soğurup bunu inorganik maddeleri organik maddelere dönüştüren; oldukça basit yapıda, ökaryotik, canlı sucul organizmalardır. Mikroalgler pek çok ortamda bulunan foto sentetik organizmalardır. Küçük tek hücreli türlerden karmaşık çok hücreli yapılara kadar çeşitlilik gösterirler. Son yıllarda adı sıkça duyulmaya başlayan “*Chlorella*” bilinen en eski (2.5 milyar yıl) canlılardan ve besin kaynaklarından biridir. Aynı zamanda çekirdeği tam oluşmuş en eski tek hücreli organizmadır. *Chlorella*, yeşil bir tatlı su alg'idir. İsmi Latince yaprak/yeşil ve küçük anlamına gelen iki kelimedenden üretilmiştir. Koyu yeşil renkte olan *Chlorella*'nın yeşilliği içindeki çok yüksek orandaki (bütün bitkiler içinde en yüksek) klorofil maddesinden gelmektedir. *Chlorella*'daki klorofil bilinen diğer alg türlerinden 5-10 misli fazla olup klorofil, oksin ve sitokininleri üretmektedir.

MARUL

Serin iklim sebzelerinden salata ve marul tüm dünyada en çok tercih edilen salata grubu sebzeleri arasındadır. Bu nedenle yılın on iki ayı pazarlar ve marketlerde yerini alan tek yıllık serin iklim sebzesidir. Marul, yıl boyunca hidroponik yetiştiriciliğe uygundur. Taze olarak tüketilen salata ve marullar, besin değeri yüksek ve iştah açıcı özelliğinin yanında vitaminler ve mineral maddeler bakımından oldukça zengindir (Aybak, 2002).

Yapılan bu Çalışmanın amacı, topraksız kültürde kokopit katı ortamında marul yetiştiriciliğinde mikoriza, mikroalg ve bakteri biyo-gübreleri kullanılması ile daha az kimyasal gübre kullanımını böylece gübre tasarrufu ve çevreyi koruma, bunun yanında mikoriza, mikroalg ve bakteri gübrelerinin, topraksız sistemde kokopit yetiştirme ortamında marulun bitki gelişimi, verim, ürün kalitesi ve marulun besin içeriği üzerine etkilerini ortaya koymayı amaçlamaktadır.



1. MATERYAL ve YÖNTEM

Bu deneme Çukurova Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü'ne ait "Topraksız yetiştiricilik" için belirlenen 500 m² cam seranın belirli bir bölümünde 2019 kış-ilkbahar sezonunda gerçekleştirilmiştir.

BİTKİSEL MATERYAL

Bitkisel materyal olarak Vilmorin firmasına ait Dragone kıvrıkcık marul çeşidi (Batavia tipi) kullanılmıştır. Denemede kullanılan Dragon marul orta erkenci, albenisi yüksek, mildiyö ve yaprak bitine dayanıklı bir çeşittir.

MİKROALG BİYO-GÜBRESİ

Çalışmada kullanılan *Chlorella vulgaris* mikroalg biyogübresi, Ç.Ü. Su Ürünleri Fakültesi'nde üretilmiştir. İçerisinde 2x10⁷ mikroalg ml⁻¹ bulunan biyo-gübreden, su kültüründe bitki köklerinde 40 kez seyreltilmiş halde kullanılmıştır. Bitki kökü seviyesinde son doz olarak, 1 L besin çözeltisi için 25 ml 2x10⁶ mikroalg ml⁻¹ bulunan biyo-gübreden kullanılmıştır. Her 10 günde bir bakteri besin çözeltisi ile sulanma yapılmıştır.

BAKTERİ BİYO-GÜBRESİ

Araştırmada kullanılan bakteri biyo-gübresi, NGB (Next Generation Biotechnology) firmasına ait ticari ismi "Rhizofill" olan ve içeriği Çizelge 1'de gösterilen 3 bakteri türü karışımı olan ürün kullanılmıştır. Bu amaçla 50 ml Rhizofill biyo-gübresi, 1 ml bakteri orijinal gübreden 1 litre besin çözeltisi içerisinde olacak şekilde her 10 günde bir yapılan sulama ile kokopit ortamına bakteri aşılması yapılmıştır.

Çizelge 1. Mikrobiyal gübre Rhizofill'in içeriğindeki bakteri türleri ve konsantrasyonları

Bakteri tür ismi	Koloni oluşturan birim (KOB*/ml)
<i>Bacillus subtilis</i>	1x10 ⁹
<i>Bacillus megaterium</i>	1x10 ⁹
<i>Pseudomonas fluorescens</i>	1x10 ¹⁰

*: KOB: Koloni Oluşturma Birimi

MİKORİZA BİYO-GÜBRESİ

Mikoriza uygulamasında Bioglobal Anonim Şirketinin ERS (Endo Root Soluble) ticari gübresi kullanılmıştır. ERS bio-gübresinin içeriği toplam canlı organizma olarak 1x10⁴(w/w) konsantrasyonda şu mikorizaları kokteyl (karışım) şeklinde içermektedir: *Glomus intraradices*, *Glomus aggregatum*, *Glomus mosseae*, *Glomus clarum*, *Glomus monosporus*, *Glomus deserticola*, *Glomus brasilianum*, *Glomus etunicatum*, *Gigaspora margarita*. Mikoriza aşılması, tohum ekimi sırasında bitki başına 1000 adet spor olacak şekilde gerçekleştirilmiştir.

DENEMEDE GERÇEKLEŞTİRİLEN UYGULAMALAR

Çalışmada aşağıda listelenen 5 uygulama gerçekleştirilmiştir. Çalışmanın amacı, su kültürü kıvrıkcık marul yetiştiriciliğinde mineral gübreleri azaltmak ve onun yerine çeşitli biyo-gübreleri yetiştiricilik sistemine entegre etmektir. Böylece mineral gübreler %50 azaltılarak biyo-gübrelerin bitki büyüme ve gelişmesi, marul kalite öğeleri ve insan sağlığı için önemli olan bileşenler üzerine etkisi görülmesi hedeflenmiştir. Bu amaçla ideal mineral gübre konsantrasyonlarını ve miktarlarını içeren "%100 Besin çözeltisi" uygulaması, klasik su kültürü



bitki besleme uygulaması olarak kontrol amacı ile kullanılmıştır. Bunun tam yarısı “%50 Besin çözeltisi” uygulaması yukarıda belirtilen tam besleme uygulamasının yarısı kadar mineral içeren azaltılmış mineral gübreleri içeren bir uygulama oluşturmuştur. Bu azaltılmış mineral gübreli uygulamada, bütün mineral gübreler eşit oranda %50 azaltılmıştır. Daha sonra %50 azaltılmış mineral gübrelemeye sırası ile mikro mikroalg, bakteri ve mikoriza biyo-gübreleri eklenmiştir.

1. %100 Besin Çözeltisi
2. % 50 Besin Çözeltisi
3. %50 Besin Çözeltisi + Mikroalg
4. %50 Besin Çözeltisi + Bakteri
5. %50 Besin Çözeltisi + Mikoriza

YÖNTEM

Bitki materyali olarak kullanılan Dragon kıvrıcık marul tohumları torf:perlit (2:1) karışımı içeren viyollere, 17 Ekim 2018 tarihinde ekilmiştir. Mikoriza tohum ekimi sırasında ekim çukurlarına uygulanarak aşılama gerçekleştirilmiştir. Dikim aşamasına gelen Dragon kıvrıcık marul fideleri 15 Kasım 2018 tarihinde kokopit paketlerine transfer edilmiştir. Denemede marul bitkileri sıra arası ve üzeri mesafe 38 cm x 17 cm olarak kullanılmıştır. Bitki yoğunluğu 33.33 bitki/m² olmuştur. Denemede 4 tekerrür ve her tekerrürde iki adet kokopit paketi her pakette 6 bitki ve tekerrürde 12 bitki olacak şekilde tesadüf blokları deneme desenine göre kurulmuştur. Fideler dikimden 43 gün sonra 29 Aralık 2018 tarihinde hasat edilmiştir.

BİTKİ BESLEME

Denemede bitki gübrelemesi için stok çözeltiler hazırlanmıştır. Stoklarda çökme olmaması için kalsiyumlu gübrenin ayrıldığı iki ayrı stok çözelti tankı kullanılmıştır. Sulama yapılan besin çözeltisi pH seviyesi 5.7-6.0 civarında tutulmuştur. Besin çözeltisi EC değerleri %100 mineral gübre kontrol uygulamasında 1.5, 2.0 ve 2.4 dS/m olarak bitki büyümesi ile beraber kademeli artırılmıştır. Mineral gübrelerin %50 azaltıldığı diğer uygulamalarda ise, %100 mineral gübre kontrol uygulamasına göre yarı yarıya azaltılarak işlemler yapılmıştır.



Şekil 1. Kokopit paketlerinde topraksız olarak kıvrıcık marul yetiştirilmesi



Çizelge 2. Denemede %100 mineral besleme kontrol uygulamasında kullanılan olan besin maddeleri konsantrasyon aralıkları

Element	mg/L
N	150-220
P	30-40*
K	270-312
Ca	170-210
Mg	50-65
Fe	3.00-5.00
Zn	0.30-0.55
B	0.70-0.97
Cu	0.20-0.30
Mo	0.10-0.20
Mn	0.55-0.96

*: Mikoriza çalışması için düşük tutulmuştur

ÖLÇÜMLER ve VERİLERİN ANALİZİ

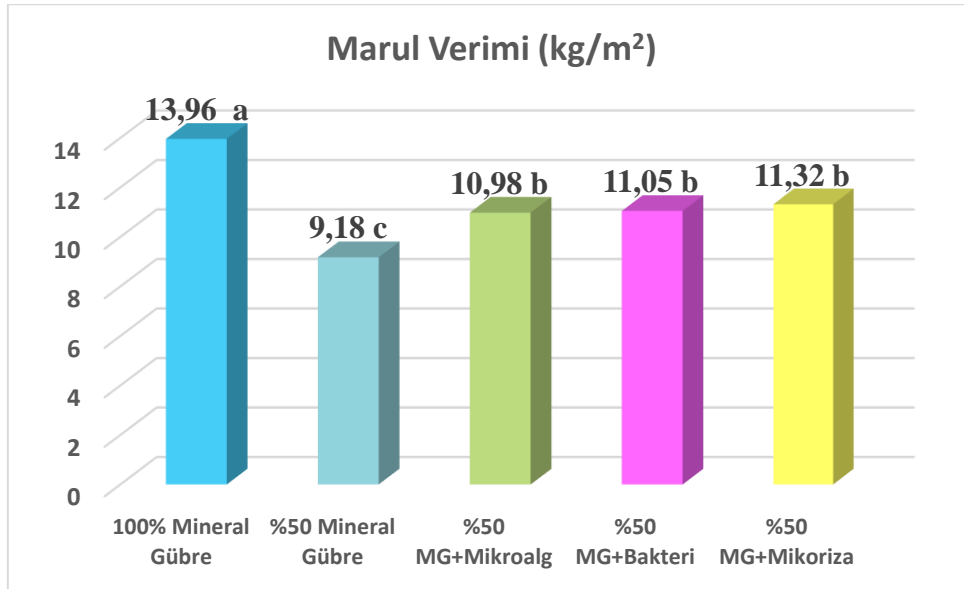
Biyo-gübrelerin marul verimi ve ürünün fiziksel kalitesi üzerine etkilerini görmek üzere ortalama ağırlık, en, boy, çap, çevre ve SPAD metre cihazı ile klorofil ölçümleri yapılmıştır. Veriler JMP *istatistik paket programı* (Version 7.0, Statistical Software, 2007) kullanılarak varyans *analizi yapılmıştır*. İstatistiki açıdan $p < 0.05$ seviyesinde önemli bulunan parametreler için, Asgari Önemli Fark (AÖF) (Least Significant Difference, LSD) çoklu karşılaştırma testi ile uygulamalar arasındaki farklar incelenmiş ve buna göre değerlendirmeler yapılmıştır.

BULGULAR ve TARTIŞMA VERİM

Kıvırcık marul bitkileri farklı biyo-gübreler ile 43 gün yetiştirilmesi sonucunda hasat edilmiştir ve birim alana verimlilik kg/m^2 olarak hesaplanmıştır. Verim değerleri uygulamalara göre istatistiksel olarak farklı bulunmuştur. En yüksek verim 13.96 kg/m^2 ile %100 kontrol grubundan elde edilmiştir. Bunu 11.32 kg/m^2 ile %50 Mineral Besin+Mikoriza ve 11.05 kg/m^2 ile %50 Mineral Besin+Bakteri-gübre izlerken, %50 Mineral Besin+Mikroalg ise dördüncü sırada ve 10.98 kg/m^2 verim oluşturmuştur. Mikroalgin biyo-gübreler arasında düşük verim oluşturma nedeni, yaşayan *Chlorella vulgaris* canlı hücrelerinin, mineral gübreler için bitki ile rekabete girdiği ve bu nedenle birim alana marul verimi mikroalg uygulamasında biyo-gübreler içerisinde en düşük olduğu söylenebilir. Denemedeki en düşük marul verimi ise 9.18 kg/m^2 ile %50 Mineral Besin uygulamasında kaydedilmiştir (Şekil 2). Biyo-gübre kullanılan uygulamaların verim değerleri mikroalg, bakteri ve mikoriza uygulamalarında, %50 mineral gübre uygulamasından sırası ile ve %14.14, %14.86 ve %17.57 daha fazla marul verimi oluşturmuştur. Arancon ve ark. (2019), %50 ve %75 azaltılan mineral beslemeyle durgun su kültüründe yetiştirilen marul bitkilerine %1.6 ve %3.2 vermikompost çayı uygulaması yapmışlardır. Marul verimi bakımından %50 besin azaltılan uygulamada her iki vermikompost çayı birbirine yakın (280 g/bitki) ve hiç çay uygulanmayan kontrolden (190 g/bitki) istatistiksel olarak yüksek verim oluşturmuştur. Yazarlar vermikompost çayı içerisinde az da olsa mevcut olan oksin, gibberellin ve sitokin gibi hormonlar ve humik asit varlığından olabileceğini bildirmiştir. Miceli ve ark. (2019) su kültürü marul yetiştiriciliğinde büyüme düzenleyici Gibrellikasitin 0 , 10^{-8} , 10^{-6} , 10^{-4} M GA_3 dozlarını kullanmışlardır. GA_3 hormonunun 10^{-4} M dozu çok yüksek gelip bitkileri öldürürken 10^{-6} M dozunun bitki büyümesini teşvik ederek; yaprak büyümesi, biyomas artması, stoma iletkenliği artması, su ve azot kullanma etkinliği



artması gibi fizyolojik özellikleri olumlu etkileyerek sonuçta marul verimini ve kalitesini artırdığı bildirilmiştir. Souza ve ark. (2019) toprakta ve su kültüründe yetiştirilen marul bitkilerini pek çok özellik bakımından karşılaştırmışlardır. Marul bitkileri tohum ekiminden itibaren 59 gün sonra ve fide dikiminden 37 gün sonra hasat edilmiştir. Marul bitkisi yeşil aksam ağırlığı toprakta 35.25 g/bitki iken su kültüründe 305.85 g/bitki bildirilmiştir. Ergün ve Daşgan (2020), su kültürü tekniği ile marul yetiştiriciliğinde %100'den %20'ye kadar azalan mineral gübre dozlarında mikroalg *Chlorellavulgaris* kullanımının etkilerini araştırmıştır. Denemede marul verimi bakımından %60 ve %40 mineral gübre kullanılarak buna mikroalg eklendiği durumda verim sırası ile 238 g/bitki ve 249 g/bitki iken, marul bitkileri %100 mineral gübre ile beslendiğinde ağırlığı 242 g/bitki olarak istatistik anlamda aynı değerlendirme grubunda bildirilmiştir.



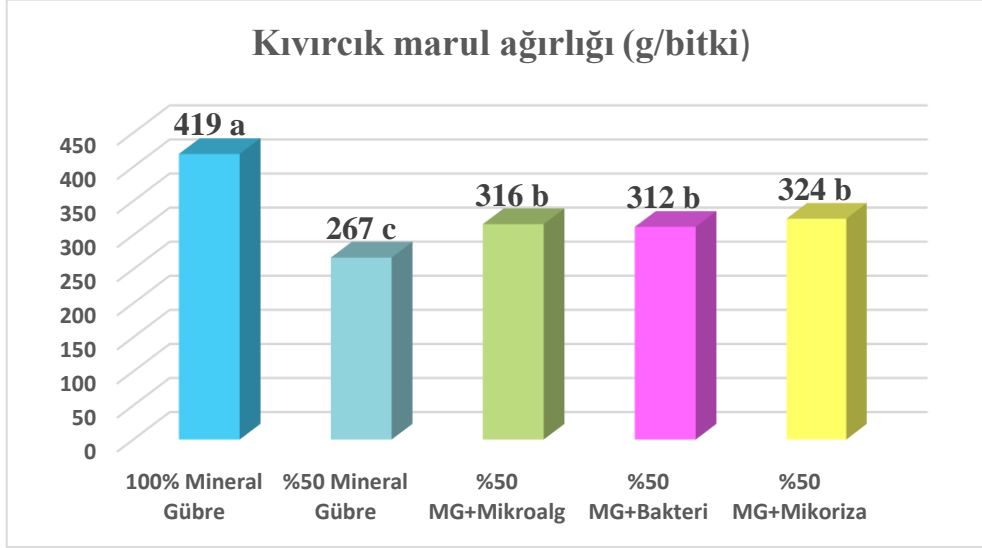
Şekil 2. Topraksız kokopit ortamında besin çözeltilisinde mineral gübreler %50 azaltılarak yerine biyo-gübre eklenmesinin kıvrıcık marul verimi üzerine etkisi

MARUL AĞIRLIĞI

Denemede marul bitki ağırlığı 267 g (%50 Mineral Besin) ile 419 g (%100 Mineral Besin) arasında değişmiştir. Kıvrıcık marul ağırlığı uygulamalara göre istatistiksel olarak farklı bulunmuştur. En ağır marul bitkileri 419 g ile %100 kontrol grubundan elde edilmiştir. Bunu ikinci sırada 324 g ile %50 Mineral Besin+Mikoriza, üçüncü sırada, 316 kg ile %50 Mineral Besin+Mikroalg gübresinden alınırken, %50 Mineral Besin+Bakteri ise dördüncü sırada ve 312 g ağırlığında marullar oluşturmuştur (Şekil 3). Biyo-gübreler etkisi birbirine benzer olmuştur. Her üç biyo-gübre de aynı istatistik grupta yer almıştır. En küçük ve hafif marul bitkileri ise 267 g ile %50 Mineral Besin ortamından elde edilmiştir. Ergün ve ark., (2020), su kültüründe kıvrıcık marul yetiştiriciliğinde mineral gübreleri %100 (kontrol), %80, %60 ve %40 oranlarında kullanmış ve azalan mineral besin maddeleri yerine bitki beslemeyi ikame etmek üzere mikroalgiyo-gübresi *Chlorella vulgaris* kullanılmıştır. Kıvrıcık marul ağırlığı üzerine alg uygulamaları, uygulanmayan kontrol gruplarına göre her zaman artırıcı etki yapmıştır. Kontrol olarak %100 Besin uygulamasında marul ağırlığı 242.35 g iken, %80 Besinde 222.77 g, %80 Besin+Alg'de 243.31 g, %60 Besin'de 211.81 g, %60 Besin+Alg'de 237.56 g, %40 Besinde



205.82 g ve %40 Besin+Alg uygulamasında 239.01 g olarak bildirilmiştir. Azalan mineral gübre seviyelerinde algin devreye girmesi ile marul ağırlığı önemli bir şekilde artmıştır.



Şekil 3. Topraksız kokopit ortamında besin çözeltilisinde mineral gübreler %50 azaltılarak yerine biyo-gübre eklenmesinin kıvırcık marul ağırlığı üzerine etkisi

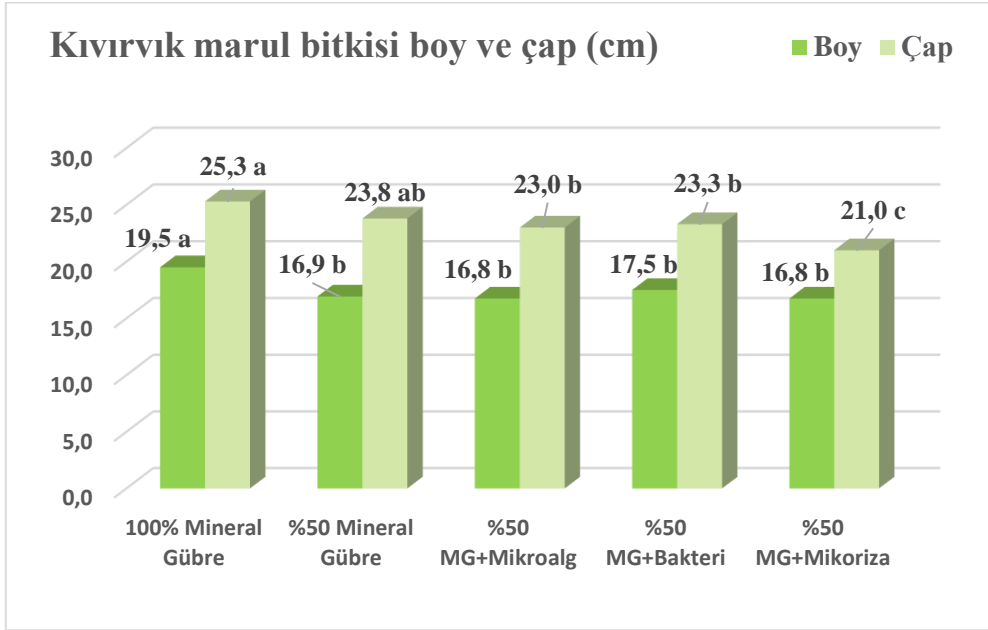
MARUL BİTKİSİ BOYU ve ÇAPI

En uzun ve en kısa boylu marul bitkileri, %100 ve %50 Mineral Besin+Mikoriza uygulamalarından sırası ile 25.3 cm ile 21.0 cm olarak kaydedilmiştir. Mikoriza uygulanan bitkilerin kısa kompakt taç içi dolu ve ağır bir habituse sahip olduğu görülmüştür. Sadece %50 Mineral Besin uygulamasındaki marul bitkilerinin ise 23.8 cm boy ile ikinci sırada uzun boylu ve taç içi seyrek ve hafif habituse sahip olduğu belirlenmiştir. Bakteri ve mikroalg gübreleri ise sırasıyla 23 cm ve 23.3 cm boyunda bitkiler oluşturmuştur. Ergün ve ark. (2020), su kültüründe kıvırcık marul yetiştiriciliğinde mineral gübreleri %100 (kontrol), %80, %60 ve %40 oranlarında kullanmış ve azaltılmış mineral gübreler yerine bitki beslemeyi ikame etmek üzere mikroalgiyo-gübresi *Chlorelavulgaris*'i eklemiştir. Çalışmada, en yüksek bitki boyu %100 Besin+Mikroalg uygulamasında elde edilmiştir. %100 Besin+Mikroalg uygulamasında bitki boyu kendi kontrolü olan mikroalgsiz %100 Besin uygulamasına göre %13.75 oranında artış göstermiştir. Benze şekilde; marul bitki boylarında %80 Besin+Mikroalg uygulaması kendi kontrolü mikroalgsiz %80 Besin uygulamasına göre %15.49 artış, %60 Besin+Mikroalg uygulaması kendi kontrolü mikroalgsiz %60 Besin uygulamasına göre %13.54 artış ve %40 Besin+Mikroalg uygulaması mikroalgsiz %40 Besine göre % 19.58 artış göstermiştir.

Miceli ve ark. (2019), yüzen su kültürü yetiştiriciliğinde kontrol, 10^{-8} M ve 10^{-6} M GA_3 uygulamışlardır. Marul bitki boyları sırası ile 25.0cm, 25.2 cm ve 31.8 cm olarak bildirilmiştir. 10^{-6} M GA_3 uygulaması boy artışı sağlamıştır. Kıvırcık marul bitkileri tacının en geniş yerinden bitki çapı ölçümleri yapılmıştır. Marul çap ölçümleri 19.5 cm ve 16.8 cm arasında değişmiştir (Şekil 4). %100 Mineral Besin uygulaması dışındaki gübreler marul çapı bakımından benzer etki yapmışlardır. En geniş bitkiler %100 Mineral Besin uygulamasından alınırken en dar çaplı bitkiler ise mikoriza ve mikroalg gübrelerinden alınmıştır. Serada topraklı organik kıvırcık marul yetiştiriciliğinde dört farklı bakteri (*Basillus subtilis*, *Bacillus*



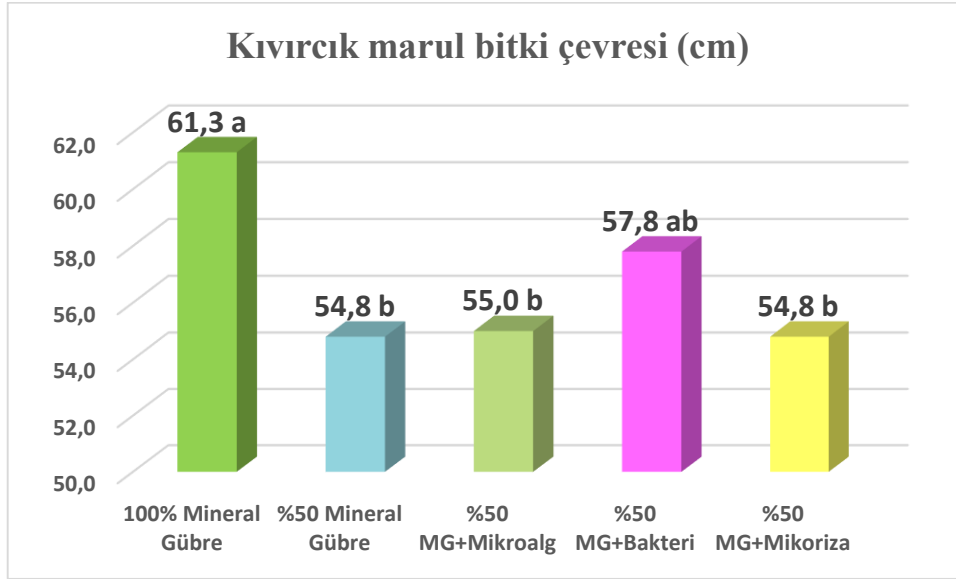
licheniformis, *Bacillus megaterium*, *Pseudomonas putita*) içeren Medbiobio-gübreli damlamadan ve yapraktan kullanılmıştır. Taç genişliği kontrole (40.6 cm) göre bakteri ile beslenen bitkilerde (50.4 cm) %24 istatistiksel olarak daha yüksek bildirilmiştir (Daşgan ve ark., 2021).



Şekil 4. Topraksız kokopit ortamında besin çözeltilisinde mineral gübreler %50 azaltılarak yerine biyo-gübre eklenmesinin kıvırcık marulun bitki boyu ve çapı üzerine etkisi

MARUL ÇEVRESİ

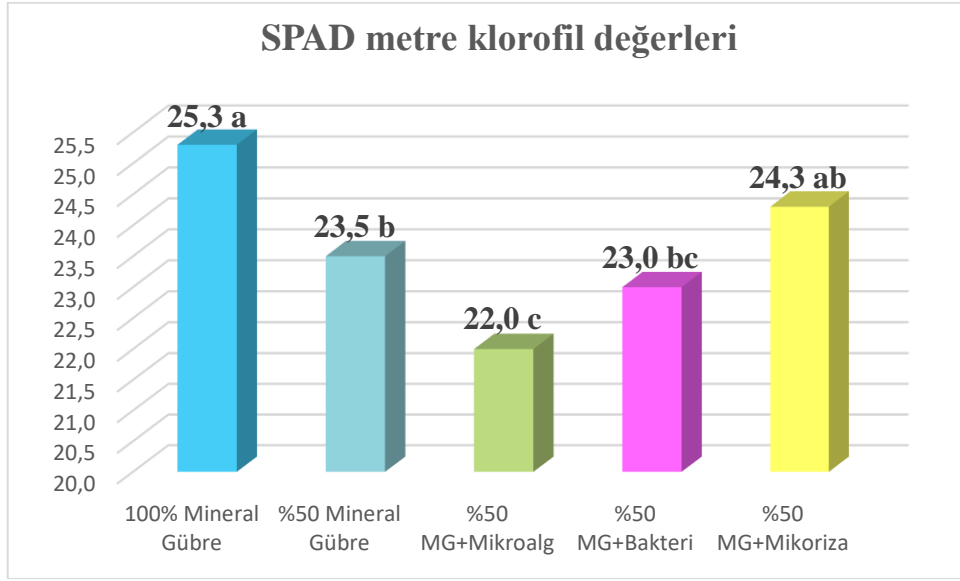
Marul bitkileri çevresi üzerine uygulamaların etkileri istatistiksel olarak farklı bulunmuştur. Bakteri (57.8 cm) uygulaması bitki çevresi bakımından olumlu etki ortaya koymuş kontrol uygulaması %100 Mineral Besin(61.3 cm) ile aynı istatistiksel grupta yer almışlardır. Diğer biyo-gübreler 55.0 cm ve 54.8 cm çevre ölçümleri sırasıyla mikroalg ve mikoriza yer almıştır (Şekil 5). Ergün ve ark., (2020), su kültüründe kıvırcık marul yetiştiriciliğinde mineral gübreleri %100 (kontrol), %80, %60 ve %40 oranlarında kullanmış ve bunun yerine bitki beslemeyi ikame etmek üzere mikroalg biyo-gübreli *Chlorella vulgaris*'i eklemiştir. Kıvırcık marul çevresi üzerine mikroalg uygulamaları, uygulanmayan azaltılmış besin uygulamalarına göre hep artırıcı etki yapmıştır. Serada topraklı organik kıvırcık marul yetiştiriciliğinde dört farklı bakteriyi (*Basillus subtilis*, *Bacillus licheniformis*, *Bacillus megaterium*, *Pseudomonas putita*) içeren biyo-gübre Medbio, damlamadan ve yapraktan kullanılmıştır. Kontrole (91 cm) göre bitki çevresi bakteri ile beslenen bitkilerde (108 cm) %19 istatistiksel olarak daha yüksek bildirilmiştir (Daşgan ve ark., 2021).



Şekil 5. Topraksız kokopit ortamında besin çözeltilisinde mineral gübreler %50 azaltılarak yerine biyo-gübre eklenmesinin kıvırcık marulun taç çevre ölçümü üzerine etkisi

MARUL YAPRAK RENGİ

Marul yapraklarında renk ile ilgili özellikler denemedeki uygulamalardan istatistiksel olarak farklı etkilenmiştir. Bitki beslemenin marulda renk özellikleri üzerine bir etkisi olduğu görülmektedir (Şekil 6). Beklendiği gibi %100 Mineral Besin uygulamasında 25.3 SPAD değeri ile en koyu yeşil renkli marul bitkileri elde edilirken, %50 Mineral Besin+Mikroalg uygulamasında en açık yeşil renkli marul yaprakları kaydedilmiştir. Bunun nedeni yaşayan *Chlorella vulgaris* canlı mikroalg hücrelerinin, verim ve marul ağırlığında da görüldüğü üzere mineral gübreler için bitki ile rekabete girdiği ve bu nedenle yapraklarda daha az klorofil oluştuğu söylenebilir. Kowalczyk ve ark., (2016)'nın yaptığı çalışmada kıvırcık bitkilerinde Minolta SPAD klorofil metre cihazı ile okunan yeşilin tonunu gösteren değerler; Kayanüde 19.6, kokopitte 24.2 ve NFT'de ise 19.6 olarak bildirilmiştir. Serada topraklı organik kıvırcık marul yetiştiriciliğinde dört farklı bakteriyi (*Bacillus subtilis*, *Bacillus licheniformis*, *Bacillus megaterium*, *Pseudomonas putida*) içeren bir biyo-gübrenin damlamadan ve yapraktan kullanıldığı çalışmada; kontrol bitkilerinde SPAD klorofil değeri 26.4 iken bakteri uygulamasında 27.5 olarak bildirilmiştir (Daşgan ve ark., 2021).



Őekil 6. Topraksız kokopit ortamında besin zltilisinde mineral gbreler %50 azaltılarak yerine biyo-gbre eklenmesinin kıvrıcık marul yapraklarında klorofil zerine etkisi



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TOPRAK TUZLULUĐU VE BİYOKÖMÜR UYGULAMALARI

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ÖZET

Artan dünya nüfusu, azalan enerji kaynakları ve fosil enerji kaynaklarının kullanımı sonucu ortaya çıkan küresel ısınma insanoğlunu dünyadaki enerji problemlerine farklı çözümler araştırmak zorunda bırakmıştır. Biyokütlenin bir enerji kaynağı olarak kullanımı bu çözümlerden bir tanesidir. Klasik yöntemlerden farklı olarak biyokütlenin uygun enerji veya madde formlarına dönüştürülmesi piroliz yöntemi ile gerçekleşmektedir. Bu çalışmada, sınırlı oksijen varlığı altında piroliz yöntemiyle üretilen okalıptüs ve yeşil atık biyokömürleri inkübasyon koşullarında olgunlaştırılmış, elde edilen materyaller 0-10-20-40 t/ha dozlarında olmak üzere kıyı etkisi sebebiyle tuzluluk gösteren kumlu tın toprağa uygulanarak bir saksı denemesi kurulmuştur. Topraklarda ilk olarak buğday bitkisi, ardından mısır bitkisi yetiştirilmiştir. Tuzluluğun olumsuz etkilerinin biyokömür uygulamaları ile azaltılması hedeflenen çalışmada, özellikle ikinci vejetasyon süresince biyokömürün toprak içerisinde önemli düzeyde etkin olduğu gözlenmiştir. Deneme sonunda, organik madde içerikleri beklenildiği üzere artış gösteren toprakların pH değerleri okalıptüs biyokömürü uygulamalarıyla küçük bir artış göstermiş, yeşil atık biyokömürü uygulamasından ise etkilenmemiştir. Toprakların elektriksel iletkenliğindeki hafif artışlar, bitki elementel içerikleri ve biyokütle oluşumuna yansımamıştır. 10 t/ha okalıptüs ve 20 t/ha yeşil atık biyokömürü uygulamalarıyla mısır bitkileri en düşük sodyum içeriği ve yükselen K/Na oranı sergilemiş; en yüksek boylanma ve biyokütle oluşumu bu dozlarda gözlenmiştir. Her iki biyokömür çeşidi de 40 t/ha dozunda uygulanmaları sonucu tarımsal sürdürülebilirlik bakımından bir risk olarak görülebilecek üzere mikro besin elementlerinin topraktaki alınabilirliği ve bitki alımında önemli düşümlere sebep olmuştur.

Anahtar Kelimeler: Toprak tuzluluğu, biyokömür, bitki besin elementi alımı



SOIL SALINITY AND BIOCHAR APPLICATIONS

ABSTRACT

The global warming that results from the growing world population is increasing the energy demand, while the decreasing resources of fossil energy has forced the societies to seek for different solutions with regards to obtain sufficient energy for the world. The use of biomass as an energy source is one of these solutions. The conversion of biomass to the suitable energy and material forms may be carried out by the pyrolysis method, which is distinguished from the conventional methods. In this study, eucalyptus wood and the green wastes were used to produce biochar by the pyrolysis method under limited oxygen supply, and applied to the highly saline sandy loam soils under low water potential conditions. Biochars were aged by incubation, then used as a soil amendment at the doses of 0-10-20-40 t/ha. Soils were used to grow wheat plants first, and then the corn plants as a consecutive vegetation. It has been observed in the present study which aims to alleviate the adverse effect of salinity damages on plant production, that the biochar applications were significantly effective especially during the second vegetation. At this final stage of the experiment, the pH values of the soils, whose organic matter content increased as expected, showed a small increase with eucalyptus biochar applications, but was not affected by the green waste biochar applications. The slight increases in the electrical conductivity of the soils were not reflected in the plant elemental contents and biomass formation. With the applications of 10 t/ha of eucalyptus wood and 20 t/ha of green waste biochar, maize plants showed the lowest sodium content and an increased K/Na ratio; the highest grading and biomass formation were observed in the soils treated with the related doses. Both biochar types caused significant decreases in the availability of soil micronutrients as well as their uptake by plants when applied at a dose of 40 t/ha, representing a risk on agricultural sustainability

Keywords: Soil salinity, biochar, plant nutrient uptake



GİRİŞ

Dünyada yaklaşık 952 ila 1100 milyon hektar tarım arazisinin veya dünya toplam kara alanının %7'den fazlasının yüksek toprak tuzluluğundan etkilendiğini bilinmektedir (Wicke ve ark., 2011; Artiola ve ark., 2019). Karasal alanların yaklaşık % 46'sını oluşturan kurak ve yarı kurak alanlar içerisinde, sulanan alanların yaklaşık %50'sinde değişik düzeylerde tuzluluk sorunu gözlenmektedir. FAO tarafından hazırlanan raporda (2014), Dünya Toprak Haritası verilerine dayanarak, dünya genelinde 954 milyon hektar tuzdan etkilenmiş ve üretkenliği kısıtlanmış toprak bulunduğu bildirilmektedir. Bu tip sorunlu topraklar; Afrika'da 80.5 milyon, Avrupa'da 50.8 milyon, Avustralya'da 357.3 milyon, Amerika'da 146.9 milyon ve Asya kıtasında 319.3 milyon hektardır. Ülkemizde de sulamanın yanlış yönetimi ve yetersiz drenaj nedeniyle 1.5 milyon hektar alanda tuzluluk sorunu yaşanmaktadır, bu alan diğer sebeplerle birlikte toplamda 2.5 milyon hektarı geçmektedir (Özcan ve ark., 2017). Yeniden oluşabilen ve uzun süreli problemlere neden olan tuzluluk, yıllar içerisinde arazilerin bozulmasına neden olmaktadır. Önlemler alınmadığı takdirde sonuç çölleşmedir. Tuzluluk probleminin bulunduğu alanlarda tuzluluğun giderilmesi son derece zordur. Bu tür alanların ıslah edilmesinde kullanılan klasik yöntemler (yıkama, drenaj, kimyasal ilavesi vb.) günümüzde artan maliyetlere karşılık ekonomik olmaması, uzun süre alması ve yeniden ıslah gerektirecek süreçlerin ortaya çıkması gibi nedenlerle terk edilmektedir (T.C. Tarım ve Orman Bakanlığı, 2018). Tuzluluk dünyanın birçok bölgesindeki tarım alanlarını neredeyse 3000 yıldan bu yana tehdit etmekte ve bu tehdit günümüzde de etkisini arttırmaya devam etmektedir (Pitman ve Lauchli, 2002).

Toprak tuzluluğu bitkilerde büyüme ve gelişmeyi, ürünün nitelik ve niceliğini olumsuz şekilde etkilemektedir (Kalaji ve Pietkiewicz, 1993). Tuz baskısı altındaki topraklarda yetiştirilen bitkiler 2 stres altındadır. Bunlardan birincisi ozmotik stres ikincisi ise iyonik strestir. Ozmotik stres toprak çözeltisindeki tuz konsantrasyonunun miktarına bağlı artmakta ve köklerin su alımını engellemekte, hücre genişlemesine sebep olmaktadır (Munns ve Tester, 2008). İyonik stres ise sürekli sodyum vb. zehir etkisi yapan elementlerin bitkide birikimine neden olmakta ve bunun sonucunda yapraklarda ölümlere, kloroz ve nekroza, hücre metabolizmasında ve fotosentez kapasitesinde düşüşe yol açmaktadır (Yeo ve Flowers, 1986; Zahir ve ark., 2012; Panuccio ve ark., 2014). Tarım topraklarının tuzlanması, toprakların ekonomik üretim alanları dışında kalmasına neden olmaktadır (Yılmaz, 2010). Toprakların hem fiziksel ve kimyasal özellikleri olumsuz etkilenmekte hem de bitkisel üretimde istenilen verimin alınmamaktadır.

Biyokömür gibi kömürleştirilmiş organik materyallerin hem toprak ıslahına hem de toprak çözeltisindeki toksik elementlerin biyokömür değişim komplekslerinde tutularak hareketsiz bırakılmasına yönelik kullanımına odaklanan çok sayıda araştırma mevcuttur (Beesley ve ark., 2011; Uchimiya ve ark., 2010; Zheng ve ark., 2010; Paz-Ferreiro ve ark., 2014; Samsuri ve ark., 2014). İlgili fizyolojik süreçlere ait mekanizmalar tam ve ayrıntılı olarak aydınlatılmamışsa da (Atkinson ve ark., 2010) olumlu etkiler göstermesinin temel sebepleri olarak yüksek spesifik yüzey alanı ve katyon değişim kapasitesi ile mikroporozite özellikleri esas alınabilir (Thies ve Rillig, 2009). Bu özellikler, su ve bitki besin elementi tutumunu artırmaları dışında, ağır metaller (Beesley ve ark., 2011), pestisitler (Kookana ve ark., 2011) ve bunlar gibi toksik özellik gösteren diğer birçok kontaminantın (Rhodes ve ark., 2008; Beesley ve ark., 2011) adsorpsiyonunda da rol oynar. Biyokömürün toprakta uzun süreler boyunca yapısını koruyarak bulunması durumu, çabuk ayrışan birçok organik materyale göre biyoremediasyon açısından önemli avantajlar sağlamaktadır (Bradshaw ve Chadwick, 1980).

Biyokömürün tuzdan etkilenen tarım topraklarını düzenleyici etkisi üzerine görece az sayıda çalışma bulunmaktadır (Li ve ark., 2007; Lehmann ve Joseph, 2009; Elad ve ark., 2010; Akhtar ve ark., 2015; Lashari ve ark., 2014; Vijayasatya ve ark., 2015). Bu anlamda konuya ilişkin



yeni veri üretimi halen önem taşımaktadır. Wang ve Xu (2013) yılında yaptıkları araştırmada biyokömürün farklı tuzlu ve alkali topraklarda bitkilerin çimlenme ve gelişmesine etkilerini araştırmışlardır. Saksı denemesinde 5 farklı tuz içeriğine sahip topraklara 4 farklı dozda biyokömür uygulamışlardır. Biyokömür ilave edilen saksılarda toprak pH'sı artış gösterirken, toprakların çözünebilir tuz içeriği ilave edilen biyokömür dozuna bağlı olarak azalış göstermiştir. Biyokömürün %45 oranında ilave edildiği yüksek tuzlu ve alkali topraklarda buğdayın çimlenmesi %48.9 oranında artış göstermiştir. Akhtar ve arkadaşları (2015) da, biyokömür uygulamasının bitkilerin tuzluluk stresine olan dirençlerini arttırdığını ve tuzun olumsuz etkilerini hafiflettiğini saptamışlardır. Saifullah ve ark. (2018), yaptıkları bir çalışmada biyokömürün toprak tuzluluğunun olumsuz etkilerini önlemedeki etkinliği araştırmış; dünyada 100'den fazla ülkede tuzlu ve alkali toprakların dağılım gösterdiğini belirten araştırmacılar, bu toprakların ıslahında organik ve inorganik maddelerin kullanıldığını rapor etmişlerdir. Liang ve ark. (2021), bu yönde gerçekleştirdikleri bir çalışmada biyokömür uygulamasının toprak kalitesini iyileştirmek için umut verici bir yaklaşım olduğunu ancak iyileştirmede uygulanacak uygun miktarın önemli olduğunu belirtmişlerdir. Tuzlu-alkali toprakların biyokömür ilavesi ile iyileştirilmesi çalışmalarının kapsamlı örneklerinden biri olan çalışma, üç yıllık bir arazi denemesi halinde Sincan'da (Çin) yürütülmüştür. Yapılan çalışmada topraklara 25 t/ha (B25), 30 t/ha (B30) ve seviyesinde biyokömür 100 t/ha (B100) uygulanmıştır. Tuzlu-alkali toprağın fiziksel ve hidrolik özelliklerinin iyileştirilmesi için en ideal biyokömür uygulama miktarı 21,9 t/ha doz önerilmiştir. Kanwal ve arkadaşlarının (2018) yürüttüğü çalışmada biyokömür uygulamalarının tuzlu toprakta buğday üretimi üzerine etkileri incelenmiştir. Tuzluluğu dünyadaki mahsul üretimini etkileyen önemli bir abiyotik stres faktörü olarak ifade eden araştırmacılar, biyokömürü tuzluluğun olumsuz etkilerini azaltabilen aktif karbonlu bir toprak düzenleyici olarak tanımlamışlardır. Araştırmaları, buğday tohumu çimlenmesi ve tuzluluk altındaki büyüme özelliklerinin %1 ve %2 oranında biyokömür uygulaması ile iyileştirilebilme potansiyelini değerlendirmek adına yürütülmüştür; her iki biyokömür uygulaması da tuzluluk koşulları altındaki çimlenme ve büyüme parametrelerini iyileştirmiştir. Bununla birlikte, %2 biyokömür uygulama dozu, %1 dozuna göre daha etkili olmuştur. Lashari ve arkadaşları (2015) da biyokömür ve hayvan gübresi karışımından elde ettikleri kompost uygulaması ile tuzlu topraklarda bitki tuz stresinin azaltılmasına yönelik olarak mısır bitkisi gelişiminde meydana gelen değişimleri incelemişlerdir. Çalışma sonucunda mısır bitkisinin gelişimi, tane verimi ve yaprak alan indeksinde artışlar gözlenirken, yaprak elektrolit sızıntılarında büyük ölçüde azalmalar gözlenmiştir. Yaprak sızıntısının Na ve Cl konsantrasyonları azalırken, N, P, K konsantrasyonları artmış, yaprak biyoaktivitesindeki strese bağlı düşüşte iyileşmeler gözlenmiştir. Destekleyici biçimde, Chaganti ve ark. (2015) tuzlu alkali toprakların iyileştirilmesinde organik materyal kullanımının inorganik materyal kullanımına göre hızla arttığını vurgulamışlardır. Biyokömür, biyokatırlar ve yeşil atıkların kompost olarak bu topraklarda kullanımının laboratuvar koşullarında denendiği çalışmalarında topraklar bir aylık inkübasyon sürecinden sonra kolonlara doldurulmuş, bitkiler orta düzeyde SAR değerine sahip bir su ile sulanmış, bu yolla kolonlar yıkanmıştır. Özellikle biyokömür ve kompost karışımı, bu sulama koşulları altında toprak tuzluluğunda düşüş sağlamıştır. Son yıllarda sunulan derleme ve meta analizlerinde de, kömürleştirilmiş organik materyallerin yüksek adsorbsiyon kapasitesi, tuzluluğun bitki üzerindeki olumsuz etkilerinin giderilmesinde en önemli faktör olarak belirtilmektedir (Vasconcelos, 2020); tuzlu topraklara uygulandığında kompostlanmış/aktive edilmiş biyokömürün, toprak organik madde içeriğini ve katyon değişim kapasitesini artırdığı; değişebilir sodyum (Na) ve toprak pH değerini düşürdüğü bildirilmektedir (Luo ve ark., 2017). Bu çalışmada iki farklı biyokömür çeşidi inert bir ticari torf materyali ile inkübe edilmiş; son



ürünler bir saksı denemesinde kullanılmak üzere topraklara uygulandıktan sonra önce buğday sonra mısır bitkisi sera koşullarında yetiştirilmiştir. Her iki vejetasyon sonrası alınan toprak örnekleri ile toprakların bazı kimyasal özellikleriyle alınabilir makro ve mikro element içerikleri araştırılmış; yetiştirme dönemi sonunda alınan bitki örneklerinin sodyum ve makro/mikro element içerikleri belirlenmiş, biyokütle oluşumları gözlenmiştir.

MATERYAL ve YÖNTEM

Bu çalışmada İzmir'in Selçuk ilçesinde taban suyuna deniz girişimi nedeniyle tuzluluk gösteren kumlu tın bünyeli topraklar örneklenmiş ve bu topraklar gösterdikleri tuzluluk sorunu açısından uygun bulunarak denemede kullanılmıştır. Kullanılan toprağın bazı fiziksel ve kimyasal özellikleri Çizelge 1'de verilmiştir. Tohum olarak Ege Üniversitesi Ziraat Fakültesi Menemen Araştırma ve Uygulama Çiftliği'nden temin edilen makarnalık buğday (*Triticum durum* Desf) ve tanelik mısır (*Zea mays* L.) tohumları kullanılmıştır. Biyokömür materyali olarak da E.Ü.Z.F. Menemen Araştırma Uygulama ve Üretim Çiftliği'ndeki okaliptus ağaçlarına ait budama atıkları ve Ege Üniversitesi Kampüsü çalılıklarına ait yeşil budama atıkları kullanılmıştır. Açıklanacağı şekilde hazırlandıktan sonra inkübe edilen biyokömürlerin özellikleri Çizelge 2'de verilmiştir.

Çizelge 1. Denemede Kullanılan Toprağın Bazı Fiziksel Ve Kimyasal Özellikleri

pH	7.85
EC (1:5 saf H ₂ O) (dS/m)	2.29
% Kum	44.40
% Mil	40.36
% Kil	15.24
Bünye (USDA)	Kumlu tın
Organik Madde %	1.05
Kireç %	5.60
Toplam N %	0.108

Çizelge 2. Denemede Kullanılan Biyokömürlerin Bazı Özellikleri ve Elementel İçerikleri

Parametreler	Yeşil Atık	Okaliptus
pH (1:5 saf su)	9.25	6.65
EC (1:5 saf su) (dS/m)	2.67	5.20
Org-C (%)	53.07	50.32
Org. Mad. (%)	91.5	86.75
N (%)	0.64	0.81
P (mg/kg)	704.4	476.5
K (mg/kg)	0.61	0.64
Na (mg/kg)	642	450
Ca (mg/kg)	2.97	4.04
Mg (mg/kg)	1836.4	2445.2
Fe (mg/kg)	-	189.75
Mn (mg/kg)	-	42.63
Cu (mg/kg)	-	7.58
Zn (mg/kg)	-	73.25

Biyokömürler parçalanıp öğütülmüş ve 1 mm'lik elekten elenmiştir. Elek altında kalan biyokömürler olgunlaştırma işlemi için inkübatör kaplarına yerleştirilmiştir; biyokömürlerin inkübasyonu genel kullanıma yönelik bir ticari torf ürünü ile karıştırılarak gerçekleştirilmiştir (1:1). Bu süreçte materyallerin su içeriği, biyokömür materyallerinin su tutma kapasitesinin %60'ı, torf materyalinin ise su tutma kapasitesinin %70'i oranında tutulmuştur (Brewer, 2012). İnkübatöre yerleştirilen materyaller ilk bir hafta 40 °C'de daha sonra 60 °C sıcaklıkta olmak üzere toplam 30 gün süre ile inkübe edilmiştir. 30 gün boyunca her gün materyallerin ağırlıkları



kontrol edilerek 7 günde bir pH ve EC değerleri kayıt altına alınmıştır. 30 gün sonunda inkübatörden çıkarılan biyokömür ve torf materyalleri hava kurusu halde iken 0, 10, 20 ve 40 t/ha dozunda olacak şekilde topraklara uygulanmış ve 2 kg'lık saksılara aktarılmıştır. Toprak analiz sonuçlarına göre azot (N), fosfor (P) ve potasyum (K) gübrelemesi gerçekleştirilmiştir. Deneme, saksı denemesi olarak E.Ü.Z.F. Toprak Bilimi ve Bitki Besleme Bölümü seralarında, bitki ve toprak analizleri de aynı birimin laboratuvarlarında yürütülmüştür. Dozları 50 cm toprak derinliği üzerinden hesaplanan deneme, 4 tekerrürlü olacak şekilde kurulmuş ve deneme konuları aşağıda verildiği şekilde toplam 28 saksıda yürütülmüştür.

- 1- Kontrol
- 2- 10 t/ha okaliptüs biyokömürü
- 3- 20 t/ha okaliptüs biyokömürü
- 4- 40 t/ha okaliptüs biyokömürü
- 5- 10 t/ha yeşil atık biyokömürü
- 6- 20 t/ha yeşil atık biyokömürü
- 7- 40 t/ha yeşil atık biyokömürü

Biyokömür materyalleri parçalanma işleminden sonra 1 mm'lik elekten elenerek analize hazır hale getirilmiştir. pH ve elektriksel iletkenlik analizleri, 1/5 oranında biyokömür ve saf su solüsyonunun 1 saat mekanik çalkalayıcıda çalkalanması 1 saat bekletilmesinden sonra, standart pH-metre ve EC-metre ile değer okumaları şeklinde (Rayment ve Higgonson, 1992), organik C içeriği modifiye edilmiş Walkley-Black yöntemiyle (Nelson ve Sommers, 1982), toplam N içeriği modifiye Makro Kjeldahl yöntemine göre belirlenmiştir (Bremmer ve Mulvaney, 1982). Biyokömürlerin toplam Na, kalsiyum (Ca), potasyum, magnezyum (Mg) içerikleri, 2 g biyokömür örneğinin 500-550 °C'de kuru yakımı yapıldıktan sonra, 1 N HCl solüsyonu içerisinde çözülen örneklerin Na, Ca, K değerlerinin fleymfotometrede, Mg değerlerinin ise atomik absorpsiyon spektrofotometrede (AAS) okunması ile belirlenmiştir (Kacar ve İnal, 2009). Biyokömürlerin toplam demir (Fe), bakır (Cu), mangan (Mn) ve çinko (Zn) değerleri aynı işlemler sonucu elde edilen ekstraktların AAS'de okunması ile belirlenmiştir (Lindsay ve Norvell, 1978). Biyokömürlerin toplam P içeriği, örneklerin kuru yakılması sonrası vanadomolibdofosforik asit sarı renk yöntemiyle belirlenmiştir (Barton, 1948; Kitson ve Mellon, 1944).

Toprak örneklerinin pH ve elektriksel iletkenlik analizleri, 1/5 oranında biyokömür ve saf su solüsyonunun 1 saat mekanik çalkalayıcıda çalkalanması ve 1 saat bekletilmesinden sonra, standart pH-metre ve EC - metre ile değer okumaları şeklinde (Rayment ve Higgonson, 1992). Toplam azot içeriği, modifiye Makro Kjeldahl yöntemine göre (Bremmer ve Mulvaney, 1982), organik madde içeriği, modifiye Walkley - Black yöntemine göre tespit edilmiştir (Nelson ve Sommers, 1982). Toprakların alınabilir Na, K, Ca, Mg değerleri, pH değeri 7.0 olan 1 N NH₄OAc ile çalkalanarak elde edilen süzüklerde Na, K, Ca değerlerini fleymfotometrede, Mg değerlerinin ise atomik absorpsiyon spektrofotometresinde (AAS) ölçülmesiyle belirlenmiştir (Pratt, 1965). Toprak örneklerinin alınabilir fosfor miktarları kolorimetrik olarak belirlenmiştir (Olsen ve Sommers, 1982). Toprakların alınabilir demir (Fe), bakır (Cu), çinko (Zn), mangan (Mn) içerikleri DTPA+CaCl₂+TEA çözeltisiyle çalkalanıp süzülmesi sonucu atomik absorpsiyon spektrofotometrede okunarak belirlenmiştir (Lindsay ve Norvell, 1978). Bitkiler 40. gün bitiminde hasat edilerek morfolojik olarak incelenmiştir (biyokütle ağırlığı ve boylanma). Bitkilerin toplam Na, Ca, K, Mg, Fe, Cu, Mn ve Zn içerikleri, 0.2-0.3 g buğday ve 0.4-0.5 g mısır bitkisi örneğinin 550 °C'de kuru yakılması yapıldıktan sonra belirlenmiştir. 1 N HCl solüsyonu içerisinde çözülen örneklerin Na, Ca, K değerleri fleymfotometrede, Mg ve mikro element değerleri ise AAS'de ölçülmüştür (Kacar, 2009). Çalışmada elde edilen veriler



TARİST programı ile değerlendirilmiştir. Uygulamalar arasındaki farkı irdelemek için %5 düzeyinde asgari önemli fark (LSD) çoklu karşılaştırma testi kullanılmıştır (Açıkgöz, 1993).

BULGULAR ve TARTIŞMA

Biyokömür Uygulamalarının Toprak Özellikleri Üzerindeki Etkileri

Denemede farklı dozlarda uygulanan biyokömür materyalinin toprakların bazı kimyasal özellikleri ile bitki verimi üzerine olan etkileri araştırılmıştır; tuzlu toprakların bu özelliklerindeki değişimler Çizelge 3'te sunulmuştur.

Çizelge 3. Biyokömür Uygulamalarının Tuzlu Toprakların Bazı Kimyasal Özelliklerine Etkisi

	<i>pH</i> 1. Dönem Buğday	<i>pH</i> 2. Dönem Mısır	<i>EC</i> 1. Dönem Buğday	<i>EC**</i> 2. Dönem Mısır	<i>Org. Madde</i> 1. Dönem Buğday	<i>Org. Madde</i> 2. Dönem Mısır
	(dS/m)				(%)	
0 t/ha Okaliptüs	7.89 a*	7.67 b	2.02	2.39 c	2.24 c	2.39 c
10 t/ha Okaliptüs	7.85	7.78 a	2.30	2.70 b	2.34 c	3.10 bc
20 t/ha Okaliptüs	7.85	7.74 ab	2.63 a	3.11 a	3.13 b	3.82 ab
40 t/ha Okaliptüs	7.86	7.70 a	2.44	2.78 b	3.68 a	4.42 a
0 t/ha Yeşil Atık	7.89 a	7.67	2.02 c	2.39 b	2.24 c	2.39 b
10 t/ha Yeşil Atık	7.73 bc	7.73 a	2.37 b	2.52 b	2.67 b	3.07 ab
20 t/ha Yeşil Atık	7.68 c	7.71	2.41 b	2.55 b	3.06 a	3.61 a
40 t/ha Yeşil Atık	7.75 b	7.73	2.80 a	3.13 a	3.01 a	3.70 a

*: Dikey yöndeki küçük harfler dönem ve biyokömür çeşidi özelinde istatistiki farkları yansıtmaktadır ($p < .05$, LSD). EC: Elektriksel iletkenlik

Okaliptüs biyokömürü uygulamaları ilk vejetasyon sonunda pH ve EC değerlerinde önemli bir değişime sebep olmamıştır. İkinci dönemde ise tüm okaliptüs biyokömürü uygulamaları pH ve EC değerlerinde artışa sebep olmuştur. Yeşil atık biyokömürü uygulamaları ise ilk vejetasyon sonunda kontrole göre pH değerlerinde düşüşe sebep olmuş, ikinci vejetasyon sonunda ise tüm topraklar benzer pH seviyesine ulaşmıştır. Yeşil atık uygulamalarıyla, ilk yetiştirme döneminde kontrol topraklarına göre daha yüksek elektriksel iletkenlik gösteren topraklar ortaya çıkmış, buna rağmen ikinci dönemde yalnızca 40 t/ha biyokömür uygulaması ile istatistiki önemde bir artış gözlenmiştir. Toprakların organik madde içerikleri her iki dönem sonunda artan dozda biyokömür uygulamalarıyla artış göstermiştir. Her uygulama için dönemler arasında da artış gösteren organik madde içeriğinin, biyokömürün ilerleyen ayrışması sonucu hızlı dikromat oksidasyonuna dayanan analiz yöntemiyle belirlenebilen karbon miktarındaki artıştan kaynaklandığı düşünülmektedir.

Biyokömür uygulamalarının toprakların alınabilir sodyum ve makro besin elementi içeriklerine etkileri Çizelge 4'te sunulmuştur. Buğday vejetasyonu sonunda, biyokömür uygulanmış toprakların toplam N içerikleri biyokömür dozu ve çeşidine bağlı önemli bir değişim göstermemiştir. Takip eden mısır vejetasyonu sonrasında ise okaliptüs biyokömürü uygulamaları toprakların azot içeriklerinde doğrusal bir artışa sebep olmuştur. Okaliptüs biyokömürü uygulamaları ilk ve ikinci dönemde toprakların alınabilir fosfor içerikleri üzerine istatistiki önemde bir etki göstermemiştir. Ancak yeşil atık biyokömürü uygulamaları ile ilk dönem sonunda alınabilir fosfor içeriğinde doğrusal bir artışın söz konusu olduğu tespit edilmiştir. Benzer bir artış ikinci dönem topraklarının özellikle 10 t/ha ile 20 t/ha yeşil atık biyokömürü uygulamaları sonucu gözlenmiştir.



Toprakların alınabilir potasyum içeriklerindeki değişimler incelendiğinde, buğday üretimi yapılan topraklarda hasat sonrası alınan toprak örneklerinde, okaliptüs ve yeşil atık biyokömür uygulamalarının artan dozları ile birlikte toprağın alınabilir potasyum içeriklerinin de doğrusal bir artış eğiliminde olduğu tespit edilmiştir. Burada önemli etkenlerden biri de biyokömürün grafit yapısı üzerinde taşıdığı çözünebilir tuzların toprak çözeltisine katkısı olabilir, takip eden ikinci dönem sonunda alınabilir K değerleri ancak okaliptüs biyokömürü uygulaması altında bir artış gözlenmiştir. Toprakların alınabilir kalsiyum ve magnezyum içerikleri her iki dönem için de istatistiksel olarak önemli bir değişim göstermemiştir.

Çizelge 4. Biyokömür Uygulamalarının Tuzlu Toprakların Alınabilir Na, Ca, K, Mg ve P ile Toplam N İçerikleri Üzerine Etkileri

	Na-1*	Na-2	Ca-1	Ca-2	K-1	K-2	Mg-1	Mg-2	P-1	P-2	N-1	N-2
	(mg/kg)										(%)	
0 t/ha Okaliptüs	4511	4525 b	5350 a	5636 a	402 c	371 b	390	412 a	153 a	198 a	0.116	0.114 b
10 t/ha Okaliptüs	4431	5002 a	4913	5996 a	429 bc	381 b	370	381	153	190	0.116	0.115 ab
20 t/ha Okaliptüs	4726	4968 ab	4978	5983 a	453 b	399 ab	380	404	145	185	0.124	0.114 b
40 t/ha Okaliptüs	4746 a**	3229 c	5300	3401 b	502 a	455 a	404 a	380	149	179	0.125 a	0.123 a
0 t/ha Yeşil Atık	4511 ab	4525 a	5350 a	5636 a	402 c	371 a	390 a	412 a	153 c	185 b	0.121 a	0.114
10 t/ha Yeşil Atık	4256 b	2793 c	5151 a	3500 bc	449 b	371 a	432 a	366 a	151 c	191 ab	0.120	0.122 a
20 t/ha Yeşil Atık	4438 b	2873 bc	5561 a	3277 c	478 a	371 a	434 a	365 a	171 b	219 a	0.119	0.118
40 t/ha Yeşil Atık	4968 a	3289 b	5487 a	3873 b	492 a	400 a	434 a	419 a	186 a	194 ab	0.116	0.116

*: 1 ve 2 rakamları, birinci ve ikinci dönem sonunda alınan toprak örneklerini temsil etmektedir. **: Dikey yöndeki küçük harfler dönem ve biyokömür çeşidi özelinde istatistiki farkları yansıtmaktadır ($p < .05$, LSD).

Buğday vejetasyonu sonrası toprakların alınabilir sodyum içerikleri, okaliptüs biyokömürü uygulamaları ile istatistiki önemde değişim göstermemiştir. Yeşil atık biyokömürü uygulanan topraklarda ise en yüksek alınabilir sodyum içeriği 40 t/ha uygulaması ve kontrol topraklarında gözlenirken, 10 ve 20 t/ha uygulamaları altındaki topraklar en düşük alınabilir sodyum içeriğini göstermiştir. Benzer şekilde, Akhtar ve ark. (2015) farklı tuzluluk düzeylerine odaklandıkları çalışmalarında, uyguladıkları biyokömür materyalinin her dozda topraktaki değişebilir Na elementini arttırdığını, en fazla etkinin ise en yüksek dozda tuz içeren koşullarda ortaya çıktığını belirtmişlerdir. Bu anlamda biyokömürün etkilerinin zamansal düzlemde izlenmesi önem kazanmaktadır, zira bu çalışmada ikinci dönem mısır vejetasyonu sonrası, toprakların alınabilir sodyum içeriklerinde belirgin ve önemli düşüşler gözlenmiştir. Yeşil atık biyokömürü uygulamaları kontrole göre bütün dozları ile alınabilir sodyum içeriğini düşürmüştür; okaliptüs biyokömürü uygulaması altındaki topraklarda ise en düşük alınabilir sodyum içeriği 40 t/ha dozunda gözlenmiştir. Bu düşüşler -bahsedilecek üzere- sodyum alımına dair bitki verileriyle de örtüşmektedir. Birkaç çalışma biyokömürün değişebilir Na üzerindeki etkilerini SAR ve elektriksel iletkenlik değerlerinin fizikokimyasal (Gul ve ark., 2015) ve biyolojik etkileşimlerle (Hammer ve ark., 2015) iyileştirilmesine bağlamaktadır. Bu iyileştirmelerin biyokömür çeşidi ile doğrudan ilgili olduğu da önemle bildirilmektedir (Liu ve ark., 2013).

Biyokömür uygulamalarının tuzlu toprakların mikro element içeriğine etkileri Çizelge 5'te verilmiştir.



Çizelge 5. Biyokömür Uygulamalarının Toprağın DTPA ile Ekstrakte Edilebilir Mikro Element (Fe, Mn, Cu, Zn) İçerikleri Üzerine Etkileri

	<i>Fe-1*</i>	<i>Fe-2</i>	<i>Mn-1</i>	<i>Mn-2</i>	<i>Cu-1</i>	<i>Cu-2</i>	<i>Zn-1</i>	<i>Zn-2</i>
	<i>mg/kg</i>							
<i>0 t/ha Okaliptüs</i>	3.35 a**	4.93 a	11.95	11.03 ab	0.68 b	0.88 ab	1.91	2.58 a
<i>10 t/ha Okaliptüs</i>	3.23	4.70 a	12.23	12.22 a	0.69 b	0.9 a	2.01	2.63 a
<i>20 t/ha Okaliptüs</i>	3.3	5.24 a	13.15 a	12.61 a	0.75 a	0.9 a	2.12 a	2.57 a
<i>40 t/ha Okaliptüs</i>	3.13	3.74 b	11.44	9.99 b	0.68 b	0.76 b	2.05	2.04 b
<i>0 t/ha Yeşil Atık</i>	3.35 a	4.93 a	11.95 b	11.03 b	0.68 b	0.88 a	1.91 b	2.58 a
<i>10 t/ha Yeşil Atık</i>	3.4 a	4.28 ab	13.99 a	12.96 ab	0.73 a	0.79 ab	2.16 a	2.2 b
<i>20 t/ha Yeşil Atık</i>	3.15 ab	3.99 b	15.02 a	13.49 a	0.72 ab	0.77 ab	2.08 ab	2.01 bc
<i>40 t/ha Yeşil Atık</i>	2.975 b	3.87 b	15.76 a	11.79 ab	0.74 a	0.68 b	2.12 ab	1.89 c

*: 1 ve 2 rakamları, birinci ve ikinci dönem sonunda alınan toprak örneklerini temsil etmektedir. **: Dikey yöndeki küçük harfler dönem ve biyokömür çeşidi özelinde istatistiki farkları yansıtmaktadır ($p < .05$, LSD).

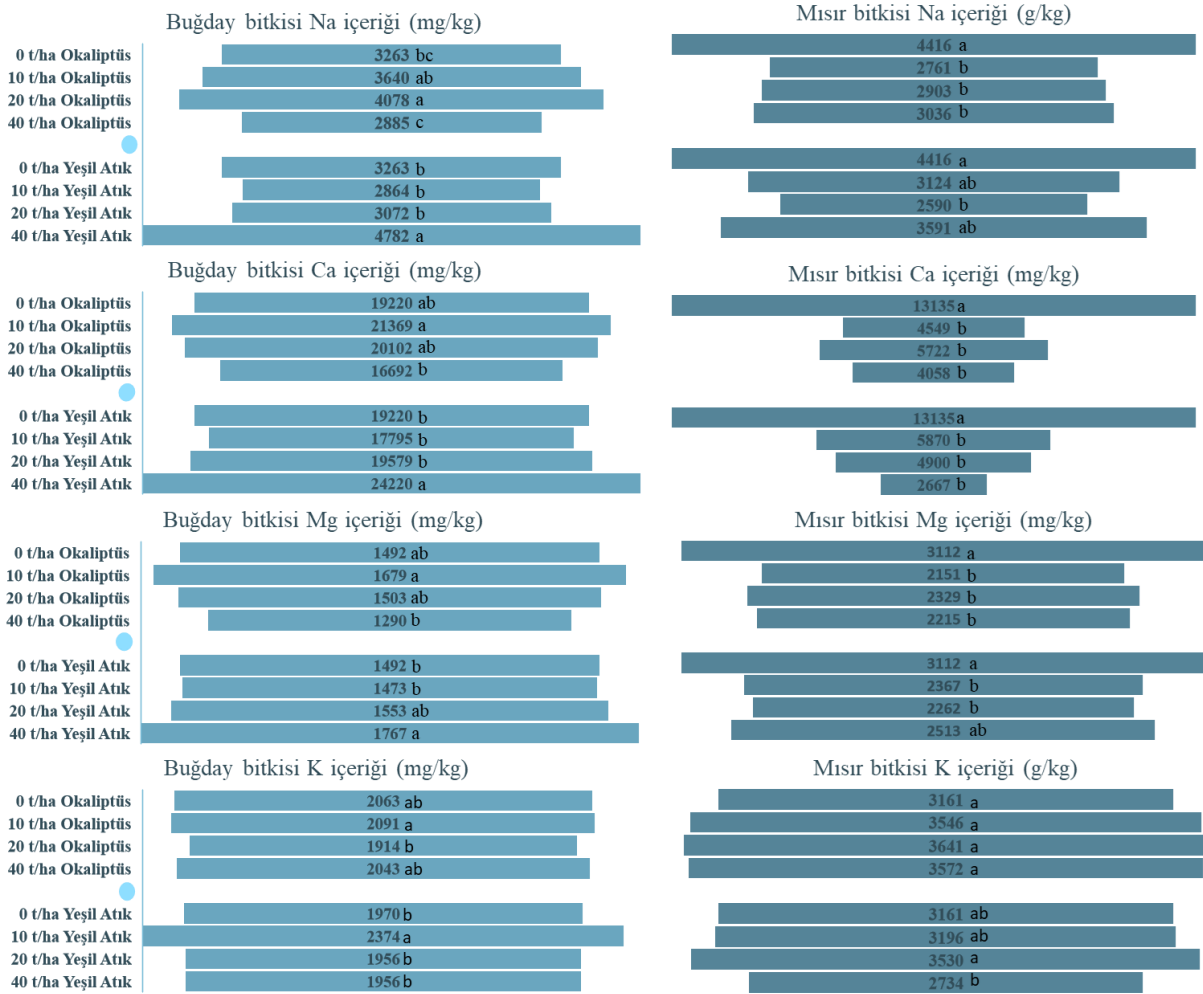
İlk vejetasyon sonunda, okaliptüs biyokömürü uygulamaları ile toprakların alınabilir demir içeriklerinde kontrole göre önemli bir değişim gözlenmemişken, 20 ve 40 t/ha yeşil atık biyokömürü uygulamaları alınabilir demir içeriğinde düşüşe sebep olmuştur. İkinci vejetasyon sonunda ise her iki biyokömür tipi için de uygulama dozu yükseldikçe alınabilir demir içeriğinde düşüşler gözlenmiştir.

Toprakların alınabilir mangan içeriğinin ilk vejetasyon sonunda biyokömür uygulamalarından etkilenmediği gözlenmiştir. İkinci dönem sonunda ise mangan içeriklerinin farklı bir düzen izlediği ve her iki tip biyokömür için de 20 t/ha dozunda en yüksek seviyeye ulaştığı belirlenmiştir (40 t/ha dozundaysa düşüşler tekrar etmiştir). İlk vejetasyon sonunda toprakların alınabilir bakır içerikleri biyokömür uygulamalarından önemli düzeyde etkilenmişken, her iki tip biyokömür için de en düşük alınabilir bakır içeriği kontrol topraklarında tespit edilmiştir. Buna rağmen ikinci dönem sonunda özellikle 40 t/ha biyokömür uygulamasının alınabilir bakır içeriğini olumsuz etkilediği belirlenmiştir. Toprakların alınabilir çinko içerikleri okaliptüs uygulamaları altında ilk vejetasyon boyu bir değişim göstermezken, ikinci dönem sonunda yine 40 t/ha uygulamasının olumsuz etkileri gözlenmiştir. Yeşil atık biyokömürü ise ilk dönem sonuçlarına göre artan dozda uygulamalar ile yine artan konsantrasyonlarda bakır gözlenmesine yol açarken, ikinci dönem sonunda tam tersi bir durum gözlenmiştir.

Özetle, özellikle ikinci dönem sonunda ve 40 t/ha dozu altında mikroelement alınabilirliği kısıtlanmıştır. Demir içinse, sodyum ve ekstrakte edilebilen makro besin elementleri üzerinde de daha etkili olduğu gözlenen yeşil atık biyokömürü (Çizelge 4), her iki dönemde sonunda da doza bağlı düşüslere sebep olmuştur. Shaaban ve arkadaşları (2018) da derlemelerinde özellikle kumlu ve kumlu tın toprakların biyokömür uygulamaları sonrası mikro besin elementleri açısından olumsuz etkilere açık olabileceğini belirtmişlerdir.



Biyokömür Uygulamalarının Bitki Üzerindeki Etkileri



Şekil 1. Bitkilerin toplam Na, Ca, Mg ve K değerleri (Dikey yöndeki küçük harfler bitki ve biyokömür çeşidi özelinde istatistiki farkları yansıtmaktadır ($p < .05$, LSD))

Biyokömür uygulamalarının bitkilerin toplam Na, Ca ve Mg içerikleri üzerine etkileri Şekil 1’de sunulmuştur. İlk vejetasyon sonunda buğday bitkilerine ait sodyum içerikleri 10 ve 20 t/ha okaliptüs biyokömürü uygulaması sonucu kontrole göre artış göstermiş, 40 t/ha dozu için ise en düşük seviyede gözlenmiştir. Yeşil atık biyokömürü uygulamaları altındaki bitkilerin sodyum içerikleri ilk dönemde 10 ve 20 t/ha dozunda önemli bir değişime sebep olmazken, 40 t/ha dozunda en yüksek seviyede gözlenmiştir. İzleyen ve doğal olarak daha yüksek sodyum absorbe eden mısır vejetasyonunda ise her çeşit ve doz biyokömür uygulaması altında daha düşük sodyum absorpsiyonu gerçekleştirmiştir. Bu durum daha önce bahsedilen toprak verileriyle de (Çizelge 4) örtüşmektedir.

Buğday bitkilerine ait kalsiyum içeriklerinin 40 t/ha okaliptüs biyokömürü uygulaması altında en düşük seviyede olduğu gözlenmiştir. Yeşil atık biyokömürü uygulamaları altındaki bitkilerin kalsiyum içerikleri ise 10 ve 20 t/ha dozunda önemli bir değişime sebep olmazken, 40 t/ha dozunda en yüksek seviyede gözlenmiştir. İzleyen mısır vejetasyonu ise daha anlamlı bir düzen ortaya koymuş ve her biyokömür çeşidi/dozu için sodyum içeriğinde olduğu gibi bitkilerin Ca alımında da bir düşüşe neden olmuştur. Hem buğday bitkisi hem de takip eden mısır bitkisi Mg içerikleri bakımından, Ca içerikleri ile birebir aynı düzeni sergilemişlerdir. Bitkilerin potasyum



içerikleri, kayda değer en önemli değişimi 40 t/ha yeşil atık biyokömürü uygulaması altında yetiştirilen mısır bitkisi içeriğindeki bir düşüşle göstermiştir.

Bitkilerin K/Na değerleri ozmolitlerin seçilimi açısından değerlendirildiğinde, özellikle mısır bitkisi bakımından önemli ve anlamlı artışlar sergilemiştir (Çizelge 6). Yüksek kalsiyum içerikli deneme topraklarının Ca/Na değerleri ise kalsiyumun biyokömürler tarafından görece yüksek adsorpsiyonu/bitkilerin kısıtlanan alım gücü (Çizelge 4 ve Şekil 1) sebebiyle benzer bir düzen izlememiştir.

Çizelge 6. Biyokömür Uygulamalarının Bitkilerin K/Na ve Ca/Na Değerleri Üzerine Etkileri

	<i>K/Na (B*)</i>	<i>Ca/Na (B)</i>	<i>K/Na (M)</i>	<i>Ca/Na (M)</i>
<i>0 t/ha Okaliptüs</i>	0.63 a**	5.88 a	0.78 b	0.28 a
<i>10 t/ha Okaliptüs</i>	0.59 ab	5.87 a	1.34 a	0.16 b
<i>20 t/ha Okaliptüs</i>	0.48 b	4.94 b	1.28 a	0.2 ab
<i>40 t/ha Okaliptüs</i>	0.71 a	5.8 a	1.18 ab	0.13 b
<i>0 t/ha Yeşil Atık</i>	0.60 b	5.88 a	0.78 b	0.28 a
<i>10 t/ha Yeşil Atık</i>	0.83 a	6.24 a	1.1 ab	0.18 ab
<i>20 t/ha Yeşil Atık</i>	0.68 b	6.49 a	1.41 a	0.18 ab
<i>40 t/ha Yeşil Atık</i>	0.41 c	5.05 b	0.85 b	0.09 b

*: *B* harfi ilk ürün buğday bitkisini, *M* harfi ise ikinci ürün mısır bitkisini temsil etmektedir. **: Dikey yöndeki küçük harfler bitki ve biyokömür çeşidi özelinde istatistiki farkları yansıtmaktadır ($p < .05$, LSD).

Tuz içeriği yüksek topraklarda genellikle fazla düzeyde kalsiyum elementi bulunmasına rağmen sodyum elementinin daha yoğun olması nedeniyle bitkilerin dokularında genellikle Ca element noksanlığının görülmesi olağandır. Genel bir kaide olarak tuzlu toprak koşullarında yetiştirilen ancak tuzcul olmayan bitkilerin dokularında K/Na oranı düşüktür. Toprak tuz içeriği arttıkça yine bitki dokularında bulunan K/Na oranı hızla azalırken toprak ekstraktında ise Ca/Na oranı (özellikle >6 dS/m) hızla artış sürecine girer. Ca/Na oranı ise yine tuzlu toprak koşullarında yetiştirilen bitki dokularında azalış eğilimindedir (Naidu ve Rengasamy, 1993). Bu bağlamda Lashari ve arkadaşları da yürüttükleri çalışmada, mısır bitkisinde yaprak ve gövde için K/Na oranlarının biyokömür uygulamalarıyla arttığı ve metabolizmada K kullanımının iyileştiğini bildirmektedirler (2015). Lin ve arkadaşları (2015) ise benzer topraklarda biyokömür uygulamalarıyla artan değişebilir K değerlerinin altını çizmişlerdir.

Biyokömür uygulamalarının bitkilerin toplam demir, bakır, çinko ve mangan içerikleri üzerine etkileri Çizelge 7'de sunulmuştur. Uygulamaların buğday bitkisinin Fe alımı üzerine etkileri incelendiğinde okaliptüs biyokömürü uygulama dozları arttıkça Fe alımının azaldığı saptanmıştır. Mısır bitkisi için ise her iki çeşit biyokömür uygulaması sonucunda da kontrole göre daha düşük gözlenen demir içerikleri, istatistiki anlamda önem göstermemiştir.

Mangan içerikleri bakımından, her iki biyokömür çeşidi uygulaması da buğday bitkisi için anlamlı ve önemli bir düşüşe sebep olmuştur. Mısır bitkileri de biyokömür uygulamaları altında, -demir içerikleri için geçerli olduğu gibi- kontrole göre daha düşük seviyede gözlenen mangan içerikleri sergilemiş fakat bu farklılıklar istatistiki olarak anlamlı bulunmamıştır. Bakır içerikleri de her iki bitkide de kontrol gruplarında en yüksek seviyede gözlenmiştir. Bitkilerin çinko alımı ise, okaliptüs biyokömürü uygulaması altındaki buğday bitkileri hariç olmak üzere, tüm diğer senaryolar için istatistiki anlamda önemli düşüşler sergilemiştir. Bitki mikroelement



içeriklerindeki gözlenen düşüşler, bu elementlerin topraktaki alınabilir formlarının gösterdiği düşüşlerle örtüşmektedir (Çizelge 5).

Çizelge 7. Biyokömür Uygulamalarının Bitkilerin Toplam Mikro Element İçerikleri Üzerine Etkileri

	<i>Fe-B*</i>	<i>Fe-M</i>	<i>Mn-B</i>	<i>Mn-M</i>	<i>Cu-B</i>	<i>Cu-M</i>	<i>Zn-B</i>	<i>Zn-M</i>
	<i>mg/kg</i>							
<i>0 t/ha Okaliptüs</i>	128.9 a**	70.1 a	51.7 a	61.9 a	5.484 a	9.221 a	28.9 a	26.4 a
<i>10 t/ha Okaliptüs</i>	111.7 ab	42.7 a	51.8 a	48.0 a	5.232 a	4.513 a	30.3 a	15.5 b
<i>20 t/ha Okaliptüs</i>	104 ab	67.4 a	43.0 ab	59.0 a	5.433 a	6.493 a	31.0 a	18.6 b
<i>40 t/ha Okaliptüs</i>	52.4 b	57.2 a	39.4 b	59.1 a	5.328 a	4.893 a	27.4 a	19.6 b
<i>0 t/ha Yeşil Atık</i>	128.9 a	70.1 a	51.7 a	61.9 a	5.484 a	9.221 a	28.9 a	26.4 a
<i>10 t/ha Yeşil Atık</i>	76.9 a	60.5 a	38.9 b	54.2 a	4.478 a	5.534 a	23.8 a	13.9 b
<i>20 t/ha Yeşil Atık</i>	111.3 a	51.9 a	38.9 b	49.8 a	3.722 a	4.756 a	21.7 ab	17.6 b
<i>40 t/ha Yeşil Atık</i>	59.2 a	51.9 a	41.5 b	49.5 a	3.855 a	7.567 a	6.9 b	14.6 b

*: *B* harfi ilk ürün buğday bitkisini, *M* harfi ise ikinci ürün mısır bitkisini temsil etmektedir. **: Dikey yöndeki küçük harfler dönem ve biyokömür çeşidi özelinde istatistiki farkları yansıtmaktadır ($p < .05$, LSD).

Buğday yetiştirme döneminde, toprak EC değerleri ve bitkilerin sodyum içerikleri korelasyon göstermektedir (sırasıyla $r = -.581$, $r = .471$; $p < .01$; Çizelge 8). Bu dönemde, ikinci dönemin aksine toprak EC değerleri de Na ile korelatif bir ilişki içerisindedir ($r = .521$, $p < .01$); tuzlu topraklardan beklenen bu korelasyonlar ikinci vejetasyon sonunda ortadan kalkmıştır. Buğday bitkileri kısa süre içerisinde canlılığını yitirmiş, Mısır bitkisinin yetiştirildiği ikinci dönemde ise tüm uygulamalar için bitki boyu ve biyokütlelerinde önemli artışlar meydana gelmiştir (Çizelge 9); Kontrol uygulamasına ait tekerrürlerin birçoğu biyokütle üretiminde oldukça başarısız olmuştur. İkinci vejetasyon sonunda, toprakların tuzluluk yaratma potansiyeli yüksek olan Na, Ca, K ve Mg gibi alınabilir katyon içerikleri ve toprak elektriksel iletkenlik değerleri arasında gözlenen ilişkisizliğin veya negatif korelasyon biyokömürün toprak çözeltisi içerisinde artan etkinliğiyle ilişkili olabilir. Buğday bitkisi biyokütle oluşumu ve toprak Na değerlerinin gösterdiği negatif korelasyonun, takip eden mısır vejetasyonu sonunda ortadan kalkması da (toprak ve bitki verileriyle de örtüştüğü üzere) yine biyokömürün zamanla artan etkinliğinin bir sonucu olabilir.



Çizelge 8. Bitki ve Toprak Özelliklerine İlişkin Bazı Korelatif Veriler (*r* Değerleri)

	<i>pH</i>	<i>EC</i>	<i>Alınabilir Na</i>	<i>Alınabilir Ca</i>	<i>Alınabilir K</i>	<i>Alınabilir Mg</i>
<i>Buğday Na</i>	0.041ns	0.521**	0.471**	-0.140ns	0.129ns	-0.035ns
<i>Buğday K</i>	-0.158ns	-0.078ns	-0.223ns	-0.105ns	-0.025ns	0.081ns
<i>Buğday Ca</i>	-0.062ns	0.375*	0.454**	-0.028ns	0.077ns	-0.008ns
<i>Buğday Mg</i>	-0.184ns	0.334ns	0.341ns	0.137ns	-0.008ns	-0.021ns
<i>Buğday Yaş Ağırlık</i>	0.441*	-0.581**	-0.322ns	-0.036ns	-0.376*	-0.242ns
	<i>pH</i>	<i>EC</i>	<i>Alınabilir Na</i>	<i>Alınabilir Ca</i>	<i>Alınabilir K</i>	<i>Alınabilir Mg</i>
<i>Mısır Na</i>	-0.370*	-0.211ns	0.238ns	0.302ns	-0.092ns	0.359*
<i>Mısır K</i>	0.002ns	-0.018ns	0.054ns	-0.002ns	-0.111ns	-0.414*
<i>Mısır Ca</i>	-0.438*	-0.457**	0.360*	0.451**	-0.105ns	0.319ns
<i>Mısır Mg</i>	-0.385*	-0.272ns	0.251ns	0.334ns	-0.015ns	0.363*
<i>Mısır Yaş Ağırlık</i>	0.439*	0.128ns	-0.233ns	-0.241ns	-0.211ns	-0.328ns

*: $p < 0.05$; **: $p < 0.01$

Çizelge 9. Biyokömür Uygulamaları ile Bitkilerin Boylanma ve Biyokütle Oluşumunda Gözlenen Değişimler

	<i>Biyokütle- Buğday (g)</i>	<i>Biyokütle- Mısır (g)</i>	<i>Bitki Boyu- Buğday (cm)</i>	<i>Bitki Boyu- Mısır (cm)</i>
<i>0 t/ha Okalipütüs</i>	2.06	1.193 b	-	19.44 d
<i>10 t/ha Okalipütüs</i>	2.14 a**	19.37 a	-	31.87 a
<i>20 t/ha Okalipütüs</i>	1.60	7.55 b	-	22.14 c
<i>40 t/ha Okalipütüs</i>	2.04	9.61 b	-	22.85 b
<i>0 t/ha Yeşil Atık</i>	2.06 a	1.193 b	-	19.44 d
<i>10 t/ha Yeşil Atık</i>	1.33 b	13.78 a	-	30.71 b
<i>20 t/ha Yeşil Atık</i>	1.62 ab	14.85 a	-	34.02 a
<i>40 t/ha Yeşil Atık</i>	0.55 c	11.59 a	-	28.87 c

*: Dikey yöndeki küçük harfler dönem ve biyokömür çeşidi özelinde istatistiksel farkları yansıtmaktadır ($p < 0.05$, LSD).

Bu çalışmada biyokömür uygulamaları sonucu özellikle mısır bitkisi verilerinde gözlenen biyokütle artışı, büyüklüğü bakımından Luo ve arkadaşlarının (2017) Sarı Nehir Deltası'nda (Çin) tuzdan etkilenmiş alanların topraklarıyla yürüttükleri çalışma ile benzeşmektedir. Çalışmalarında tuz toleransı bu çalışmada kullanılan bitkilerden daha yüksek olan sesbanya ile ebegümecei yetiştirmişler ve %1,5 biyokömür uygulaması sonucu sesbanya için %309, ebegümecei için ise %72.9 biyokütle artışı gözlemlenmiştir. Giriş kısmında değinilen çalışmalarda elde edilen, görece daha düşük biyokütle artışları da yine destekleyici veriler olarak incelenebilir.



SONUÇ

Ege Üniversitesi Ziraat Fakültesi Toprak Bilimi ve Bitki Besleme Bölümü seralarında gerçekleştirilen bu çalışmada, yüksek tuz içeren topraklarda (1:5 sulu çözeltilerde 2.69 dS/m) saf su ile sulama yapılarak önce buğday sonra mısır bitkileri yetiştirilmiştir. Çalışmada topraklara uygulanan farklı biyokömür çeşidi ve dozlarıyla ile tuzluluğun negatif etkilerinin bitkisel üretime olan etkilerinin azaltılması amaçlanmıştır. Çalışmanın bir başka amacı da doğal olarak toprak koşullarında yaşlanması uzun süre alan biyokömürün laboratuvarında ve inkübasyon yolu ile daha hızlı olgunlaştırılması ve daha fazla yararlı hale getirilmesidir. Okaliptus odunu ve yeşil materyalleri laboratuvar koşullarında biyokömür haline getirilmeleri ve torf ile inkübasyonları sonrasında toprak düzenleyici olarak kullanılmıştır. Kurulan saksı denemelerinden elde edilenlere göre, biyokömür uygulamaları ilk vejetasyon süresince toprakların alınabilir Na, Ca ve Mg içeriklerinde önemli değişimlere neden olmamıştır; ikinci vejetasyon sonunda ise özellikle Na ve Ca için önemli düşümlere sebep olmuştur. İkinci dönem sonunda kısıtlandığı belirlenen bu elementel hareketlilik, mısır bitkisi elementel içeriklerine de açıkça yansımıştır. Mısır biyokütle ve boylanma değerleri önemli artışlar göstermiştir. Toprakların toplam azot içeriğindeki tek önemli değişim, okaliptüs biyokömürü altındaki topraklarda ve ikinci dönemde gözlenmiştir. Alınabilir fosfor içerikleri ise yeşil atık biyokömürü uygulamasıyla her iki dönemde de artış göstermiştir. Okaliptüs biyokömürü, toprakların K içeriğini her iki dönemde de artırırken, yeşil atık biyokömürü ancak ilk dönemde istatistikî önemde bir fark yaratmıştır. Biyokömür uygulamalarının bitki K alımı üzerinde herhangi bir olumsuz etkisinin olmadığı, aksine bitkilerin K/Na oranlarını artırdığı da söylenebilir. Yaprakların Fe, Cu, Zn ve Mn içerikleri ise özellikle 40 t/ha dozunda genel bir düşüş göstermişlerdir.

Biyokömürlerin uygulama dozu ve çeşidi tuzluluğun bitkiler ve toprak üzerindeki olumsuz etkilerinin giderilmesi süreci için önemli kriterler olarak öne çıkmıştır. Olgunlaştırılan biyokömürlerin topraklarda tuz oluşturan elementleri bünyesinde tutarak topraktaki tuzluluğun azaltılmasında, toprak organik maddesinin artırılmasında önemli bir görev üstlenebilme olasılığı bu çalışmada öne çıkan sonuçlardandır. Okaliptüs biyokömürü 10 t/ha dozunda; yeşil atık biyokömürü ise 20 t/ha dozunda en yüksek biyokütle oluşumu sağlamış ve bu dozlar aynı zamanda en düşük sodyum alımının gözlemlendiği dozlar olmuştur. İlgili dozlarda mikroelement alınabilirliği/alımı yüksek dozlara kıyasla çok daha az etkilense de, bu toprak özelliklerinin uygulama sonrası izlenmesi olumlu sonuçlar alınmasına katkı sağlayacaktır. Bu bağlamda, daha önce örneklenen birçok ıslah çalışmasında rapor edildiği gibi (özellikle ağır metaller ve organik kirleticilere yönelik), biyokömürlerin tuzluluğa karşı da aktif hale gelmesi/yaşlanması ve bu yolla etkinliğinin artışı çalışmanın önerebileceği sonuçlardan bir diğeridir.

İleri seviyede tuzluluk koşulları ve denemeler boyunca saf su ile sulama yapılması sebebiyle çok düşük su potansiyeline sahip topraklar üzerinde elde edilen bu bulgular, daha kapsamlı/zamansal çalışmaların olası bulgularına ilişkin teşvik edicidir. Saksı denemeleriyle bir ön çalışma niteliğinde yürütülen bu araştırmanın tarla denemeleri şeklinde planlanarak geniş alanlara uygulanması ve dünyada artan bir eğilimle kullanılan biyokömür uygulamalarının ülkemizde de kullanım alanı bulmasına öncülük etmesi bakımından yararlı olacağı düşünülmektedir.



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RURAL DEVELOPMENT

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ABSTRACT

When we hear these 2 words 'Rural development', the main thing that strikes our mind is the process by which we can improve the condition of people living in isolated areas. India has been declared as the "Developed nation" by the USA after seeing how quickly India has been progressing in almost every sector. India's rural population is about 70% of its total population and therefore, a nation can't be fully developed unless its rural areas are developed. But unfortunately, in India Rural areas are always ignored. In any rural area, agriculture is the main source of livelihood for the people. But unfortunately, due to the lackadaisical nature of the governments, people are forced to migrate to urban area or they decide to end their life. Farmer suicides account for approximately 10% of all suicides in India. Currently, farmers are protesting for their rights and many of them have committed suicide.

The objective of the paper is to:

- a) Issues and challenges faced by rural areas and how to overcome these obstacles.
- b) How we can stop the migration of farmers to urban areas.
- c) How to bridge the digital divide.

This can be achieved through development research, effective use of local resources, introducing new technologies and upgrading the skills, educating youth and community participation.

Keywords: Rural development, poverty, development schemes, agriculture, challenges



1. Rural development

Separately, Rural means, " in, of, or like the countryside, and, development refers to, the process in which someone or something grows or changes and becomes more advanced. (Source: Cambridge dictionary)

Therefore, in simple terms, we can say, rural development refers to the ways by which we can enhance the quality of life of people living in remote far-flung areas. Below are the two definitions of rural development to get a more subjective knowledge of what the term means:

1) 'a multidimensional process that seeks to integrate, in a sustainable manner, economic, socio-cultural, and environmental objectives' (Kearney et al.,1994: 128)

2) 'a sustained and sustainable process of economic social cultural and environmental changes designed to enhance the long-term well-being of the whole community' (Moseley, 1996: 20)

According to the 2011 census, the population of India living in rural areas was almost 70%. India has always been an agricultural country and farming is its main occupation. The All India Rural Credit Review Committee in its report warned "If the fruits of development continue to be denied to the large sections of the rural community, while prosperity accrues to some, the tensions social and economic may not only upset the process of orderly and peaceful change in the rural economy but even frustrate the national efforts to set up agricultural production". India cant become a developed nation unless and until its rural areas are developed. Therefore, it becomes essential that rural areas are economically developed, there is improvement in the living standard, people get social justice, their minimum basic needs are fulfilled, and, they don't have to migrate to urban areas in search of employment.

Governments have been trying to improve the conditions of rural areas by introducing schemes but unfortunately, rural areas are still grappling with serious major problems.

1.1 Major hurdles in the rural development of India

1) Poverty: Poverty simply means, the state of not having enough material possessions or income for a person's basic need. (Source: Wikipedia).

The mint on its website shared an analysis on 3rd December 2019 stating that India's rural poverty has shot up. In its article, it was shared that rural poverty rose nearly 4% points between 2011-12, and 2017-18, to 30%.

A report under the title "State of Working India" report published by Azim Premji University in May 2021, stated, that there has been an increase of 15% in rural poverty after 1 year of the coronavirus pandemic.

2) Unemployment: According to the OECD (Organization For Economic Co-operation And Development), unemployment is when persons above specified age (usually 15) are not being in paid employment or self-employment but currently available for work during the reference period.

On 19th May 2021 Hindustan Times published an article saying, Rural unemployment in India saw an increase of 14.34% in the week, ended May 16 from 7.29% in the week ended May 9th. Data collected from the center for monitoring the Indian Economy (CMIE) showed Rural unemployment is at a 50-week high. An article published by, " The Wire," on 20th November 2019, stated that the center has admitted that the rural unemployment has shot up from 2.9% in 2013-14 to 5.3% in 2017- 18.

3) illiteracy: According to UNESCO, illiteracy is an inability to read or write a simple sentence in any language. According to the social-economic and caste census (SECC) 2011, over one-third of the Indian population living in rural areas is illiterate, that is, 315.7 million Indians in rural areas as illiterate.



4) Digital Divide: It simply means a gap between those people who have the access to the internet and those who do not. A survey was conducted by the National sample survey between July 27 and June 2018 which found only 4.4% of rural households have a computer and 14.9% of rural households have access to the internet.

According to a survey by BCG INDIA, the digital divide is one of the major problems why people of rural areas are showing hesitancy towards vaccination. Moreover, rural people are finding it very difficult to register themselves on the CoWin app (an application developed by India to vaccinate Indians). About 63% in rural areas didn't know how to register on the CoWin app for vaccination.

5) Suicide among farmers: National crime records bureau accidental death and suicide in India was released in Arabic in 2019 and stated at 11,379 farmers died by suicide in India in 2016. This means 948 suicide every month or 31 suicides every day. The data was confirmed by the Ministry of Home affairs India. However, suicide among farmers has been on the downfall, as the report submitted by the national crime records bureau under the title accidental deaths in suicide in India 2019 showed 10281 farmers commit suicide which accounts for 7.4 % of the total deaths by suicide.

The protest against agriculture laws which were introduced by the government of India in September 2020 also so a rising number of suicides among farmers. Three 3 farm acts are described by the government as an initiative to help the farmers but farmers formed a collation of over 40 Indian farmers union, known as Sanyukt Kisan Morcha (SKM) in November 2020 and started protesting against the 3 farm bills. According to the data collected by Sanyukt Kisan Morcha, 248 farmers have died in just 87 days during a protest against 3 Central agricultural laws. According to the data, the protest against the three farm laws took 16 farmers' life per week in the past three months from November 26 to February 19. Unfortunately, the protest is still going on and farmers are dying daily.

Farmer dies after consuming poison at protest site in Hry

Chandigarh: A 58-year-old farmer died allegedly after consuming poison at a site of protest against the Centre's three farm laws in Jind district in Haryana, police said on Wednesday.

The deceased farmer has been identified as Pala Ram, Uchana Police Station SHO Ravinder Singh said over the phone.

"He consumed poison late Tuesday night and on Wednesday morning we received information that a farmer has died," he said, adding that no suicide note has been found from the spot.

At the protest site at Khatkar toll plaza, 500-700 protesters usually gather during the day, while only a few stay there overnight, according to the police.

"While two to three people slept on mats outside on Tuesday night, Pala Ram went to sleep in a tent erected at the site and consumed poison," Singh said.

Pala Ram used to serve food and tea to the protesting farmers at the toll plaza for the past few months.

Farmers at the protest site told the police that he seemed dejected for the past few days as the demands of the peasants agitating against the farm laws for over six months now had not been met.

A few cases of suicide by farmers have been reported during the agitation. In December last year, a Sikh preacher had also allegedly ended his life near the Singhu border protest site, claiming that he was "unable to bear the pain of the farmers".

A lawyer from Punjab had allegedly killed himself by consuming poison near the protest site at the Tikri border.

Farmers have been protesting since November last year demanding that the three farm bill be rolled back and a new law made to guarantee minimum support price for crops. PTI

2. Initiatives taken by the Indian Government to tackle the rural problems:

1) The Mahatma Gandhi National Rural Employment Guarantee Act (2005): MANREGA was launched by the then Prime Minister of India in 2005 to employ adult members of any household for up to 100 days. It was an attempt by the Government of India to bridge the gap



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between the rich and the poor of the country. Currently 14,11,80,086 worker are registered among which 30,36,95,767, are active i.e 46.48% of workers were active in 2021-22.

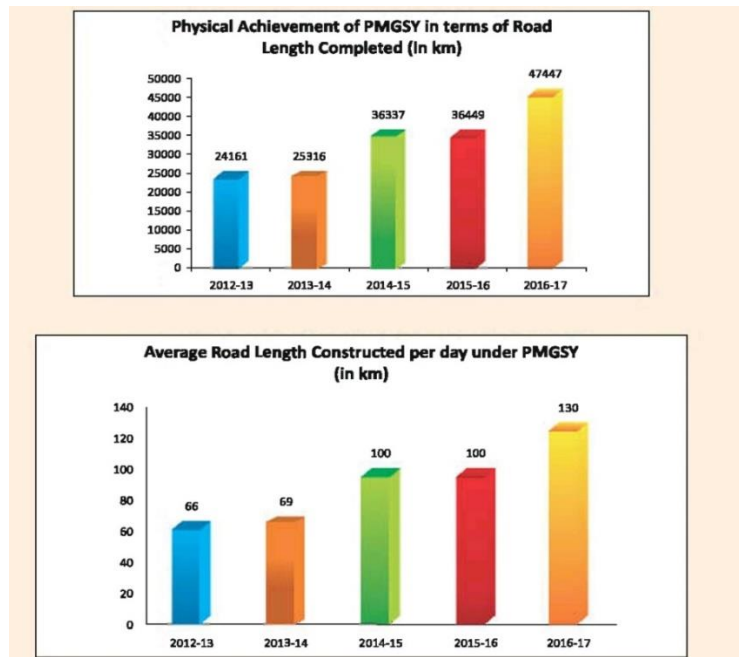


(image taken from <https://iasbaba.com/2020/07/mgnrega-a-ray-of-hope-to-secure-livelihoods/>)

2) Swarnajayanti Gram Swarajgar Yojna (SGSY)

started in 1999 the main aim of the scheme was, that poor families have an income of RS 2000 so that they can come above the poverty line in three years. Its main focus is on groups of people. Under this yojana (scheme) self-groups are formed and are with skill development training. Under this scheme, they get infrastructure and marketing support for the products produced by them.

3) Pradhan Mantri Gram Sadak Yojana (PMGSY): PMGSY was launched by the Government of India in 2000 to show that the connection can be made apple two unconnected habitations to eradicate poverty. According to the minister of road transport and highway, average construction reaches the level of 130 kilometres in 2016 17 which is the highest in the last seven years. The total number of habitations connected to the road system under the PMGSY in India in India reached 1.65,902.



Picture source: a book sustainable development published by the rural development ministry of [India](#)

2.1. Schemes by the Government of India to bridge the digital divide in India:

Digital India initiatives: launched in 2011 the Bharat net project aimed to connect 0.25 million panchayats through win optical fiber with Henry 100 Mbps speed.

Internet Sathi Program: Launched in 2015 by Google India and Tata Trusts, this program aimed to facilitate digital literacy among rural Indian women.

DIKSHA (Digital Infrastructure For Knowledge Sharing) Platform: National platform for school education available for all states in the central government her grades 1 TO 12 and was launched in 2017. its main aim is one nation one digital platform for school education in India.

Pradhan Mantri Ujjwala Yojna (PMUY) Launched in 2016 by the PM of India, it aimed to distribute 50 LPG connections to women below the poverty line in India.

CONCLUSION

About 70% of the total population of India lives in rural areas and after so many ruler development schemes by the Government of India almost, 200 million rural people live below the poverty line. However, rural development can't be achieved by just targeting one area of the lives of rural people. It's important to consider all aspects of ruler life in an integrated manner. For instance, acknowledging the potential of the private sector, the Government of India has inked pact digital ecosystems of farmers with 4 private firms of India The companies are, Patanjali organic Research Institute ESRI India private limited, Agri bazaar India private limited, Amazon Web Series. Moreover, Government needs to eradicate the loopholes in its schemes, that caused failure in the goals of the previously implemented programs, MANREGA is the world's public work program but still, workers have to face regular payment delays and the bank process is way too complicated for workers. Government has to pay attention to energy transmission, climate change, and initiatives that make rural people digitally educated.



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HASAT ÖNCESİ SALİSİLİK ASİT, ASETİLSALİSİLİK ASİT VE METİL SALİSİLAT UYGULAMALARININ VIŞNE (*Prunus cerasus* cv. Kütahya) MEYVESİNİN KALİTESİ ÜZERİNE ETKİLERİ

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ÖZET

Bu çalışmada bitki fenolikleri grubunda bulunan salisilik asit (SA) ile türevleri olan asetil salisilik asit (ASA), Metilsalisilat (MeSa) uygulamalarının vişne (*Prunus cerasus* L.) meyvelerinin meyve gelişimi ve kalitesi üzerine olan etkileri incelenmiştir. Bu amaçla uygulamalar, tam çiçeklenmeden sonraki üç farklı dönemde (çekirdeğin sertleşmeye başladığı dönem, ben düşme dönemi ve olgunlaşma öncesi) ve üç farklı doz (SA ve ASA 0.5, 1.0, 2.0 mM, MeSA 0.05, 0.1, 0.2 mM) şeklinde yapılmıştır. Meyveler temmuz ayının ikinci haftasında hasat edilmiştir. Çalışmada vişne meyvelerinin en-boy-sutur (mm), meyve ağırlığı (g), meyve sertliği (N), meyve rengi, sap rengi ölçümleri ile kimyasal analizleri suda çözünebilir kuru madde miktarı (SÇKM), pH, titre edilebilir asitlik (TEA)) incelenmiştir. Uygulamalar neticesinde vişne meyvelerinde en yüksek boy değeri SA 2.0 Mm (19.4mm), en yüksek en ve sutur değeri ise SA 0.5 mM (20.9-18.8mm) uygulamalarından elde edilmiştir. Meyve ağırlığı en fazla MeSA 0.1 mM (5.3g) uygulamasında, meyve sertliği ise SA 1.0 mM (4.5N) uygulamasında gözlemlenmiştir. Meyve renk değerlerinde uygulanan kimyasal dozlarındaki artış ile kontrol meyvelerine göre farklılıklar tespit edilmiştir. Aynı şekilde meyve sap renk değerleri bakımından uygulamalar arasında farklılıklar bulunmuştur. Farklı kimyasal ve doz uygulamalarının vişne meyvesinin SÇKM, pH ve TEA gibi kimyasal özellikleri üzerinde etkileri bulunmaktadır. SA 0.5 mM ve SA 1.0 mM uygulamaları kontrol ile kıyaslandığında meyve iriliği ve pomolojik özellikler bakımından genellikle daha olumlu sonuçlar vermiştir. Kontrol grubu meyve örneklerinin sertlik değerlerinin MeSA uygulamalarına göre daha yüksek olduğunun ve bu uygulamanın meyve sertliğine olumlu bir etkisinin olmadığı gözlemlenmiştir. Uygulanan kimyasal ve dozlara bağlı değişimle birlikte meyve iriliğinde, ağırlığında ve sertlik değerlerinde kontrole nazaran daha olumlu sonuçlar alınmıştır. SÇKM ve pH değerleri ise kontrol grubu meyvelerinde uygulama meyveleri değerlerine göre daha düşük kalmıştır.

Anahtar Kelimeler: *Prunus cerasus* L., vişne, kalite, salisilik asit



**THE EFFECTS OF PRE-HARVEST SALICYLIC ACID, ACETYLSALICYLIC ACID
AND METHYL SALICYLATE APPLICATIONS ON THE QUALITY OF SOUR
CHERRY (*Prunus cerasus* cv. Kütahya) FRUIT**

ABSTRACT

This research was carried out to determine the effects of salicylic acid (SA) and its derivatives Acetylsalicylic acid (ASA), Methyl salicylate (MeSa) treatments on growth and ripening of sour cherry (*Prunus cerasus* L.) fruit quality attributes. For this purpose, three different doses (SA and ASA 0.5, 1.0, 2.0 mM; MeSA 0.05, 0.1, 0.2 mM) were applied at three different periods of fruit development (pit hardening, straw-color stages and ripening). The fruits were harvested in the second week of July. Fruits analyzed for some pomological and physical properties (width-length-suture (mm), fruit weight (g), fruit firmness (N), fruit skin color, stem color measurements, total soluble solid content, titratable acidity, pH). As a result of the applications, the highest fruit-length value was obtained from SA 2.0 mM, the highest fruit-width and suture value was obtained from SA 0.5 mM applications. The highest fruit weight was observed in MeSA 0.1 mM (5.27g) application, and fruit firmness was observed in SA1.0 mM (4.52N) application. Differences were determined in fruit color values with the increase in the applied chemical doses compared to the control fruits. Likewise, differences in fruit stem color values were found between applications. SA 0.5 mM and SA 1.0 mM applications generally gave more positive results in terms of fruit size and chemical analysis values compared to the control. It was observed that the firmness values of the control group were higher than the MeSA applications and this application did not have a positive effect on fruit firmness. Although it varies depending on the chemicals and doses applied, more positive results were obtained in fruit size, fruit weight and fruit firmness values compared to the control. Total soluble solid content and pH values were lower in the control group fruits than the application fruits.

Keywords: *Prunus cerasus* L., sour cherry, quality, salicylic acid



GİRİŞ

Vişne (*Prunus cerasus* L.) ülkemizde, geniş alanlarda yetiştiriciliği yapılabilen ve ekonomik olarak önemi olan, farklı tüketim şekilleri nedeniyle sanayide çokça tercih edilen bir meyve türüdür. Konserve sanayisinde, meyve suyu sanayisinde ve pasta, dondurma, kek yapımında, kerestesinden çekirdeğine kadar birçok kısmı farklı alanlarda kullanılmaktadır (Kalyoncu vd., 2008).

Vişnenin anavatanı İstanbul ile Hazar Denizi arasında bulunan Kuzey Anadolu dağlarıdır (Özçağırın vd., 2011). Gen merkezinin, Türkiye olduğu diğer meyve türlerinde olduğu gibi vişne meyvesi de ilk Anadolu'da kültüre alınmış ve buradan Yunanistan'a geçmiştir (Özbek, 1978). Bazı araştırmacılar ise vişnenin anavatanı sınırlarını biraz daha genişletmişler ve Anadolu'nun yanında İran, Irak ve Suriye'yi de kapsayan alanı bu sınırlara dahil etmişlerdir. Janick ve Moore (1995).

Dünyada vişne üretiminin %62' si Avrupa, %28'i Asya ve %10' u Amerika kıtasında yapılmaktadır. Türkiye 2019 yılı verilerine göre 182.165 ton vişne üretimi ile dünyada Rusya'nın ardından ikinci sırada yer almaktadır (FAO, 2021).

Antosiyanin içeriğinin yüksek olması vişne meyvesine olan ilgiyi artırmaktadır. Fakat önemli bir antosiyanin kaynağı olmasına rağmen ekşi tadından dolayı taze tüketimde fazla tercih edilmemekte ve daha çok sanayi ürünü olarak kullanılmaktadır. Bu nedenle üretim oranı, hasat zamanında pazarda bulunan diğer meyve türlerine göre düşük kalmaktadır (Blando vd., 2004; Celepaksoy, 2011).

Salisilik asit (SA), genellikle bir hidroksil grubu ya da onun fonksiyonel türevini taşıyan, aromatik bir halkaya sahip bitki fenoliklerinin bir grubudur. Salisilik asidin diğer fenolik bileşikler gibi bitki büyümesinin düzenlenmesinde bitki gelişimi ve diğer organizmalarla etkileşiminde rolünün olduğu belirtilmektedir (Harborne, 1980). Salisilik asit (SA) ve türevleri, asetil salisilik asit (ASA) ve metil salisilat (MeSA), tüm bitkilerde bulunmakla birlikte bitkilerin metabolizmasında çeşitli düzenleyici rollere sahip bitki hormonları grubunda sınıflandırılan doğal olarak oluşan bileşiklerdir (Garcia-Pastor, 2020). Metil salisilat (MeSA), bitki savunma anında iken enfekte olmuş dokulardan enfekte olmamış dokulara floem aracılığı ile hareket eden uçucu özelliğe sahip bir sinyal molekülüdür. MeSA, gerekli durumlarda salisilik aside dönüşebilen ve transloke olabilen SA'nın inaktif bir öncüsüdür (Yıldız vd., 2014).

Salisilik asidin bitkilere olan etkileri oldukça geniştir buna göre yapılan birçok çalışmada SA ve türevlerinin bitki savunma mekanizmasını tetiklediğine, hasat öncesi meyve kalitesini, hasat sonrasında da meyve kalite ve dayanıklılığını artırdığına, birçok meyve türünde poligalaktronaz (PG) ve pektinmetilesteraz (PME) enzimlerinin aktivitesi azaltarak daha uzun ve kalitede çürüme ve üşüme zararından uzak depolanabilme imkanı sağladığına, bitki büyüme ve gelişmesini etkilediğine, farklı konsantrasyonlarının olgunlaşmayı hızlandırdığına yada geciktirdiğine, fotosentez, stomatal düzenleme, solunum, çiçeklenme, senesens ve iyon alımında önemli rollerinin bulunduğu bilgileri bulunmaktadır. (Asghari ve Aghdam, 2010; Vicente and Plasencia 2011; Yıldız, 2014; Sabır F., 2017; Garcia-Pastor, 2020). SA'nın, etilenin öncül molekülü olan ACC sentaz oluşumunu veya etilene dönüşümünü engelleyerek etilen biyosentezini engellediğini ve hasat sonrasında meyve kalite ve dayanıklılığının sürekliliğini uzatmaya yardımcı olduğunu belirten araştırmalar da mevcuttur. (Özeker, 2005; Erbaş ve Koyuncu, 2019)

Bu çalışma ile salisilik asit, asetil salisilik asit ve metil salisilat gibi salisilik asit türevlerinin hasat öncesi uygulamalarının vişne meyvesinin kalitesine ve olgunlaşmasına olan etkilerinin incelenmesi amaçlanmıştır.



MATERYAL ve YÖNTEM

Bu çalışmanın arazi basamağı Isparta ilinde bulunan üretici bahçesinde gerçekleştirilmiş olup laboratuvar analizleri ise Isparta Uygulamalı Bilimleri Üniversitesi Derim Sonrası Fizyolojisi Laboratuvarında yapılmıştır. Araştırmada materyal olarak gerek uzun saplı oluşu gerekse meyve iriliği bakımından tercih edilen geçici bir vişne çeşidi olan Kütahya çeşidi kullanılmıştır. Çeşide ait ağaçlar 7 yaşında ve *Prunus mahaleb* anacına aşıdır. Denemelerde SA, ASA MeSA ve herbirinin 3 farklı dozu denenmiştir. SA ve ASA 0.5, 1.0, 2.0 mM'lık dozları ile MeSA 0.05, 0.1, 0.2 mM dozları uygulanmıştır. Her bir uygulama çekirdeğin sertleşmeye başladığı dönem, ben düşme dönemi ve olgunlaşma öncesi olmak üzere üç farklı dönemde sabahın erken saatlerinde ağaçlar tamamen ıslanacak şekilde püskürtme yöntemi ile tekrarlanmıştır. Tüm dozlara %0.2 oranında yayıcı yapıştırıcı (Tween 20) ilave edilmiştir. Kontrol ağaçlarına sadece su+Tween 20 karışımı püskürtülmüştür. Isparta koşullarında temmuzun ikinci haftasında hasat edilen meyveler laboratuvara getirilerek kalite analizleri yapılmıştır. Meyve ağırlığı 0.01 g'a duyarlı terazi ile tartılarak belirlenmiştir. Meyve eni (mm), meyve boyu (mm) ve sutur ölçümleri 0.01 mm'ye duyarlı dijital kumpas yardımıyla ölçülmüştür. Bu ölçümler için tekerrürde 30 adet meyve kullanılmıştır. Meyve sertliği ve renk ölçümleri için her tekerrürde 20 adet meyve kullanılmıştır. Meyve sertliği Lloyd Marka LF Plus Model tekstür cihazı ile belirlenmiştir. 50 N'lük load cell ile 100 mm/dk değişmez hızda, 3 mm çapındaki silindirik uç meyveye batırılmış ve elde edilen maksimum kuvvet Newton (N) cinsinden meyve sertliği olarak değerlendirilmiştir. Meyve kabuk rengi, renk cihazı (CR-300 Minolta) kullanılarak CIEL*a*b* cinsinden ölçülmüştür. Meyve sapsarı bir araya getirilerek arada boşluk kalmayacak şekilde birleştirilmiş ve beyaz bir zemin üzerinde renk ölçümleri gerçekleştirilmiştir. Suda çözünebilir kuru madde miktarı (SÇKM) dijital el refraktometresi (Atago Pocket PAL1) ile ölçülmüş ve sonuçlar % olarak belirlenmiştir. Titre edilebilir asit (TEA) miktarı, çıkartılan meyve suyundan 10 mL alınmış 0.1 N'lik sodyum hidroksit (NaOH) ile pH değeri 8.1 oluncaya kadar pH metre (WTW Inolab) kullanılarak titre edilerek belirlenmiştir. Sonuçlar harcanan NaOH miktarı üzerinden mg mL⁻¹ olarak hesaplanmıştır. Deneme tesadüf bloklarında faktöriyel deneme desenine göre 3 tekerrürlü (her tekerrürde 1 ağaç kullanılmıştır) olarak yürütülmüştür.

Verilerin istatistik analizleri için SPSS 23 paket programından yararlanılmıştır. Grup ortalamalarının arasındaki farkların belirlenmesinde Tukey testi kullanılmıştır.

SONUÇ ve TARTIŞMA

Salisilik asit ve türevlerinin Kütahya vişnesinin meyve kalitesi üzerine olan etkilerinde en, boy, sutur, meyve sertliği ve meyve ağırlığı değerleri Çizelge 1' de verilmiştir. Meyve sertliği, ağırlığı, en, boy ve sutur değerlerinin tamamında SA uygulamaları kontrol grubu uygulamalarına göre artış gösterdiği belirlenmiştir. Uygulamaların meyve ağırlığı, sertliği, en, boy ve sutur değerleri üzerine olan istatistik etkisi önemli bulunmuştur (p<0.05). Sonuçlarımızla benzer şekilde kiraz meyvesinin kalitesi üzerine yapılan bir araştırmada SA ve ASA uygulamalarının meyve hacmini ve ağırlığını artırdığı belirtilmiştir (Özeker vd. 2014). Hasat ile ASA 2.0mM ve MeSA 0.05mM dozları hariç diğer tüm uygulama dozlarının meyve ağırlığı üzerine etkilerinin olduğu görülmüştür. Meyve iriliği pazarda ürünün tercih edilebilirliğini artıran kriterlerden birisidir ve ekonomik performansı da etkilemektedir. ASA 2.0 mM uygulamasının Çizelge 1' deki ölçüm değerleri kontrol grubu değerleri ile karşılaştırıldığında daha düşük kaldığı görülmektedir.



Çizelge 1. Salisilik asit ve türevlerinin meyve ağırlığı (g), meyve sertliği (N), en (mm), boy (mm) ve sutur (mm) üzerine etkileri

Uygulamalar	Meyve Sertliği (N)	Ağırlık (g)	En (mm)	Boy (mm)	Sutur (mm)
Kontrol	4.13 abc*	3.93 cd	19.27 c	17.96 c	17.48 c
SA (0.5 mM)	3.74 bcd	5.10 ab	21.16 a	19.47 a	18.91 a
SA (1.0 mM)	4.52 a	4.91 ab	20.10 abc	18.55 bc	18.19 abc
SA (2.0 mM)	3.85 abcd	5.13 ab	20.91 ab	19.54 a	18.86 ab
ASA (0.5 mM)	3.59 cd	4.84 ab	20.31 abc	18.93 ab	18.41 abc
ASA (1.0 mM)	4.39 ab	4.55 bc	19.73 bc	18.39 bc	17.85 bc
ASA (2.0 mM)	3.42 d	3.02 e	16.61 d	15.68 e	15.20 e
MeSA (0.05mM)	3.60 cd	3.44 de	17.55 d	16.91 d	16.21 d
MeSA (0.1 mM)	3.43 d	5.33 a	20.17 abc	18.91 ab	18.10 abc
MeSA (0.2 mM)	3.54 cd	4.85 ab	20.72 ab	19.30 ab	18.60 ab

*Aynı sütunda farklı harfler ile gösterilen uygulamalar arasındaki fark istatistik olarak önemlidir (p<0.05)

Meyve rengi ve sap renk değerleri Çizelge 2' de verilmiştir. Çalışmada tüm uygulamaların meyve rengi ve sap renk değerleri üzerine etkileri istatistik olarak önemli bulunmuştur (p<0.05). L değeri parlaklığı göstermektedir. MeSA 0.2 mM uygulamasına ait meyveler ile kontrol grubu meyvelerinin L değerlerinin diğer uygulamalara göre daha yüksek olduğu görülmüştür.

Sap rengi albeni ve tazeliğin başka bir göstergesi olarak nitelendirilmektedir (Bal, 2012). Meyve sap rengine uygulamaların etkisinin istatistik olarak önemli olduğu tespit edilmiştir (p<0.05). MeSA uygulamasının 0.05mM ve 0.1 mM dozlarına ait meyveleri kontrole göre daha parlak meyvelere sahip olmuştur. SA uygulamalarının tamamında sap renginin kontrol grubuna göre daha yeşil durumda olduğu tablodan görülmektedir.

Çizelge 2. Salisilik asit ve türevlerinin meyve rengi ve sap rengi üzerine etkileri

Uygulamalar	Meyve Rengi			Sap Rengi		
	L	A	b	L	a-	b
Kontrol	29.81 a*	20.41 cd	7.57 c	51.98 abc	12.35 b	32.75 ab
SA (0.5 mM)	25.91 e	21.47 bcd	8.25 bc	49.90 bc	15.58 a	31.99 ab
SA (1.0 mM)	26.91 de	21.05 cd	7.63 bc	50.12 abc	14.57 ab	31.80 ab
SA (2.0 mM)	27.79 bcd	20.83 cd	7.68 bc	48.69 c	12.75 ab	30.96 b
ASA (0.5 mM)	27.50 d	21.68 bcd	8.62 bc	53.42 abc	14.06 ab	33.22 ab
ASA (1.0 mM)	28.16 bcd	27.52 a	11.91 a	49.47 bc	14.45 ab	32.25 ab
ASA (2.0 mM)	27.56 cd	25.15ab	9.76 b	51.32 abc	6.13 c	31.03 b
MeSA (0.05mM)	29.07 abc	23.39 bc	8.65 bc	53.72 ab	14.86 ab	34.20 a
MeSA (0.1 mM)	29.20 ab	18.15 d	6.81 c	54.83 a	13.71 ab	34.16 a
MeSA (0.2 mM)	30.37 a	20.26 cd	8.09 bc	50.84 abc	14.77 ab	31.68 b

*Aynı sütunda farklı harfler ile gösterilen uygulamalar arasındaki fark istatistik olarak önemlidir (p<0.05)

Uygulamaların SÇKM ve TEA değerlerine olan etkileri Çizelge 3' te sunulmuştur. Uygulamaların SÇKM ve TEA miktarı üzerine olan etkileri istatistik olarak önemli bulunmuştur (p<0.05). Değerler incelendiğinde genel olarak uygulamaların SÇKM değerlerinin kontrol grubuna (%17.80) göre daha yüksek olduğu görülmektedir. Kontrol grubunda SÇKM miktarında görülen azalışın şekerlerin solunumda kullanılmasından ileri gelebileceği düşünülmektedir. SÇKM miktarındaki benzer düşüşler farklı çalışmalarda da belirtilmiştir (Bayram vd., 2010; Erbaş ve Koyuncu, 2019). Bu durum olgunlaşmaya bağlı olarak şekerlerin solunumla parçalanması ile açıklanabilir. Görülen bu azalış, klimakterik olmayan bir meyve



olan vişnede hasat sonrası olgunlaşma devam etmediği için SÇKM birikimi olmayıp, tek taraflı solunumla parçalanma işleminin gerçekleşmesidir. (Selçuk, 2012).

TEA üzerine uygulamaların etkisi istatistik olarak önemli bulunmuştur ($p<0.05$). SA uygulamaları kontrol grubu ile karşılaştırıldığında meyvelerin asitliğinin genel olarak daha yüksek değere sahip olduğu görülmektedir. Elde edilen bulgular Gimenez vd. (2014)' nin yaptıkları araştırma sonuçları ile benzerlik göstermektedir.

Çalışmada elde edilen pH değeri üzerine uygulamaların etkisi istatistik olarak önemli bulunmuştur. Uygulamaların pH değeri kontrol grubuna göre daha yüksek değerlere sahip olduğu Çizelge3' te gözlemlenmiştir.

Çizelge 3. Salisilik asit ve türevlerinin suda çözünür kuru madde miktarı (%), titre edilebilir asitlik (mg.mL⁻¹) ve pH üzerine etkileri

Uygulamalar	SÇKM (%)	TEA (g 100mL ⁻¹)	pH
Kontrol	17.80 cd*	2.85 abc	3.24 e
SA (0.5 mM)	18.65 c	3.00 ab	3.76 ab
SA (1.0 mM)	19.88 ab	3.05 a	3.73 ab
SA (2.0 mM)	16.83d	2.78 de	3.37 c
ASA (0.5 mM)	18.95 bc	2.83 cd	3.79 a
ASA (1.0 mM)	18.95 bc	2.98 abc	3.80 a
ASA (2.0 mM)	20.17 a	2.63 e	3.57 c
MeSA (0.05mM)	18.58 c	2.83 bcd	3.73 ab
MeSA (0.1 mM)	18.62 c	2.97 abc	3.66 bc
MeSA (0.2 mM)	17.03 d	2.82 cd	3.41 d

*Aynı sütunda farklı harfler ile gösterilen uygulamalar arasındaki fark istatistik olarak önemlidir ($p<0.05$)

Araştırma sonunda; SA ve türevlerinin hasat öncesi uygulamalarının, meyve ağırlığı, meyve sertliği, meyve iriliği özellikleri gibi bazı kalite parametrelerini artırdığı gösterilmiştir. Genel olarak SA uygulamalarının diğer uygulamalara göre daha iyi sonuçlar verdiği belirlenmiştir. ASA uygulamasının 2.0 mM' lık dozunun sonuçları değerlendirildiğinde bu dozun vişne meyvelerinin kalite parametrelerinin artırılmasına yönelik etkisinin olmadığı ve vişne meyvesi için dozun yüksek olduğu kanaatine varılmıştır. Bu görüşümüze paralel olarak Çanakçı ve Munzuroğlu (2006), asetil salisilik asitin yüksek konsantrasyonlarının mısır fidelerinde osmotik ve toksik stres yaratarak büyümeyi engellendiği, yaş ağırlığı ve transpirasyon hızını azalttığı, kuru ağırlığı artırdığı yönünde görüşlerini bildirmişlerdir.



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THE EFFECT OF STORAGE TIME ON VOLATILE COMPOUNDS AND SENSORY PROPERTIES OF TABLE OLIVES FERMENTED USING STARTER CULTURE

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ABSTRACT

In this study, the effect of storage period on the volatile compounds and sensory properties of Gemlik table olives obtained by using *Lactobacillus pentosus* and *Lactobacillus plantarum* starter cultures were investigated. The storage period was determined as 6 months and changes in fermented olives were evaluated by analysis. Volatile compounds were extracted by Purge&Trap method and identified by GC-MS. At the beginning of the storage period, while 42 volatile compounds were identified in the inoculated treatments, 43 volatile compounds were identified in the spontaneous fermentation treatment. At the end of the 6 months period, while 37 volatile compounds were identified in the inoculated treatments, 35 volatile compounds were identified in the spontaneous fermentation treatment. In all samples, volatile acids were the compounds with the highest amount and it was followed by higher alcohols and phenols. As the storage period progressed, the amount of volatile compounds decreased and at the end of the 6th month it was determined as 1503.98 µg/kg in the spontaneous fermentation treatment, 1551.64 µg/kg in the *L. plantarum* inoculation treatment and 1341.30 µg/kg in the *L. pentosus* inoculation treatment. Volatile compounds determined in maximum amounts in stored olives were; 3-penten-2-ol, butanoic acid, phenylethyl alcohol and creosol. Compounds such as phenyl ethyl alcohol, benzyl alcohol, 2-hexanol and (E,E)- α -farnesene, which give preferred flavor such as flowers, grass and fruits, are found higher in inoculated table olives. In spontaneously fermented olives, acetic acid and butanoic acid were found in higher amounts and this situation causes off-odors. In the sensory analysis performed at the end of the storage period, table olives fermented with *L. pentosus* were preferred products in the general acceptability, general taste and preference (ranking) test. This was followed by olives fermented with *L. plantarum* and olives fermented spontaneously. According to the results, it was determined that the use of starter cultures provides advantages in storage period and promotes the development of aroma. At the end of the storage period the best results were obtained by *L. pentosus* starter culture.

Keywords: Table olives, starter culture, storage, volatile compounds



1. INTRODUCTION

Olive is a plant in the form of bushes and shrubs, included in the Oleaceae family, growing in tropical and semi-tropical climate zones (Kıralan, 2010). Although the olive tree is distributed to all continents, 98% of the olive tree existence in the world is located in the Mediterranean basin, including Turkey (Zeytin et al., 2008; Erbay et al., 2010). Olives are grown in 38 countries, of which 30 are in the Northern hemisphere and 8 are in the Southern hemisphere (Öztürk-Güngör, 2010).

There are 28 olive varieties with economic importance in our country (Yıldız, 2014). Gemlik, Ayvalık and Memecik constitute 95% of olive property in Turkey (Aktan and Kalkan-Yıldırım, 2012). Gemlik variety has a wide distribution area in our country and constitutes 11% of the tree existence in Turkey. On average, 90% of the olives produced in the world are used for oil and 10% for table (Yıldız, 2014) on the other hand; 60-70% of the olives produced in Turkey are used for oil and 30-40% as table (Bozdoğan-Konuşkan, 2008).

Table olives produced by lactic acid fermentation are an important economic resource for producing countries (Bleve et al, 2014; Bonatsou et al, 2017). Table olives; according to the degree of maturity of the raw olive, it is divided into three classes as green, pink and black (Rejano et al, 2010; Alves et al, 2012). While of table olives produced in the world are 43% green, 31% black and 26% pink (Aktepe-Tangu et al., 2008), the table olives produced in Turkey are 83% black, 11% green and 6% are pink (Öztürk and Yalçın, 2017).

Olive, which is very rich in nutritional value, is 50-70% water, 10-25% oil, 3-6% reducing sugar, less than 0.3% non-reducing sugar, 1-2% protein, 1-4% fiber, 1-4%, 1-1.5% mineral substances, 2-3% phenolic compounds, 0.5-1% organic acids, less than 0.6% pectin and 3-7% other compounds (Ergönül and Tokuşoğlu, 2016). Owing to the phenolic substances it contains, olive gains a functional feature (Bianchi, 2003; Brenes, 2004). Thus, olive shows anticarcinogenic, antimicrobial, antioxidant, anti-inflammatory, antiviral, hypocholesterolemic and hypoglycemic properties (Yıldız and Uylaşer, 2011; Pistarino et al, 2013).

Olive is distinguished from other fruits with its low sugar content, high oil content and unique bitter taste (Irmak et al, 2010). It needs to be processed in order to remove this bitterness and make the olive consumable. Table olive production in the world is carried out in three different techniques. These transactions are; Spanish method, California method and Greek method (Arroyo-Lopez et al, 2010).

Olive fermentation is when the microorganisms in the microflora break down the sugars in the olive flesh and form lactic acid, making the olive edible. Olive fermentation is usually conducted spontaneously and it involves some risks (Randazzo et al, 2010; Corsetti et al, 2012; Bonatsou et al, 2017). The fermentation population is a dynamic process that includes Enterobacteriaceae, *Clostridium*, *Pseudomonas*, *Staphylococcus*, LAB, yeast and sometimes molds (Bevilacqua et al, 2012; De Angelis et al, 2015; Erten et al, 2016). These different groups of microorganisms determine the taste and quality of the final product during fermentation. Lactic acid bacteria and yeasts, which are involved in almost all fermentation processes, are the two most important groups (Hurtado et al, 2012; Bonatsou et al, 2017).

Salt concentration, temperature and pH adjustments in fermentation and the use of starter culture increase the formation of lactic acid, resulting in more delicious and durable olives (Oliveira et al, 2004; Randazzo et al, 2010). Despite being an important economic value, table olive fermentation is still carried out spontaneously (Corsetti et al, 2012). The use of starter culture is recommended to prevent the disadvantages that may be encountered in fermentation, to provide optimum conditions and to produce high quality table olives (Özdemir, 2011). The two most preferred species in table olive fermentation are *Lactobacillus plantarum* and



Lactobacillus pentosus (Botta and Cocolin, 2012; Benincasa et al, 2015). Starter culture plays a role in ensuring the safety of the end product by preventing the development of pathogenic microorganisms that cause rapid acid production. The use of starter cultures accelerates the hydrolysis of oleuropein, which causes bitterness, and contributes to the prolongation of its shelf life. It is also known that the use of starter cultures improves organoleptic properties.

The aroma of table olives has an important role on product quality. Higher alcohols, volatile acids, hydrocarbons, aldehydes, ketones, esters, terpenes and phenols in table olives are the main volatile compounds and are in balance to form a pleasant smell in olives (Malheiro et al., 2010). The aroma of table olives comes from the olive fruit and substances produced by microorganisms (lactic acid bacteria, yeasts and other competitive microorganisms) during fermentation (Sabatini et al, 2008). Volatile compound composition of table olives changes according genetics, fruit variety, degree of fruit ripening, processing conditions (fermentation, brine, packaging solution, temperature), storage period and conditions (Malheiro et al, 2010; Cabaroğlu and Koyuncu, 2019). The use of starter culture in olive fermentation is one of the most important factors affecting the aroma and improves sensory properties (Sabatini et al., 2008).

In the literature, studies on the change in volatile compounds with the storage of table olives are quite limited. There is no study on the contribution of the use of starter cultures to volatile compounds and sensory properties in the production of natural brine olives with the Gemlik variety. In this study, it was aimed to determine the differences in volatile compounds between olives produced by spontaneous and controlled fermentation during storage and to determine the effect of inoculation on the sensory properties of table olives at the end of storage.

2. MATERIALS and METHOD

2.1. MATERIEL

In this research, a total of 100 kg of Gemlik black olives obtained from an orchard in Seyhan District of Adana Province in 2016 were used as material. Fermentation was carried out in 50 l plastic barrels with lids. Rock salt and potable tap water were used for the brine.

2.2. METHOD

When black olive samples reached processing maturity (skin color purple-black and blackening changed from skin to fruit flesh), they were harvested and brought to Çukurova University Food Engineering Department Laboratory. Selection and sorting process was applied to the harvested olives and the olives that were not suitable for processing were separated. The olives are divided into 3 lots and left to fermentation under the following conditions:

1. Olives were placed directly in brine containing 10% NaCl and the salt concentration in the brine was kept constant at 10% (Control, spontaneous fermentation, code A).
2. Olives were placed directly in a brine containing 10% NaCl, a lyophilized culture of *L. plantarum* (Chr. Hansen Bactoform Vega-Start 60, Hoersholm, Denmark) was added one week later at a rate of 0.0156 g/kg and the salt concentration in the brine was kept constant at 10% (Treatment with *L. plantarum* inoculation, code B).
3. Olives were placed directly in a brine containing 10% NaCl, a lyophilized culture of *L. pentosus* (Lallemand OL1, Saint-Simon, France) was added one week later at a rate of 0.0156 g/kg and the salt concentration in the brine was kept constant at 10% (*L. pentosus* inoculation, code C).

Perforated discs were used and 15% pressure was applied to prevent the olives from reaching the brine surface. Salt concentrations of the brines were kept constant at 10% NaCl. The lids of the barrels are loosely closed to allow gas escape. Fermentations were carried out in 2



replications at room temperature ($21\pm 3^{\circ}\text{C}$) and were completed at the end of the 26th week. Olives, whose fermentation was completed were taken into lacquered tins and stored in brine at $+4^{\circ}\text{C}$ for 6 months. In the storage period, samples were taken at intervals of 3 months and these samples were subjected to volatile compounds analysis. Sensory analysis was carried out at the end of storage.

Volatile Compounds Analysis

Volatile compounds were extracted by the modified 'Purge&Trap' method according to Rodriguez-Bencomo et al (2015). For extraction, 10 g of homogeneous olive sample was taken into 40 ml vials and heated in a 60°C water bath for 10 minutes. Before processing, the traps were conditioned by passing 5 ml of dichloromethane solvent. After heating, nitrogen gas was passed through the vials at a rate of 500 ml per minute and the process was continued at 60°C for 90 minutes. It is ensured that the volatile compounds are attached to the trap. At the end of the time, the trap was removed and washed with 5 ml of dichloromethane solvent. Volatile taken into the solvent. 5 μl of 4-nonanol was added as internal standard. The solvent phase containing the volatiles was concentrated in a hot water bath at 40°C until 0.5 ml remained. Concentrated aromatic extract was injected directly into GC/MS. Analyzes were carried out in three repetitions.

Quantitation of volatile compounds was made using "Agilent 6890" GC-FID (USA) device. Separation of flavoring agents was performed using a DB-WAX capillary column (60 m x 0.25 mm x 0.4 μm). While the injector temperature was 220°C , the detector temperature was 250°C and the column temperature was 60°C , after waiting for 3 minutes, it was adjusted to 220°C by increasing 2°C per minute. Then, it was increased to 245°C by increasing 3°C per minute and it was adjusted to remain constant at this temperature for 20 minutes. The amount of sample injected into the device is 3 μl . Helium was used as the carrier gas. The flow rate of helium is 1.5 ml/min, and the detector and injector temperatures are 250°C . Identification of volatile compounds was carried out using "Agilent 5975B VL MSD" (USA) brand mass spectrometer connected to gas chromatography. Injector type and temperature program have the same conditions as gas chromatography. The velocity of helium used as carrier gas is 1.5 ml/min. The library of mass spectroscopy (MS) and flavor standards (Std) were used to identify the volatiles. Wiley 6.0 and NIST-98 were used as libraries for the identification. Volatile compounds concentrations were calculated by using the internal standard method using the following formula (Schneider et al, 2001).

$$C_i : (A_i/A_{st}) \times C_{st} \times RF \times HF$$

C_i : Concentration of the compound

A_i : The peak area of the compound

A_{st} : Peak area of the internal standard

C_{st} : Concentration of internal standard (45.45 $\mu\text{g}/100\text{ ml}$)

RF: Response factor (response factor taken as 1)

HF: Calculation factor (factor for converting sample amount to kg: 100)

Sensory Analysis

After the storage period was completed, the flavor profile analysis and odor profile analysis forms specified by Lee et al. (2012) were used in the sensory analyzes table olives. Sensory analyzes were performed by 9 panelists using a 10-point scale. In order to determine the effect of the use of starter cultures and storage period on taste, the 'Preference (Ranking) Test' was also applied. The panelists were asked to rank the table olive samples from the most liked to



the disliked. Panelists were asked to give 1 point to the ones they liked the most and 3 points to the ones they liked the least (Altuğ Onoğur & Elmacı, 2015).

Statistical analysis

In order to see the effects of starter cultures use and storage time on table olives, the findings obtained during storage were analyzed by using the SPSS 18 package program and the significant differences were evaluated according to the Duncan multiple comparison test.

3. RESULTS and DISCUSSION

3.1. Change In Volatile Compound Of Fermented Olives During Storage

The volatile compounds identified in table olives during storage are given in Table 1. At the beginning of the storage period, from 9 different volatile groups 43 volatile compounds were identified in the control samples and 42 volatile compounds were identified in inoculated samples. At the end of 3 months of storage periods this number dropped to 40 in all treatments.

Table1. Volatile compounds of table olives during storage ($\mu\text{g}/\text{kg}$)

Volatile Acids	Control			<i>L. plantarum</i> Inoculated			<i>L. pentosus</i> Inoculated			F
	0. mth	3. mth	6. mth	0. mth	3. mth	6. mth	0. mth	3. mth	6. mth	
Acetic acid	1575.04±18.9 ^{6a}	1055.88±8.9 ^{4e}	510.49±2.35 ^f	1444.45±23.0 ^{9b}	962.43±14.0 ^{6d}	483.70±2.5 ^{5a}	1044.99±6.2 ^{1c}	661.18±10.9 ^{5e}	234.82±1.0 ^{1b}	** *
Propanoic acid	55.08±1.35 ^c	23.23±0.38 ^f	11.83±0.65 ^f	66.21±0.71 ^b	32.74±0.54 ^e	15.75±0.81 ^h	70.62±0.31 ^a	40.78±0.61 ^d	20.09±0.67 ^g	** *
2-Methyl propanoic acid	36.90±0.37 ^{dk}	41.84±0.49 ^b	46.25±0.29 ^a	28.81±0.12 ^c	34.68±0.57 ^d	38.66±0.48 ^c	25.34±0.87 ^f	30.57±4.62 ^e	36.97±0.15 ^c	** *
Butanoic acid	73.75±2.17 ^e	154.65±9.54 ^b	222.68±2.60 ^a	45.63±2.02 ^f	89.13±1.51 ^d	157.83±3.3 ^{5b}	42.89±0.78 ^f	84.81±0.79 ^d	141.09±1.9 ^{6c}	** *
Pentanoic acid	15.48±0.11 ^d	17.56±0.44 ^b	18.90±0.32 ^a	12.98±0.67 ^e	16.10±1.16 ^{cd}	16.77±0.20 ^c	12.32±0.54 ^e	15.33±0.46 ^d	16.15±0.14 ^d	** *
Hexanoic acid	35.82±0.57 ^c	40.12±0.88 ^b	45.13±1.21 ^a	20.92±0.72 ^e	24.29±0.53 ^f	29.57±0.62 ^d	20.64±0.61 ^e	23.57±0.65 ^f	27.12±0.62 ^e	** *
3,5,5 Trimethyl hexanoic acid	1.14±0.08 ^a	0.00±0.00 ^b	0.00±0.00 ^b	0.00±0.00 ^b	0.00±0.00 ^b	0.00±0.00 ^b	0.00±0.00 ^b	0.00±0.00 ^b	0.00±0.00 ^b	** *
Octanoic acid	1.84±0.10 ^d	0.88±0.08 ^e	0.00±0.00 ^f	2.87±0.05 ^a	2.39±0.12 ^b	2.13±0.06 ^c	2.92±0.02 ^a	2.44±0.21 ^b	2.17±0.08 ^c	** *
Decanoic acid	3.30±0.08 ^{ef}	1.79±0.09 ^e	1.43±0.12 ^b	5.22±0.08 ^b	3.65±0.07 ^d	3.21±0.14 ^f	5.45±0.16 ^a	4.07±0.09 ^c	3.44±0.06 ^e	** *
Higher Alcohols										
3-Penten-2-ol	194.52±3.78 ^f	203.48±4.22 ^{de}	207.60±4.33 ^{cd}	200.59±2.69 ^e	208.38±1.75 ^b	213.08±3.3 ^{5a}	207.74±2.44 ^{cd}	211.86±3.21 ^{abc}	216.83±3.4 ^{8a}	** *
3-Methyl-1-butanol	27.05±1.32 ^c	23.92±1.05 ^f	22.19±1.58 ^f	44.44±0.49 ^b	38.79±1.63 ^c	36.21±1.59 ^d	46.61±2.16 ^a	39.73±1.32 ^c	37.88±0.89 ^e	** *
1-Dodecanol	23.67±1.94 ^d	17.89±0.58 ^f	15.30±2.31 ^e	31.56±1.63 ^a	25.81±0.88 ^c	20.71±1.19 ^e	28.24±0.76 ^b	24.32±1.02 ^{cd}	21.32±0.75 ^e	** *
2-Hexanol	40.68±0.88 ^{bc}	40.61±0.67 ^{bc}	39.17±0.72 ^c	41.94±1.12 ^b	41.13±1.44 ^{bc}	39.47±0.97 ^c	45.23±2.26 ^{ac}	42.56±2.19 ^b	40.84±2.03 ^b	** *
1-Hexanol	8.92±0.27 ^b	3.33±0.49 ^{de}	1.12±0.18 ^e	11.74±1.21 ^a	3.87±0.36 ^d	1.64±0.12 ^{fe}	12.38±1.36 ^a	5.64±0.79 ^c	2.57±0.27 ^{ef}	** *
(Z)-3-Hexene-1-ol	7.74±0.88 ^c	2.68±0.20 ^e	0.00±0.00 ^f	9.47±1.40 ^b	3.12±0.09 ^e	0.15±0.04 ^f	10.69±0.40 ^a	4.32±0.61 ^d	0.46±0.10 ^f	** *
3-Octanol	6.65±0.19 ^b	5.98±0.39 ^d	5.41±0.54 ^e	8.46±0.24 ^a	6.46±0.35 ^{bc}	5.90±0.27 ^d	8.04±0.16 ^a	6.15±0.16 ^{cd}	5.87±0.17 ^d	** *
2,3-Butanediol	24.83±0.75 ^c	11.76±0.35 ^b	7.51±0.49 ^e	32.19±0.45 ^b	18.50±1.01 ^d	12.74±1.10 ^f	37.29±0.30 ^a	23.97±0.09 ^c	16.95±0.25 ^e	** *
1,2-Propandiol	3.59±0.35 ^a	0.85±0.05 ^c	0.00±0.00 ^d	1.10±0.10 ^b	0.00±0.00 ^d	0.00±0.00 ^d	0.68±0.11 ^c	0.00±0.00 ^d	0.00±0.00 ^d	** *
2-Butoxyethanol	10.08±1.02 ^c	2.77±0.15 ^f	0.00±0.00 ^e	13.23±0.64 ^b	4.15±0.52 ^e	0.00±0.00 ^e	14.60±0.78 ^a	4.99±0.43 ^d	0.00±0.00 ^e	** *
Benzyl alcohol	103.57±1.72 ^c	36.65±1.37 ^f	13.64±1.01 ^f	114.80±0.59 ^b	43.49±2.21 ^e	18.12±1.13 ^h	126.10±3.83 ^a	52.14±1.64 ^d	23.27±0.75 ^f	** *
Phenylethyl alcohol	133.26±2.54 ^e	106.11±2.25 ^g	82.02±2.06 ^h	171.85±3.53 ^b	146.60±1.27 ^d	125.37±3.2 ^{4f}	183.73±3.58 ^a	153.83±2.29 ^c	130.05±3.1 ^{2e}	** *
Aldehydes/Ketones										
(E)-2-Decanal	13.48±1.00 ^c	8.37±1.04 ^f	4.57±0.25 ^e	20.19±0.72 ^b	9.63±0.31 ^e	8.18±0.53 ^f	22.08±0.50 ^a	11.70±1.06 ^d	9.50±0.59 ^e	** *
3-Hydroxy-2-butanone	112.35±11.62 ^b	48.61±1.94 ^c	6.82±1.04 ^e	266.87±16.18 ^a	33.85±0.80 ^d	14.45±2.68 ^c	276.35±11.8 ^{4a}	41.22±1.63 ^{cd}	17.09±1.88 ^e	** *
4-Hydroxy-4-methyl-2-pentanone	106.76±6.14 ^c	42.61±1.80 ^f	15.32±1.10 ^f	124.39±3.79 ^b	81.21±0.56 ^e	26.44±0.54 ^h	146.31±4.60 ^a	94.69±1.23 ^d	35.84±0.61 ^g	** *
Esters										



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2-Hydroxy-methyl propanoate	1.94±1.81 ^b	16.96±1.75 ^b	5.91±0.82 ^c	26.90±0.19 ^a	15.48±0.76 ^c	4.82±0.23 ^c	15.03±0.73 ^c	8.02±0.42 ^d	2.18±0.29 ^f	**
2-Hydroxy-ethyl propanoate	16.39±2.01 ^{bc}	7.65±1.17 ^c	3.62±0.83 ^f	24.78±2.94 ^a	16.08±1.28 ^c	3.08±0.92 ^f	18.83±1.86 ^b	13.44±2.59 ^d	2.66±0.46 ^f	**
Bis(2-methylpropyl) benzene-1,2-dicarboxylate	5.35±0.22 ^b	3.31±0.20 ^d	2.75±0.22 ^e	6.71±0.25 ^a	4.47±0.30 ^c	3.55±0.22 ^d	6.63±0.10 ^a	4.30±0.26 ^c	3.56±0.19 ^d	**
Hydrocarbons										*
1-Methyl-3-(1'-methylcyclopropyl) cyclopentene	15.28±0.39 ^c	10.05±0.59 ^d	3.56±0.22 ^f	18.37±0.54 ^{ab}	12.33±0.78 ^d	4.77±0.53 ^{ef}	20.68±0.56 ^a	17.04±5.21 ^{bc}	6.74±0.24 ^e	**
Phenols										*
Gaiakol	27.32±0.88 ^d	17.79±0.64 ^e	11.96±0.38 ^b	31.18±0.69 ^b	23.55±0.80 ^e	15.47±0.79 ^h	39.0±1.11 ^a	29.37±0.76 ^c	21.33±1.05 ^f	**

Continuation of Table 1

Phenol, 2,6-bis (1,1-dimethylethyl)-4-methyl	11.51±1.40 ^d	8.64±0.11 ^c	4.75±0.45 ^e	18.96±0.22 ^b	11.35±0.75 ^d	6.38±0.42 ^f	20.37±0.34 ^a	14.16±0.56 ^c	7.91±0.45 ^e	**
Creosol	185.23±1.98 ^b	159.31±0.84 ^e	148.67±0.57 ^f	196.45±3.23 ^a	175.16±1.51 ^c	164.41±1.5 ^{gd}	195.09±2.36 ^a	177.42±2.55 ^c	164.37±6.4 ^{5d}	**
Phenol	4.58±0.24 ^c	2.75±0.13 ^c	2.09±0.09 ^f	5.59±0.33 ^b	3.82±0.40 ^d	2.77±0.13 ^c	7.55±0.10 ^a	5.72±0.40 ^b	3.60±0.51 ^d	**
p-Cresol	6.68±0.23 ^c	5.75±0.14 ^f	5.14±0.11 ^e	7.98±0.17 ^a	6.53±0.08 ^{cd}	6.18±0.09 ^c	7.47±0.07 ^b	6.43±0.07 ^d	6.19±0.10 ^c	**
4-Ethylphenol	15.19±0.82 ^d	12.01±0.80 ^f	9.67±0.59 ^e	18.94±0.32 ^b	14.67±0.32 ^{de}	11.90±0.47 ^f	20.73±0.65 ^a	16.90±0.54 ^c	13.86±0.21 ^e	**
di-t-butyl-phenol	2.11±0.09 ^a	1.82±0.12 ^c	0.83±0.06 ^c	1.91±0.05 ^b	0.85±0.06 ^c	0.00±0.00 ^e	1.61±0.06 ^d	0.51±0.06 ^f	0.00±0.00 ^e	**
2,4-Dimethoxy-3-methyl-phenol	2.74±0.10 ^b	1.22±0.08 ^d	0.00±0.00 ^e	3.13±0.06 ^a	1.50±0.06 ^c	0.00±0.00 ^e	3.17±0.06 ^a	1.49±0.07 ^c	0.00±0.00 ^e	**
2,6-Dimethoxy-4-methyl-phenol	5.01±0.15 ^a	0.00±0.00 ^d	0.00±0.00 ^d	3.42±0.13 ^c	0.00±0.00 ^d	0.00±0.00 ^d	3.65±0.16 ^b	0.00±0.00 ^d	0.00±0.00 ^d	**
Vanillin	0.82±0.07 ^c	0.00±0.00 ^e	0.00±0.00 ^e	2.22±0.10 ^a	1.11±0.03 ^b	0.66±0.13 ^d	2.32±0.14 ^a	1.22±0.02 ^b	0.67±0.11 ^d	**
Tyrosol	7.92±0.30 ^b	4.60±0.40 ^d	2.73±0.12 ^f	10.70±0.40 ^a	6.44±0.13 ^c	3.47±0.13 ^c	10.79±0.22 ^a	6.56±0.22 ^c	3.47±0.16 ^c	**
Terpenes										*
(E,E)- α -Farnesen	21.09±0.98 ^{ef}	12.26±0.98 ^f	14.15±18.38 ^f	46.25±3.07 ^{ab}	35.93±1.37 ^{cd}	27.04±0.58 ^{de}	51.53±0.82 ^a	39.69±0.92 ^{bc}	30.29±1.59 ^c	**
Lactones										*
Δ -Nonalactone	3.69±0.36 ^d	1.76±0.33 ^c	0.76±0.18 ^e	5.89±0.54 ^b	3.33±0.29 ^d	1.25±0.10 ^f	9.42±0.53 ^a	5.22±0.24 ^c	2.21±0.13 ^c	**
Others										*
Dimethyl sulfoxide	22.52±0.96 ^d	15.65±0.49 ^f	7.77±0.39 ^e	26.41±0.57 ^b	21.01±0.73 ^c	9.92±0.65 ^b	29.84±1.08 ^a	24.10±0.37 ^c	13.12±1.02 ^e	**
N-Methyl Benzenamine	8.92±0.85 ^f	7.06±0.33 ^e	2.24±0.14 ^b	32.12±0.98 ^b	20.04±1.29 ^d	15.89±2.04 ^e	33.97±1.39 ^a	21.91±0.44 ^c	18.82±0.59 ^d	**

* Significant at the p<0.05 level. ** Significant at the p<0.01 level. *** Significant at the p<0.001 level. Honor: not significant (p>0.05). Expressions given with different letters on the same line were found to be statistically significant (p<0.05) according to Duncan's test. Values without lettering in the same line in the table are statistically insignificant on a product basis. \pm standard deviation

At the end of 6 months storage period this number dropped to 35 in the control treatments and 37 in the inoculated treatments. At the end of the storage period, 9 higher alcohol, 8 phenol, 7 volatile acids, 3 esters, 2 aldehydes, 2 lactones, 1 hydrocarbon, 1 terpene and 2 other components were determined in the table olives obtained by the control treatments, while 11 high alcohol, 10 volatile acid, 8 phenol, 3 ester, 3 aldehyde/ketone, 2 lactone, 1 hydrocarbon, 1 terpene and 2 other components were determined.

Volatile acids constituted the largest portion of the volatile compound in all samples, followed by higher alcohols and phenols. While a total of 2180.16 $\mu\text{g}/\text{kg}$ volatile compound was determined in the control sample after 3 months of storage, it decreased to 1503.98 $\mu\text{g}/\text{kg}$ in the 6th month. In olives with added *L. plantarum*, 2204.05 $\mu\text{g}/\text{kg}$ volatile compound was identified in the 3rd month and 1551.64 $\mu\text{g}/\text{kg}$ in the 6th month. It was determined as 1973.37 $\mu\text{g}/\text{kg}$ and 1341.30 $\mu\text{g}/\text{kg}$ in table olives with added *L. pentosus*. The change in the amount of volatile



compounds of table olives during the storage period is given in Figure 1, and the total amount according to the volatile compound classes is given in Table 2.

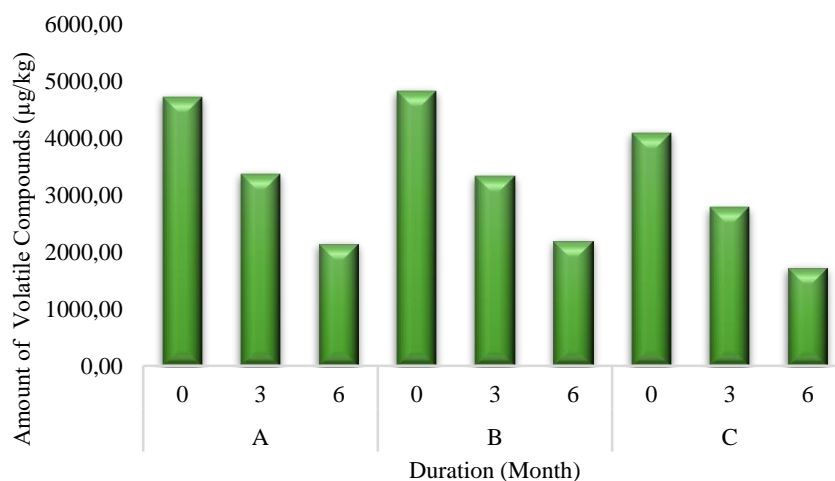


Figure 1. Change in the amount of volatile compounds during storage
A: Control, B: *L. plantarum* inoculated, C: *L. pentosus* inoculated

Table 2. Amount of volatile compounds of table olives during storage (µg/kg)

	Control			<i>L. plantarum</i> Inoculated			<i>L. pentosus</i> Inoculated		
	0. Mth	3. Mth	6. Mth	0. Mth	3. Mth	6. Mth	0. Mth	3. Mth	6. Mth
Volatile Acids	1798.35	1335.95	856.71	1627.09	1165.41	747.62	1225.17	862.75	481.85
Higher Alcohols	584.56	456.03	393.96	681.37	540.3	473.39	721.33	569.51	496.04
Aldehydes/Ketones	232.59	99.59	26.71	411.45	124.69	49.07	444.74	147.61	62.43
Esters	38.68	27.92	12.28	58.39	36.03	11.45	40.49	25.76	8.4
Hydrocarbons	15.28	10.05	3.56	18.37	12.33	4.77	20.68	17.04	6.74
Phenols	269.11	213.89	185.84	300.48	244.98	211.24	308.19	259.78	221.4
Terpenes	21.09	12.26	14.15	46.25	35.93	27.04	51.53	39.69	30.29
Lactones	3.69	1.76	0.76	5.89	3.33	1.25	9.42	5.22	2.21
Others	31.44	22.71	10.01	58.53	41.05	25.81	63.81	46.01	31.94
Total	2994.79	2180.16	1503.98	3207.82	2204.05	1551.64	2885.36	1973.37	1341.3

In the control group with storage, 3,5,5 trimethylhexanoic acid (3rd month), octanoic acid (6th month), (Z)-3-hexen-1-ol (6th month), 1,2 propanediol (6th month). months), 2-butoxyethanol (at 6 months), 2,4-dimethoxy-3-methyl phenol (at 6 months), 2,6-dimethoxy-4-methyl-phenol (at 3 months), vanillin (at 3 months)) compounds were completely eliminated. Compounds that could not be identified in the experiments with the inoculation of starter cultures; 1,2-propanediol (3 months), 2 butoxyethanol (6 months), di-t-butyl-phenol (6 months), 2,4-dimethoxy-3-methyl phenol (6 months), 2, 6-dimethoxy-4-methyl-phenol (at 3 months). The ratio of volatile compounds that contribute to the aroma of stored olives is given in Table 3. It can be seen in the table olives volatile acids showed the highest ratio. Although the rate of volatile acids decreased during storage, the highest rate was determined in control olives. This elevation is due to the high content of acetic acid in the control treatment. While the ratio of higher alcohols and phenols increased with storage, the highest ratio was determined in olives with *L. pentosus* inoculation, followed by *L. plantarum* added and control olives. While the ratios of aldehydes/ketones, esters and hydrocarbons decrease with the storage period; the proportions of phenols, terpenes and lactones increased.



Table 3. Percentage distribution of volatile compounds of table olives during storage

	Control			<i>L. plantarum</i> Inoculated			<i>L. pentosus</i> Inoculated		
	0. Mth	3. Mth	6. Mth	0. Mth	3. Mth	6. Mth	0. Mth	3. Mth	6. Mth
Volatile Acids	60.05	61.28	56.96	50.72	52.88	48.18	42.46	43.72	35.92
Higher Alcohols	19.52	20.92	26.19	21.24	24.51	30.51	25.00	28.86	36.98
Aldehydes/Ketones	7.77	4.57	1.78	12.83	5.66	3.16	15.41	7.48	4.65
Esters	1.29	1.28	0.82	1.82	1.63	0.74	1.40	1.31	0.63
Hydrocarbons	0.51	0.46	0.24	0.57	0.56	0.31	0.72	0.86	0.50
Phenols	8.99	9.81	12.36	9.37	11.11	13.61	10.68	13.16	16.51
Terpenes	0.70	0.56	0.94	1.44	1.63	1.74	1.79	2.01	2.26
Lactones	0.12	0.08	0.05	0.18	0.15	0.08	0.33	0.26	0.16
Others	1.05	1.04	0.67	1.82	1.86	1.66	2.21	2.33	2.38

The component with the highest concentration of volatile acids in table olives was acetic acid in all samples. While this component decreased with the storage period, it was determined the highest level in the control olives at the end of the 6th month. Acetic acid was followed by butanoic acid in all samples. This bad, rancid odor compound increased with storage and was highest (222.68 µg/kg) in the control sample. The statistical variation of volatile acids according to the products was found to be significant at the $p < 0.001$ level. The amounts of propanoic acid and decanoic acid decreased in all samples with storage, and at the end of the period, they were determined the highest level in olives with *L. pentosus* inoculation and the least in control olives. The amount of octanoic acid also decreased over time and could not be identified in the control samples at the end of the 6th month. The amounts of 2-methyl propanoic acid and hexanoic acid increased with storage period and these compounds were determined the highest level in table olives obtained from the control experiment.

Alcohols were the group of volatile compounds with the highest number in all treatments. Among the alcohols identified, other alcohols except 3-penten-2-ol decreased with storage. While 3-penten-2-ol was the highest determined alcohol compound in all samples, this compound was followed by phenylethyl alcohol. All alcohol compounds were found the highest level in olives with *L. pentosus* added one and the lowest level in the control one. While (Z)-3-hexen-1-ol was not found in control olives at 6 months, it was identified in small amounts in the others. 1,2-propanediol could not be determined at the end of the 6th month in the control, at the end of the 3rd month in the starter cultures inoculations. 2-butoxyethanol disappeared in all samples at the end of the 6th month. The change in alcohols during storage in all samples was statistically significant ($p < 0.001$).

Creosol was found to be the highest amount among the phenols (164.31 to 148.67 µg/kg) in all samples. During the storage period, the highest level creosol was found in *L. plantarum* inoculated treatment and followed *L. pentosus* inoculated and control. According to the amount, creosol was followed by gaiacol and 4-ethyl phenol. All phenolics compounds decreased with storage and were determined the highest concentrations in olives inoculated with *L. pentosus*. Di-*t*-butyl-phenol, eliminated at 6th months in the treatments with starter culture inoculation. 2,6-dimethoxy-4-methyl-phenol was not identified in any of the samples with storage. Vanillin was not found only in the control sample after storage. 2,4-dimethoxy-3-methyl-phenol could not be determined after 6 months of storage.

Three esters were identified during storage. However, they all decreased with storage time. While 2-hydroxy-methyl-propanoate and 2 hydroxy-ethyl-propanoate were found mostly in control samples, bis (2 methylpropyl) benzene-1,2-dicarboxylate inoculated samples were determined in higher amounts. (E)-2-decanal aldehyde decreased in all treatments and reached the range of 4.57-9.50 µg/kg at the end of the period. Higher level of (E)-2-decanal was determined in the experiments with the inoculation of starter cultures. The 3-hydroxy-2-



butanone decreased inversely with the storage period and it was determined the highest level in inoculated with *L. pentosus*.

Δ -nonalactone is the only lactone identified and this compound decreased with the storage period and the highest amount was determined in table olives inoculated with *L. pentosus*. The only hydrocarbon identified, 1-methyl-3-(1' methylcyclopropyl) cyclopentene, decreased from 15.28 $\mu\text{g}/\text{kg}$ to 3.56 $\mu\text{g}/\text{kg}$ in the control sample, 18.37 $\mu\text{g}/\text{kg}$ to 4.77 $\mu\text{g}/\text{kg}$ in the inoculated *L. plantarum* sample and 20.68 $\mu\text{g}/\text{kg}$ to 6.74 $\mu\text{g}/\text{kg}$ in the inoculated *L. pentosus* sample at the end of the storage period.

The terpene compound (E,E)- α -farnecene was found to be the highest in olives with *L. pentosus* at the end of the storage period with 30.29 $\mu\text{g}/\text{kg}$. This was followed by olives inoculated with *L. plantarum* with 27.04 $\mu\text{g}/\text{kg}$ and control olives with 14.15 $\mu\text{g}/\text{kg}$. The other two compounds identified were dimethyl sulfoxide and N-methyl benzenamine, which decreased during storage. These components were determined in higher amounts in the experiments with the inoculation of starter cultures.

Sanchez et al. (2017) stored Spanish type Manzanilla olives at 30°C for 6.5 months. For this, glass, polyethylene bags and aluminum oxide coated bags on polyethylene were used. They determined 43 volatile compounds as a result of storage and reported that 36 of them changed with the storage material. It has also been reported that the amount of volatile compounds is highest in glass packaging. Sanchez et al. (2018) identified 132 volatile compounds in Spanish type olives of Manzanilla, Gordal and Hojiblanca varieties they processed, during the fermentation stages and after two months of storage in glass packaging. They stated that while hydrocarbons, aldehydes and terpenes increased in very small amounts with the storage period, other components decreased significantly.

3.2. SENSORY PROPERTIES OF FERMENTED OLIVES AFTER STORAGE

After the storage period was completed, flavor profile analysis, odor profile analysis and preference (ranking) tests were carried out by panelists. According to the findings obtained, the spider web graphics in Figures 2 and 3 were created.

The sample with the darkest peel and flesh color was the table olives with the *L. plantarum* culture added. While the control experiment gave similar results, the experiment with the inoculation of *L. pentosus* remained lighter than the others. The bitterness was low (1.18-1.81) in all samples at the end of storage period. *L. pentosus* inoculated olives are the sample with the highest score in general taste. Treatments with the inoculation of starter cultures also achieved highest scores in general acceptability. Results other than peel color were not statistically significant.

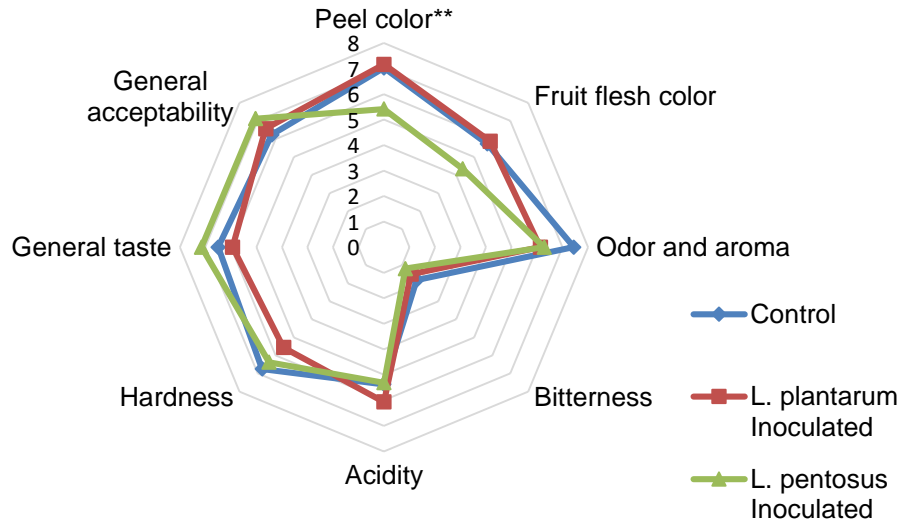


Figure 2. Flavor profile analysis results of table olives at the end of storage
** Significant at the $p < 0.01$ level.

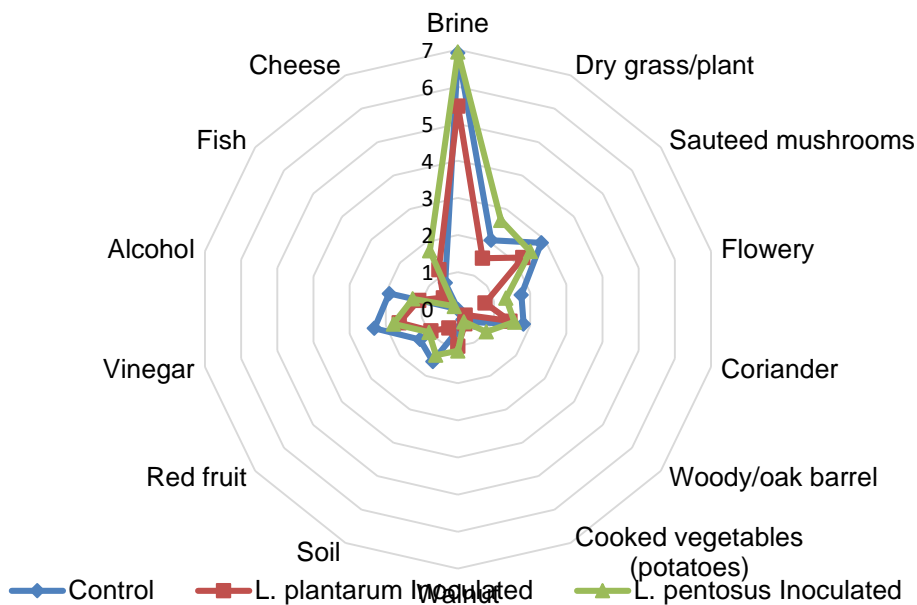


Figure 3. Odor profile analysis results of table olives at the end of storage

According to the odor profile analysis, the odor of brine was dominant in all samples. While dry herb/herbal odor was highest score in olives with *L. pentosus* inoculated; sautéed mushrooms, floral and coriander odors scored highest in olives obtained by spontaneous fermentation. As expected, earth (soil), smell vinegar and alcohol, which are undesirable odors, was felt more in spontaneous fermentation.



Table olives storage for 6 months were also evaluated with preference (ranking) test. According to the results, table olives inoculated with *L. pentosus* were the most liked treatment with 14 points and followed by *L. plantarum* inoculated treatment with 17 points. The least preferred one was the spontaneously fermented treatment with 23 points. The sensory analysis data were supported by volatile compounds results. The difference between olives inoculated with *L. pentosus* and spontaneously fermented olives was found to be statistically significant.

4. CONCLUSION

In this study, volatile compounds and sensory properties of table olives of Gemlik variety, which were fermented spontaneously with the inoculation of *L. plantarum* and *L. pentosus* starter cultures, were determined during 6 months of storage.

A decrease in the number and amount of volatile compounds was observed with the storage period. At the end of the storage, 35 different volatile compounds were identified in the control treatment and 37 different volatile compounds in the experiments with starter cultures inoculation. Volatile acids were the compounds with the highest ratio, followed by alcohols and phenols. As the storage period progressed, the amount of volatile compounds decreased and at the end of the 6th month, it was determined as 1503.98 µg/kg in the control, 1551.64 µg/kg in the experiment with *L. plantarum* inoculation and 1341.30 µg/kg in the experiment with *L. pentosus*. Other volatile compounds determined in maximum amounts in stored table olives; it was 3-penthen-2-ol, butanoic acid, phenylethyl alcohol and creosol. While compounds such as phenyl ethyl alcohol, benzyl alcohol, 2-hexanol and (E,E)-α farnecene, which give a pleasant odor such as flowers, grass and fruit, are found higher in olives with starter cultures inoculation, compounds such as acetic acid and butanoic, which cause unpleasant taste and odor were found in higher amounts in spontaneously fermented olives.

In the sensory analysis at the end of the storage period, the most liked product in the general acceptability, general taste and ranking test was the table olive fermented with *L. pentosus*. This was followed by olives fermented with *L. plantarum* and spontaneously one. The sensory evolution data supported by the volatile compound analysis results in the study.

As a result, it was determined that the preferred flavor from *L. pentosus* and volatile compounds were found in higher level compare with the two starter cultures. Studies on the use of starter cultures in table olives and the effect of cultures on volatile compounds should be continued, and data on table olives should be enriched and contribution should be made to the production of higher quality products.

ACKNOWLEDGMENT

This article is a part of the first author's Doctoral Thesis supported by Çukurova University Scientific Research Projects Unit with project number FDK-2017-7735. We thanks to Çukurova University for supporting the project.



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NATURAL FIBER COMPOSITES APPLICATION CONSTRAINTS, THEIR REMEDIES AND CHALLENGES IN THE AUTOMOTIVE SECTOR: A HOLISTIC REVIEW

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ABSTRACT

The paper aims to discuss the solutions for constraints faced by natural fibers composites along with the application for interior of automobiles along with the impact it has on the environment. The paper also explains natural fiber composites future challenges. Vehicle weight and material used is a vital factor for the cost of vehicle and fuel consumption. Fuel consumption leads to harmful emissions. Governments around the world have put strict checks and restrictions on emissions to control the depleting situation. On the other hand, if the material is not biodegradable it will add up to the landfills, resulting in land pollution. The paper takes a vertical approach on the different available natural fibers and put forwards various natural fibers that have been used for the interior of the vehicles. Natural fibers like Flax, Kenaf, Abaca, Hemp, Coir, cotton etc are used in sound proofing, seatbacks, covers, rear parcel shelves, interior trim, floor trays, pillar panels, door inner panel and floor panels. Every material have limits in its use but treatment of the material and combining with other materials and by making the matrices with reinforcements pushes the limit of the material which will be explained in this paper. The paper gives an outlook on the recent trend and forecast the challenges of natural fiber composite materials in the field of automobile applications with the long lasting use that will provide a gateway for the reduction of automotive fuel consumption and weight reduction. To cope up with the current environmental situation, automotive companies are switching to naturally occurring materials from conventional materials as raw materials. Natural fibers composite come with many advantages like low cost, low density, reduced energy consumption, and carbon dioxide reduction which give this fiber an upper hand over man-made glass fiber in many areas.

Keywords: Natural fibers, automotive application, green composites, car interior



INTRODUCTION

In the Twenty-First Century, the growing use of materials has attached importance to one of the major issue of current industrial society. The consumption of materials is rising rapidly to satisfy market demand. Manufacturers develop products with numbers of materials to fulfill their product functional requirement. Sustainable Design or Eco Design has emerged in modern industry and becoming the main focus for future market [1].

Growing need for 'green' materials has led to the increased utilization of natural fibers in the production of composite materials. Due to their annual renewability and biodegradability, natural fibers derived from agricultural residues and wood industry waste represent an ecological and inexpensive alternative to the traditional petroleum-based materials, as they significantly decrease the use of fossil fuels and reduce the greenhouse gas emissions. In addition, these materials are easy to process, recyclable, have good mechanical properties and require lower consumption of energy for their production. These natural fiber composite materials can be described as a macroscopic mixture, having an identifiable interface among two or more separate continuous and discontinuous intermediate materials. The stiffer and heavier intermittent medium than the ceaseless stage is called strengthening, and the purport steady stage is called matrix[2]. A composite material can have magnificent and unique mechanical and physical properties, as it joins the most alluring attributes of its constituents while simultaneously taking out the least attractive[3]. Due to the physical properties of natural fiber composites their application in the automotive industry is on a large scale. They are mostly being used for interior parts such as dashboards, door panels, parcel shelves, seat cushions, backrests and cabin linings. Now automobile industry is able to create cars increasing their performance and their appearance. The ability to leverage this kind of lightweight material gives a competitive advantage that will benefit the cars, as well as the production process[4].

Although natural fiber composites have many benefits as stated above but then also there are various causes which hold them back [5]. These causes are due to various factors such as lower durability than for synthetic fiber composites, high moisture absorption which in results swelling, lower strength, in particular impact strength compared to synthetic fiber composites, lower processing temperatures etc [6]. Therefore in this paper various limitations and their solutions along with the applications natural fiber composites are discussed.

Natural Fiber Composites

Agricultural products and byproducts are utilised to make fibers for biocomposites, which are then blended with various polymer-based matrices. Natural fibers known as lignocellulosic fibers are blended with biodegradable and renewable polymer matrices. Natural fibers are commonly used as reinforcements, but they can also be employed as a matrix. Biocomposites fall under the category of polymer matrix composites. Cellulose fibers are organic and are produced from biomass and associated derivatives of agricultural products [7]. Cellulose is currently considered one of the most studied and used polymers, followed by lignin [8]. In addition to cellulose, hemicellulose, lignin, and pectin, cellulose makes up about 40–60 percent of plant matter Fig1. shows structural constituents of a natural plant fiber. Anhydro-D-glucose is the most basic cellulose unit, and it contains three hydroxyls that give it its hydrophilic properties. Lignin lowers water sorption and improves thermal stability, while cellulose provides exceptional mechanical qualities. Lignin is a cementing substance that assists to bind plant parts together. It also has an impact on plant structure and characteristics. The lumen is a hollow core cavity in a fiber cell that reduces density, increases thermal insulation, and improves noise resistance. [9]. A microfibril is a basic structural unit of a plant's cell wall. The angle at which the microfibril fiber joins to the cell wall has a direct impact on mechanical



qualities and works as a reinforcing element resulting from crystallite linear linkage. Some lignocellulosic fibers have mechanical characteristics and overall strength that are equivalent to manmade fibers like fiberglass. Bio-based composite materials have seen substantial advancements in their qualities in recent years, and they are now widely employed as an alternative to conventional materials in a variety of technical sectors. Natural fiber polymer composites are innovative composite material consisting of a polymer matrix reinforced with high-strength natural fibers. The polymer materials in the composition of NFPCs can be divided into two main categories – thermosets and thermoplastics [10].

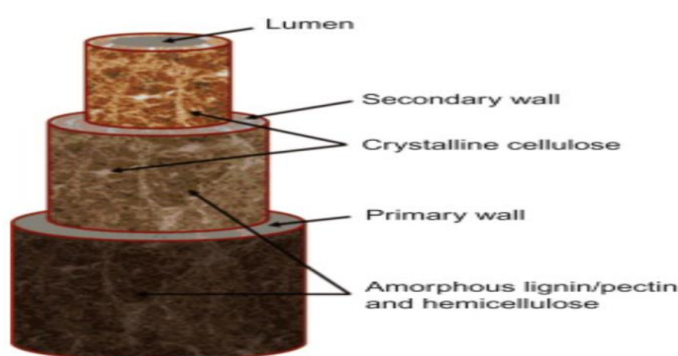


Fig 1. Shows structural constituents of a natural plant fiber.[1]

Constraints associated with natural fibers

Despite the numerous advantages of natural fibers, there are limitations that reduce their potential as a raw material by compromising the strength of the resulting composite material [11][12][13]. Some of these disadvantages include incompatibility with the matrix and insufficient adhesion, low water and thermal resistance, susceptibility to microbial attacks, etc. These disadvantages impose some limits on the application of natural fibers in composite materials, but also provide opportunities for researchers to either eliminate or minimize their effects. The main advantages and limitations of natural lignocellulosic fibers, related to their utilization for production of composite materials are listed in Table 1 [10].

Table 1. Advantages and Constraints of Natural Fibers

Advantages	Constraints
Renewable resources	Inhomogeneous structure of fibers
Lower production costs	Dimensional instability as a negative consequence of water absorption
Good specific mechanical properties	Lower water and thermal resistance
Lower density of composites	Susceptibility to microbial attacks and rotting
Reduced energy consumption during manufacturing	Insufficient adhesion and incompatibility with the polymer matrix
Biodegradability and eco-friendly materials	Degradation and aging
Lower risk to human health	Restricted processing temperature (to avoid thermal degradation)

Cellulose

Cellulose is the most common type of biological organism on the planet. Cotton and hemp fibers are purer forms of cellulose, whereas cellulose is found in conjunction with lignin and hemicellulose in wood, stalks, and leaves. A secondary wall made up of linear homopolysaccharide made up of anhydro-D-glucose contains cellulose (C₆H₁₁O₅).



The structure's 3D crystallinity and hydrophilic character are due to hydrogen bonding between hydroxyl groups (with water removal). Water absorption produces swelling because cellulose is hydrophilic, despite the fact that it is insoluble in water [14][15][16].

Poor fiber/matrix interface

Due to the dependence of biocomposites qualities on the fiber/matrix interface, adding fiber to a matrix drastically changes the matrix's properties. To achieve the majority of the requisite mechanical qualities, strong interface bonds must be ensured. Strong fiber/matrix adhesion improves a wide range of physical qualities. [17]. Reduced mechanical and physical qualities occur from a poor fiber/matrix interaction. Poor interfaces are caused by the hydrophilic nature of fiber, which leads to poor fiber dispersion in a matrix. The incompatibility of hydrophobic matrix material with hydrophilic fibers decreases the composite's ability to transfer stress between matrix and fiber. Microcracking occurs as fiber dimensions vary, altering fiber/matrix adhesion [16].

REMEDIES FOR CONSTRAINTS

Fiber Modification

Fiber modification can help natural fibers overcome issues such poor fiber/matrix adhesion, moisture absorption, low fire resistance, poor mechanical qualities, low thermal resistance, and high processing temperatures. To solve these issues, a variety of approaches are used. Due to the dependence of biocomposites qualities on the fiber/matrix interface, adding fiber to a matrix changes significantly the matrix's properties. To achieve the majority of desirable mechanical qualities, strong interface connections are required. Strong fiber/matrix adhesion improves a wide range of physical qualities [16].

Corona discharge

Corona discharge modifies natural fiber's surface energy and improves its compatibility with matrix material. Researches reveals that Tensile properties are significantly enhanced with the corona treatment of hemp fiber[16]. Corona treatment involves the use of oxygen-containing species and plasma generated by means of a high voltage to sharp electrode tips separated by quartz at low temperature and atmospheric pressure [17]. It has been shown to bring about chemical and physical changes of fibers including increased surface polarity (thought to be due to increased carboxyl and hydroxyl groups) and increased fiber roughness but is known to be difficult to apply to three- dimensional surfaces including fibers. Gassan and Gutowski treated jute fibers with corona plasma and UV, both of which increased the polarity of the fibers [6].

Plasma treatment

Plasma treatment also improves fiber/matrix compatibility. In plasma treatment, the charge is induced on the surface, and various gases can induce different modifications [16]. This is a highly effective treatment approach for changing the surface properties of natural polymers without affecting their bulk properties. Cold plasma treatment or corona treatment can be used to create the plasma discharge. Both are plasma treatment methods in which an ionized gas contains an equal number of positively and negatively charged molecules that react with the material's surface. The fundamental difference between the two types of plasmas is the frequency of the electric discharge. Microwave radiation can create cold plasma with a high frequency, but corona plasma is created by an alternating current discharge with a lower frequency at atmospheric pressure. The type of ionized gas influenced the modification of the wood and synthetic polymer surfaces reported an avenue to activate a wood surface for getting better adhesion with polyolefin by exposure to plasmas [18].



Chemical Treatment

There are various chemical treatments available in order to enhance the properties of the natural fibers. Table 2 gives some of the methods involved in the treatment.

Table 2. Different methods involved in the treatment of natural fibers

Composites	Fabrication Method	Key Findings and Mechanical Properties	Effect of Surface Treatments Alkali	References
Areca fibers/Pine resin composite	Solvent casting method	The adhesion of the fiber/matrix affects the composite's tensile strength; 10 wt.% areca fibers and 90 wt.% pine resin had shown improved mechanical properties due to efficient stress transfer between fibers and matrix.	The use of an alkali enhanced fiber/matrix adhesion. Treatment resulted in a 25% increase in tensile strength and a 24% increase in impact strength.	[19]



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Banana fibers/PLA/Nanoclay composite	Melt blending Vacuum	The addition of nanoclay and PLA to a composite increased its stability, flame resistance, and thermal properties. Nanoclay formed a protective coating on the surface to keep flames at away and served as a thermal barrier to keep the material from deteriorating.	Silane treatment improved fiber/matrix adhesion by increasing the contact area of fibers.	[20]
Flax/epoxy composite	Vacuum infusion	Flax/epoxy composite is susceptible to water absorption due to high void content.	The elimination of contaminants in sodium bicarbonate-treated fibers resulted in a lower void content. The flexural, tensile, and flexural moduli of fibers improved chemical content in the treatment increased.	[21]
Hemp fibers/polycaprolactone biocomposite	Twin screw extrusion	The composite's flexural, tensile, and impact characteristics have all been improved. Water absorption increased as the aspect ratio of hemp fiber rose. For a 26 aspect ratio, flexural strength increased by 169 percent and flexural modulus increased by 285 percent. The rigidity of the composite was improved by using hemp fibers.		[16]
Jute fibers/clay/epoxy biocomposite	Compression molding	The addition of 15 wt.% clay improved mechanical properties due to uniform dispersion in a composite. Clay can agglomerate, which increases composite porosity and decreases fiber/matrix adhesion.	Alkali treatment improved fiber/matrix adhesion with increased cellulose after removing pectin, lignin, and other impurities. An increase in cellulose content leads to better interfacial adhesion.	[22]
Ramie fibers/PLA composite	Hot compression molding	Compression moulding at low temperatures and pressures resulted in poor fiber/matrix adhesion and wettability.	Wear resistance and thermal deterioration were improved via agglomeration. At the fiber/matrix contact, treated fiber developed a layer that needed to be broken at a	[23]



			high temperature. The moisture resistance of the composite was improved by using modified fibers.	
Sisal fibers/starch composite	Hot pressing	The addition of sisal fibers enhanced the composite's compressive and tensile strength. The biodegradability of the composite was improved by the use of natural fibers.	The alkaline treatment improved mechanical characteristics by increasing fiber/matrix adhesion.	[24]

Applications

The idea of using bio-based materials in vehicle parts was first pondered by the founder of the Ford Motor company in early 1930s. Inspired by the farmers' plight, Henry Ford sought means of financially empowering them and having soil as the practical source of car parts and fuels seemed feasible. Besides, in a quest for environmentally friendly light-bodied cars, these materials offered a promise of weight and emissions regulation. Thus, the Ford motor company undertook an aggressive research into the extensive use of natural fibers in automobiles which climaxed with the unveiling of the T concept car in 1941. The year 1957 saw a major breakthrough for bio composites in the automotive with the East German built a Trabant car having a monocoque construction with the roof, bootlid, bonnet, wings, and doors manufactured from a thermosetting phenolic resin reinforced with cotton. In 1982, FIAT introduced wood floor filled door panels in the FIAT Punto. In the modern era of automotive biocomposites, the initial Mercedes Benz innovation involved using jute- reinforced plastics for the interior door panels of their 1994 E-Class model. The door was made with flax/sisal fiber mat-reinforced epoxy matrix giving a weight reduction of about 20% [25].

By continuing the development of composite materials technologies, the automobile industry is able to create cars increasing their performance and their appearance. The ability to leverage this kind of lightweight material gives a competitive advantage that will benefit the cars, as well as the production process, in the future [4]. Natural fiber composites are mostly being used for interior parts such as dashboards, door panels, parcel shelves, seat cushions, backrests and cabin linings whereas the use of natural fiber composite parts for exterior applications is very limited. As an example, the following Figure 6 shows the production of door from hemp fiber [26].

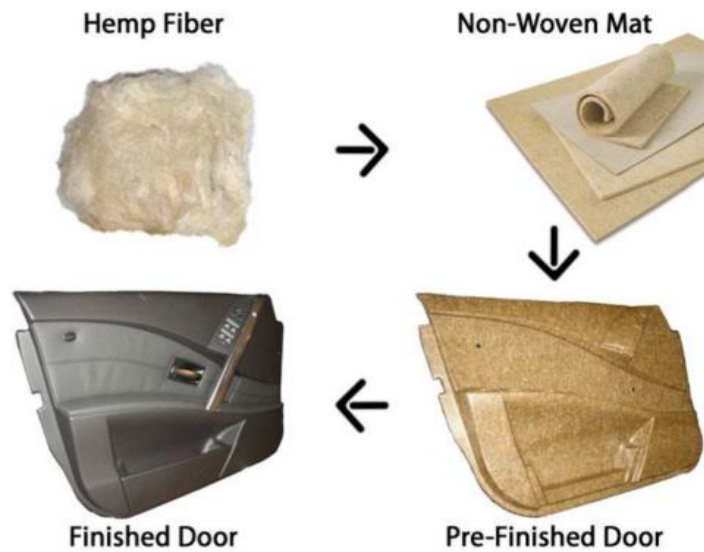


Fig 2: Car door from hemp fiber

Future Trends and Challenges

Natural fibers are lighter and have greater properties for airplanes and vehicles. But they have a variety of challenges in terms of achieving higher-quality mechanical qualities, water absorption, fiber variation, flammability, toughness, and other changes that are dependent on environmental conditions. Glass fibers are naturally hydrophobic and humidity resistant, according to previous research results. Natural fibers' hydrophilic nature might be a disadvantage, making them more difficult to compete with glass fibers. In humid conditions, the natural fibers absorb water from the environment, which in turn causes fiber bumps within the composite making it a challenge to use for the internal components of automobile and aircraft.

One of the challenges associated with natural fiber is flammability as natural fiber composites, by their very nature, have poor fire resistance, which is a major drawback for using them in aircraft parts, the automotive sector, and many other production fields where flammability is a major consideration. This disadvantage is one of natural fibers' most significant disadvantages, making it even more difficult for them to compete with synthetic fibers. Natural fibers are not thermoplastic and have a low decomposition temperature when compared to other thermal parameters like melting and glass temperature. Along with this mechanical characteristics and physical behaviour may be affected by humidity, hydrothermal, and common weathering environments. These are some of the most common problems with green fiber composites. The surface and internal adhesion of the composite are inextricably linked to the fiber toughness. The existing literature on natural fiber strength and what it takes to select the best fibers for a certain application is extremely sparse. The mechanical characteristics of natural fibers may alter as a result of changing environmental factors such as humidity and time exposure [27]. The natural fiber composites form one of the emergent areas in material science that makes awareness for use in various applications.

Discussion and Conclusions

Natural fibers have played a vital role in the development of modern bio-based products, and they have a long history in human science and culture. As a result of their environmental and financial benefits, these materials usage are expanding. Many years of research went into developing improved natural fiber composite materials. As a result, there is currently a lot of work being done on composites all over the world. The composites are arranged according to



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their applications, which include a variety of uses for a variety of qualities. The popularity of plant fiber reinforced composites has grown as a result of their easy accessibility, light weight, little effort, and environmentally friendly character [5]. The natural fiber composites form one of the emergent areas in material science that makes awareness for use in various applications [28]. Sooner or later the researchers will get the breakthrough in natural fibers and it will be used in making structural components of automobiles.



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BİYOAKTİF BİLEŞİKLERİN ANTİVİRAL ETKİLERİ

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ÖZET

Göç, küresel seyahat ve kentleşmenin artması her yıl milyonlarca kişinin viral enfeksiyonlara maruz kalmasına neden olmaktadır. Bu enfeksiyonlar ağır seyredebilir hatta ölüme bile sonuçlanabilir. Tedavide kullanılan antiviral ilaçlar hem sınırlı etkiye hem de ciddi yan etkilere sahiptir. Bu durum araştırmacıları potansiyel yeni antiviral ilaçların kaynağı olabilecek bitki dünyasına yönlendirmiştir. Tüm dünyada son yıllarda yaşanmakta olan Covid-19 viral hastalık salgını antiviral terapötikler olarak nükleik asit analoglarının, proteaz inhibitörlerinin veya diğer toksik sentetik moleküllerin yerine daha az toksik olabilecek antiviral fitomoleküllere olan ilgiyi artırmıştır. Bitkiler insan sağlığının korunmasında sinerjik rol oynayan çeşitli biyoaktif fitokimyasallar içermektedir. Fito-farmasötiklerden klinik ürünlerin geliştirilmesi, çevre dostu terapötik moleküller aramak için iyi bir yaklaşım olacaktır. Batı ülkelerinde kullanılan ilaçların %50'den fazlası bitkilerden veya bunların bileşenlerinden elde edilmektedir. Geçmişte, ümit vaat eden çeşitli tıbbi bitkilerin antiviral aktivitesinin araştırılması, virüslerin bulaşıcı doğası ve bitkilerden antiviral bileşenlerin tanımlanması için uygun ayırma tekniklerin yeteri kadar gelişmemiş olması gibi nedenlerle sınırlı olmuştur. Son yıllarda virüsün bulaşıcı olmayan moleküler klonunun antiviral tarama amacıyla kullanılabilmesi vektör tabanlı stratejilerin geliştirilmesi ve ayırma teknolojilerindeki ilerlemeler bitkilerin antiviral etkilerinin araştırılmasını daha kolay kılmıştır. Buna ilaveten, yeni antiviral tedaviler için bitkiler aleminin büyüklüğü ve bitki bileşenlerinin çeşitliliği umut verici bir kaynak olarak dikkat çekmektedir. Bu çalışmada, bitkilerden izole edilmiş farklı biyoaktif bileşenlerin çeşitli virüs gruplarına karşı potansiyel antiviral özellikleri ve bunların etki mekanizmaları hakkında kanıta dayalı veriler değerlendirilmiştir.

Anahtar Kelimeler: Tıbbi bitkiler, antiviral, fitokimyasallar



ANTIVIRAL EFFECTS OF BIOACTIVE COMPOUNDS

ABSTRACT

Increasing migration, global travel and urbanization cause millions of people to be exposed to viral infections every year. These infections can be severe and even result in death. Antiviral drugs used in the treatment have both limited effects and serious side effects. The Covid-19 viral disease epidemic, which has been taking place in recent years all over the world, has increased the interest in antiviral phytochemicals that may be less toxic, replacing nucleic acid analogues, protease inhibitors or other toxic synthetic molecules as antiviral therapeutics. Plants contain various bioactive phytochemicals that play a synergistic role in the protection of human health. The development of clinical products from phyto-pharmaceuticals would be a good approach to search for environmentally friendly therapeutic molecules. More than 50% of the drugs used in Western countries are derived from plants or their components. In the past, the investigation of the antiviral activity of various promising medicinal plants has been limited due to the infectious nature of viruses and the inadequate separation techniques for identifying antiviral components from plants. In recent years, development of vector-based strategies using the non-infectious molecular clone of the virus and advances in separation technologies have made easier to study the antiviral effects of various plants. In addition, the size of the plant kingdom and the diversity of plant components are drawing attention as a promising resource for new antiviral treatments. In this study, data on the potential antiviral properties of different bioactive components isolated from plants against various virus groups and their mechanisms of action were evaluated.

Keywords: Medicinal plants, antiviral, phytochemicals



1.GİRİŞ

Dünya üzerinde en yaygın tür olan virüsler geçmişte olduğu gibi günümüzde de önemli morbidite ve mortalite nedenidir. Bunlar influenza, gastroenterit gibi yaygın enfeksiyonlar başta olmak üzere AIDS (kazanımsal bağışıklık yetmezliği sendromu), SARS (ağır akut solunum yolu yetersizliği sendromu), Ebola, bazı kanser türleri ve son zamanlarda yaşamakta olduğumuz Covid-19 gibi ölümcül ciddi hastalıkların sebebi olmaktadır (Ege & Elmastaş, 2020). Virüs organizmaların canlı hücrelerinde çoğalabilen hem nükleik asitleri (DNA ya da RNA) hem de proteinleri içeren zorunlu hücre içi parazitidir (Anonim, 2019). Bu mikroorganizma grubu hücre duvarı ve hücre zarına sahip değildir ve metabolik olayları gerçekleştiremez. Virüsün lipit membranı bulunur ve bu membranın üzerine glikoprotein molekülleri saplanmıştır. Lipit membranın içinde protein tabakaları vardır ve çekirdek kısmını oluşturan genetik materyal bulunmaktadır (Ege & Elmastaş, 2020). Bir virüs bir hücreyi enfekte ettiğinde, hücre homeostazını etkileyerek organ işlevlerinde değişikliğe yol açmaktadır (Anonim, 2019).

Virüs ile konak hücre arasındaki ilişki genellikle özgüldür. Virüslerin bazıları sadece insan, bitki veya hayvan hücrelerini enfekte etmekte buna karşın kuduz gibi hem insan hem hayvanları etkileyen virüslerde bulunmaktadır. İlk çalışmalarda, virüsler konukçu (bitki, hayvan, insan, bakteri) çeşidine göre gruplandırılmışlardır. Çalışmalar ilerledikçe; genetik materyalin DNA veya RNA oluşu, virüsün simetrik yapısı, virüsün bir zarfla kaplı olup olmayışı, partikül çapı, moleküler ağırlığı ve partikül boyutu gibi farklı temel özellikler virüslerin sınıflandırılmasında öne çıkmıştır (Uzunogulları & Gümüş, 2017).

Virüslerin insanlara bulaşma yolları çeşitlidir. İnfluenza ve genellikle çocukluk çağı döküntülü hastalıklarından (su çiçeği, kabakulak, kızamık vb.) sorumlu olan virüsler aerosol yolla; sarılık, viral gastroenteritlere sebep olan bazı virüsler kontamine gıdalardan ve sulardan; AIDS, uçuk, kuduzca yol açan virüsler fiziksel temas yolu ile; sarıhumma ve kene humması gibi hastalıklara neden olan virüsler ise eklem bacaklı ve kene gibi hayvanların ısırması ile bulaşmaktadır (Ege & Elmastaş, 2020). Son olarak Covid-19 salgını ile ilişkili virüs SARS CoV2 ve MERS-CoV olarak adlandırılmakta ve bu virüsün de damlacık yoluyla bulaştığı bilinmektedir.

Ortaya çıkan enfeksiyonlar ve viral hastalıklar insan sağlığı açısından ciddi tehdit oluşturmaktadır çünkü yeni ve özellikle zoonotik insan hastalıklarının ortaya çıkışını etkileyen faktörler (nüfus artışı, coğrafi genişleme, tarımın yoğunlaşmasına bağlı olarak doğal yaşam alanlarının bozulması, küresel seyahat ve ticaretteki artış) giderek artmaktadır. Bu durum viral hastalık salgınlarının tespiti bunlara bağlı yanıtın özel dikkat konusu olması ve öneri politikalarının iyileştirilmesi gerektiği anlamına gelmektedir. Konuyu ele almak sonuçları hızlı ve başarılı bir şekilde elde etmeye çalışmak ve konuyla sinerjik bir şekilde yüzleşmek için farklı mesleki becerileri entegre etmek gerekir (Anonim, 2019).

Antiviral tedavi viral hastalık semptomları ile bulaşıcılığı en alt düzeye indirmeyi ve tedavi sürecini kısaltmayı amaçlamaktadır. Antiviraller farklı şekillerde viral replikasyon basamaklarına etki etmektedir. Mevcut antiviral ilaçlar, viral şeklin edinilmesinde veya replikasyon döngüsünde yer alan spesifik viral enzimler üzerinde etki ederek onları potansiyel hedefler haline getirir. Örneğin asikloguanosin, nükleotid analogları için afiniteleri olan belirli anahtar herpes viral enzimlerine müdahale ederken, edinilmiş immün yetmezlik sendromuna neden olan retrovirüslerin tedavisi için bazı ilaçlar viral retrotranskriptaz veya proteaz inhibitörleridir (Denaro ve ark., 2020).

Günümüzde, tüm viral enfeksiyonlar için antiviral bir tedavi bulunmamaktadır. Mevcut tedavide kullanılan antiviral ilaçların çoğu, Herpes virüsleri, Hepatit B ve C virüsleri, HIV ve İnfluenza A ve B virüslerinin sebep olduğu enfeksiyonların tedavisinde etkin olmaktadır.



Virüslerin zorunlu, hücre içi parazitler olması nedeniyle, konak hücreye zarar vermeden viral replikasyonu önleyen hedefler bulmak diğer antimikrobiyal ilaçlardan çok daha zordur (Dar ve ark., 2019). Bunun dışında mevcut sınırlı ilaçların etkinliğine engel olan viral enzime özgü inhibitörler dirençli mutantlar geliştirebilmekte ve bu durum hastalık seyrini daha kötüye götürebilmektedir. Antiviral ajanlar maliyetli olmalarının yanında beklenen etkiyi viral direnç nedeniyle de sağlayamayabilmektedirler. Ayrıca bazı yan etkiler de gösterebilmektedir (Ege & Elmastaş, 2020). Bunlar gibi nedenlerle antiviral tedavideki gelişmeler gerek antibakteriyel gerekse antifungallere göre daha yavaş ilerlemektedir. Bu süreç günümüzde hala devam etmektedir (Dar ve ark., 2019).

Virüslerin hücrelere yolculukları ve içlerindeki replikasyonları boyunca binlerce hücrenel proteinle etkileşime girdiği gösterilmiştir. Viral replikasyon için en önemli etkileşimlerin ne olduğu tam olarak bilinmemekte ve hücrenel proteinlerin bir kısmı diyabet ve otoimmün hastalıklar gibi bulaşıcı olmayan hastalıklarda düzensiz olduğu söylenmektedir (Anonim, 2019). Virüslerin hücrelerde tutunmasına veya kopyalanmasına yardımcı olan molekülleri hedeflemeye dayanan antiviral ilaçlar için yeni stratejiler geliştirilmeli viral enfeksiyonların yönetimi ve kontrolü için yeni antivirallerin keşfi gerekmektedir.

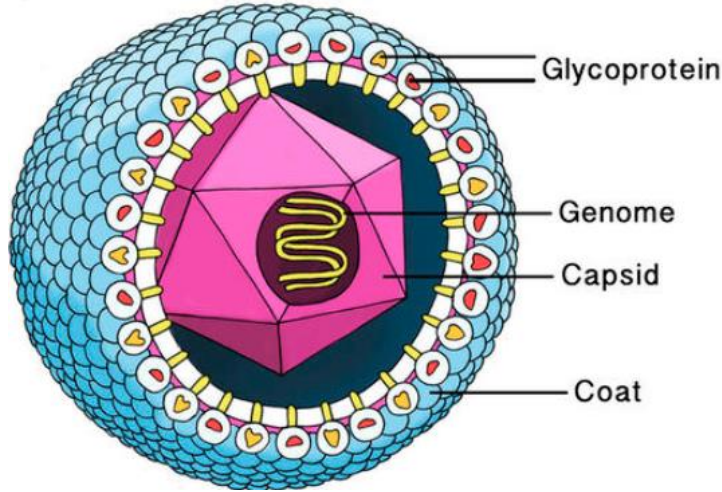
Bu anlamda tıbbi bitkiler yeni antiviral ajanların geliştirilmesi için önemli bir potansiyel taşımaktadırlar. Çünkü bitkilerde bulunan özellikle flavonoidlerden glisirizin, kuersetin, silimarin, ve kurkumin gibi bileşiklerin antiviral etkileri gösterilmiştir (Güçlü & Yüksel, 2017). Ayrıca bitkiler antiviral etkileri dışında antiinflamatuvar, antibakteriyel, antifungal gibi birçok farklı etkiyi gösterebilecek kompleks bir yapıya da sahiptir. Böylelikle bitkisel ekstraktlardan, ayrıştırılacak fitokimyasallar oldukça zengin bir kaynak teşkil edecektir (Ege & Elmastaş, 2020).

Bu çalışmada, bazı tıbbi bitkilerde bulunan biyoaktif bileşenlerin çeşitli virüs gruplarına karşı potansiyel antiviral özelliklerini ve antiviral fitokimyasallar hakkında bilgileri derlemek amaçlanmıştır.

2.VİRÜSLER

Yakın bir geçmişe kadar virüsler açısından sağlıklı insan vücudu anlamlı bir bulaşma olmadıkça steril olarak kabul edilmekteydi. Oysa sağlıklı bir insan vücudu çok sayıda virüs ve yabancı hücre içermektedir (Virgin, Wherry, & Ahmed, 2009). Çoğu virüs sürekli patojen olmamakla birlikte konağın sağlık ve immünolojik durumlarına bağlı olarak farklı sonuçlara neden olmaktadır (Altındış, 2020, s. 109). Virüs, enfeksiyöz süreçlerini yürütmek için konakçı hücrenin mekanizmalarına ihtiyaç duyan zorunlu hücre içi organizma olarak tanımlanmaktadır (Dar ve ark., 2019). Virom ise insan mikrobiyomunun virüslere ilaveten insan genomu ile bütünleşmiş endojen Retrovirüsler gibi virüslerin toplamı olarak ifade edilmektedir (Altındış, 2020, s. 109).

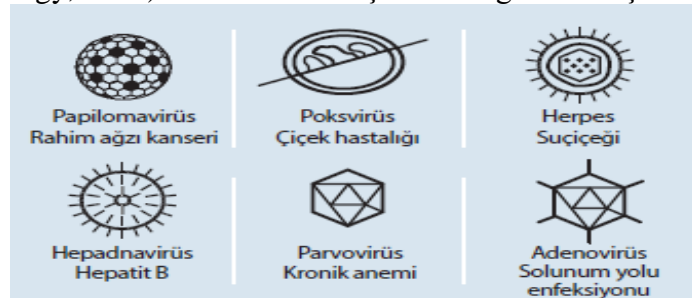
Virüsler yapılarına göre değişir. Bir virüs parçacığı, kapsid adı verilen koruyucu bir protein kaplaması içindeki DNA veya RNA'dan oluşur (Şekil 1). Kapsidin şekli bir virüs türünden diğerine değişebilmektedir. Kapsid, genomların içindeki viral genler tarafından kodlanan proteinlerden yapılmaktadır. Viral olarak kodlanmış proteinler, bir kapsid oluşturmak için kendi kendine birleşmektedir. Bazı virüslerin bir fosfolipit ve protein zarfı vardır. Zarf, konağın hücre zarının bölümlerinden yapılı ve kapsidi çevreleyerek virüsün konakçı bağışıklık sisteminden korunmasına yardımcı olur. Zarf ayrıca, konakçı hücreler ile bağlanabilen reseptör moleküllerine sahip olabilir ve virüsün hücrelere bulaşmasını kolaylaştırabilir (LibreTexts, 2020).



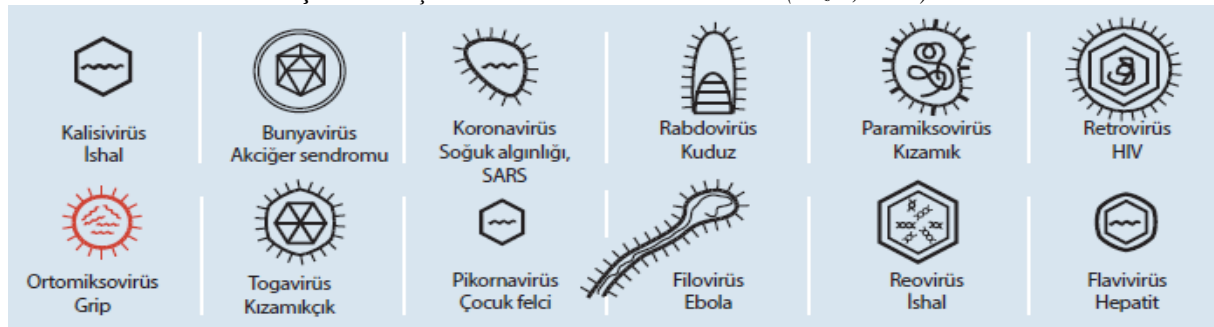
Şekil 1. Sitomegalovirüs (LibreTexts, 2020)

Virüsler, çekirdek içerikleri (DNA veya RNA), kapsid yapıları, dış zarfın varlığı ve mRNA'nın nasıl üretildiği gibi faktörlere göre sınıflandırılmaktadır.

DNA virüslerinde, viral DNA, konakçı hücrenin replikasyon proteinlerini viral genomun yeni kopyalarını sentezlemeye ve bu genomu viral proteinlere kopyalayıp çevirmeye yönlendirir. DNA virüsleri, suçiçeği, hepatit B gibi insan hastalıklarına ve herpes ve genital siğiller gibi bazı zührevi hastalıklara neden olmaktadır (Biology, 2020). DNA virüsleri Şekil 2'de gösterilmiştir. RNA virüsleri, genetik materyalleri olarak yalnızca RNA içerir. Konakçı hücrede genomlarını kopyalamak için RNA'yı DNA'ya kopyalayabilen enzimleri kodlar, bu da konakçı hücre tarafından yapılamaz. Bu RNA polimeraz enzimlerinin, DNA polimerazlara göre kopyalama hataları yapma olasılığı daha yüksektir ve bu nedenle, çoğu kez transkripsiyon sırasında hata oluşmaktadır. Bu nedenle RNA virüslerindeki mutasyonlar, DNA virüslerine göre daha sık meydana gelir. Bu onların değişmelerine ve konakçılarına daha hızlı uyum sağlamalarına neden olur. RNA virüslerinin neden olduğu insan hastalıkları arasında grip, Hepatit C, kızamık ve kuduz bulunur (Biology, 2020). RNA virüsleri Şekil 3'te gösterilmiştir.



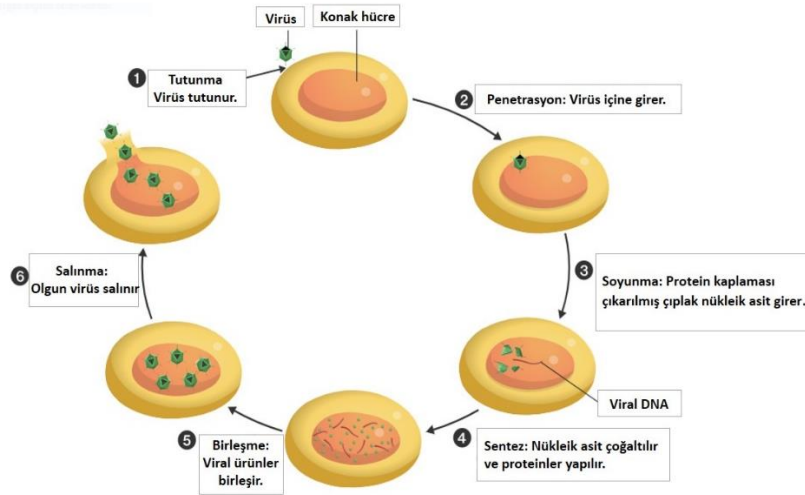
Şekil 2. Taşıdıkları nükleik asit DNA olanlar (Sezer, 2020)



Şekil 3. Taşıdıkları nükleik asit RNA olan virüsler (Sezer, 2020)



Bir virüsün bir hücreye girebilmesi için öncelikle hücre yüzeyine tutunması gerekir. Bu tutunma (adsorpsiyon) virüsün kapsid veya zarfı üzerindeki tutunma proteinlerinin hedef hücre üzerindeki reseptörle ilişki kurulması ile gerçekleşir. Virüslerin konak hücre ile reseptör ilişkisi konak seçiminde önemli rol oynamaktadır. Bazı virüsler birkaç hücre tipini enfekte ederken bir kısmı ise daha geniş bir konak spektrumunu gösterebilmektedir. Virüsler konak hücre reseptörü ile ilişki kurduktan sonra genetik materyallerini konak hücreye iletmeleri zarflı veya zarfsız olmalarına göre farklı mekanizmalar ile gerçekleştirmektedir. Zarflı virüsler genellikle membran fizyonu ve endositoz ile hücre içine iletirken zarfsız virüsler penetrasyon ile genetik materyallerini konak hücre içine enjekte etmektedir. Virüsle, konak hücrelerin enfeksiyonu sırasında yeni virüslerin üretilmesi olayı viral replikasyon olarak ifade etmektedir (Şekil 4). Replikasyon virüsün genetik materyaline göre (DNA veya RNA) farklı mekanizmalar ile gerçekleşmektedir. DNA virüslerinin replikasyonu genellikle konak hücre çekirdeğinde gerçekleşirken RNA virüslerinin replikasyonu sitoplazmada meydana gelmektedir. Virüsler genetik materyallerini kopyalamak ve yeni virüs partikülleri oluşturmak için sürekli yeni hücreleri enfekte etmeye devam etmekte ve böylece türlerinin devamlılığını sağlamaktadır (Süzergöz, 2016).



Şekil 4. Viral replikasyon adımları (Coursehero, 2020)

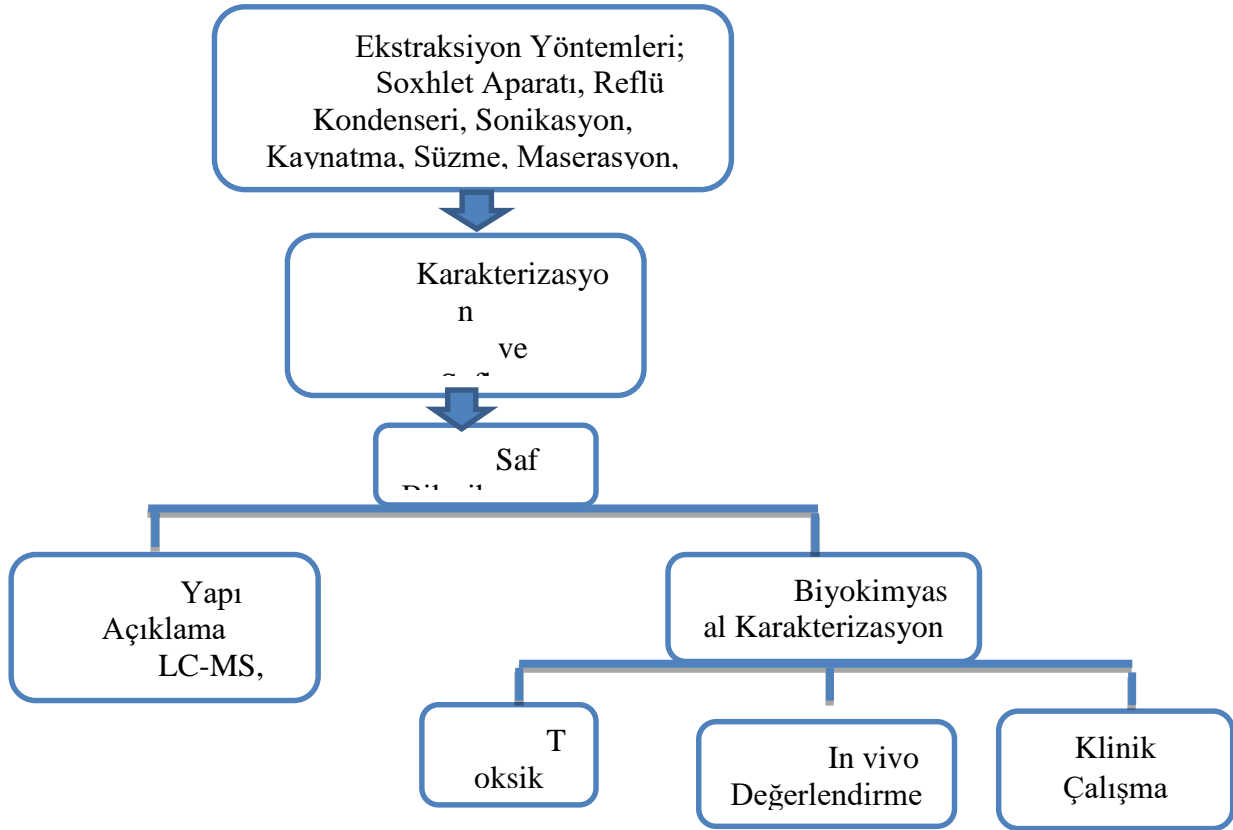
3. BİYOAKTİF BİLEŞENLER

Gıdaların doğal yapısında bulunan biyoaktif bileşenler; fizyolojik ve hüresel aktiviteleri etkileyerek sağlık üzerine olumlu yönde katkı sağlayan ikincil metabolitlerdir. Biyoaktif bileşenler, birincil metabolitler olarak bilinen karbonhidrat, protein ve yağ gibi canlılığın büyüme ve gelişmesi için olmazsa olmaz ana besin kaynakları içinde değildir. Ancak günümüzde sıkça karşılaşılan obezite, diyabet, kanser ve kalp damar hastalıkları riskini azaltıcı ve önleyici etki göstermektedirler (Nizamlioğlu & Nas, 2010).

Biyoaktif maddeler, geniş kimyasal fonksiyon ve yapıya sahip bileşiklerdir. Yapılarına göre karotenoidler, fenolik bileşikler, glikosinolatlar, lignanlar, organosülfür bileşikleri ve bitki steroller gibi bazı alt gruplara ayrılmaktadır (Nizamlioğlu & Nas, 2010).

Biyoaktif bileşenlerin pek çok sağlık yararları bulunmakla birlikte çeşitli hastalıkların tedavisinde de kullanılmaktadırlar. Anti-inflamatuar, antibakteriyel, antioksidan, antiviral, diüretik, analjezik, etkilere sahip bu bileşiklerin ekstraksiyonu, karakterizasyonu, saflaştırılması ve yararlı sağlık etkilerinin ortaya çıkarılması, yeni ilaçları keşfetmenin yollarını kolaylaştıracaktır (Ahmad, 2017).

Bitkilerden biyoaktif bileşiğin ekstraksiyonu, izolasyonu ve karakterizasyonundaki genel yaklaşımlar Şekil 5'te özetlenmiştir.



Şekil 5. Bitki ekstraktından biyoaktif bileşiğin ekstraksiyonu, izolasyonu ve karakterizasyonundaki genel yaklaşımlar (Sasidharan ve ark., 2011)

3.1.Fenolik Bileşikler

Bitkilerde doğal olarak en çok bulunan sekonder metabolit fenolik bileşiklerdir. Fenolik bileşikler, temelde bir veya daha fazla hidroksil grubuna bağlanan bir aromatik halkadan oluşur bu nedenle basit fenol molekülünden yüksek moleküler ağırlıklı polimerlere kadar değişir. Tahıllar, meyveler, sebzeler gibi bitkisel gıdalarda yaygın olarak bulunur ve vücudumuza en çok alınan antioksidan bileşikler olarak kabul edilir. Onları diğer antioksidan bileşiklerden farklı kılan, moleküler yapılarındaki çeşitliliğidir. Fenolik bileşikler antioksidan özelliklerinden dolayı oksidatif stres altında vücut dokularını koruduğu ve oksidatif stresle ilişkili birçok ölümcül hastalık (kalp damar hastalıkları, kanser, iltihaplı hastalıklar vb.) riskini azalttığı için son yıllarda dikkatleri üzerine toplamıştır. Antioksidan yeteneği, serbest radikalleri temizleme ve elektron verme veya metal katyonları şelatlama gücünden kaynaklanmaktadır (Ahmad, 2017). Fenolik bileşikler, fenolik asitler ve flavonoidler olmak üzere başlıca iki ana başlıkta incelenir.

3.1.1. Fenolik Asitler

Fenolik asitler hidroksisüsamik asitler ve hidroksibenzoik asitler olmak üzere iki gruba ayrılır (Şekil 6) (Evcimen & Aslan, 2015).



Asit	R1	R2	R3	Asit	R1	R2	R3
<i>p</i> -Hidroksibenzoik	H	OH	H	<i>p</i> -Kumarik	H	OH	H
Pirokate şüik	H	OH	OH	Kafeik	H	OH	OH
Vanilik	CH ₃ O	OH	H	Ferulik	CH ₃ O	OH	H
Siringik	CH ₃ O	OH	CH ₃ O	Sinapik	CH ₃ O	OH	CH ₃ O
Gallik	OH	OH	OH				

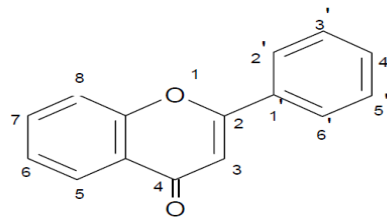
Şekil 6. Fenolik asitlerin genel yapısı: a) Benzoik asit türevleri b) Sinamik asit türevleri (Nizamlıoğlu & Nas, 2010)

Bu bileşikler, karboksilik asidin bağlı olduğu bir benzen halkası ve ayrıca benzen halkasına bağlı bir veya daha fazla hidroksil veya metoksil grubu içerir (Ahmad, 2017).

Fenolik asitler genel olarak serbest halde bulunmaz. Karboksil grupları karbonhidratlar, proteinler veya aminoasitler ile reaksiyona girebilir ve alkollerle fenol esterleri, amino bileşikleriyle de amidleri oluşturabilir. Bu asitlerin enzimsel aktivitelerinin kontrolü, nitrozaminlerin oluşmasının engellenmesi ve kan lipid düzeyi dengesizliklerinin giderilmesinde aktif rolleri olduğu bilinmektedir (Evcimen & Aslan, 2015).

3.1.2. Flavonoidler

Flavonoidler, fenolik bileşiklerin en yaygın grubudur (Şekil 3). Difenilpropan (C₆-C₃-C₆) yapısındadır. Propan zinciri ile birleşen iki fenil halka ve 15 karbon atomundan oluşurlar. Yapısında bulunan hidroksil grupları reaktif özelliklerinden dolayı kolaylıkla glikozitlenir. Yapısal olarak beş gruba ayrılırlar; antosiyanidinler, flavonlar ve flavonoller, flavanonlar, kateşinler ve löykoantosiyanidinler, proantosiyanidinler (Nizamlıoğlu & Nas, 2010).



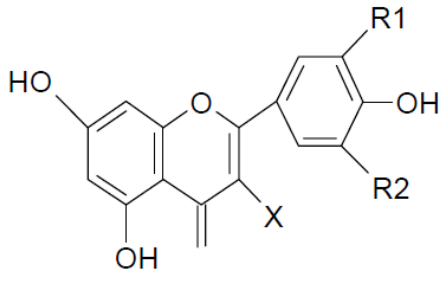
Şekil 7. Flavonoidlerin genel yapısı (Nizamlıoğlu & Nas, 2010)

Antosiyanidinlerin glikozit formu olan antosiyaninler bitkilerdeki suda çözünebilir pigmentlerin en önemli grubudur. Bitkilerde siyanidin, delphinidin, pelargonidin, peonidin, malvidin, ve petunidin gibi farklı çeşitleri olan antosiyanidinler esas olarak çiçeklerde, pulplarda, meyve kabuklarında bulunmaktadır. Bu bileşikler, ortamın pH değerine bağlı olarak turuncu, kırmızı ve mavi renk vermektedir (Yıldız, 2012).

Flavonlarda orta halkanın 3. karbon atomuna (H), flavanollarda ise (OH) grubu bağlanmıştır (Şekil 8) (Nizamlıoğlu & Nas, 2010). Flavonlar açık sarı renkli bileşikler olup hemen her

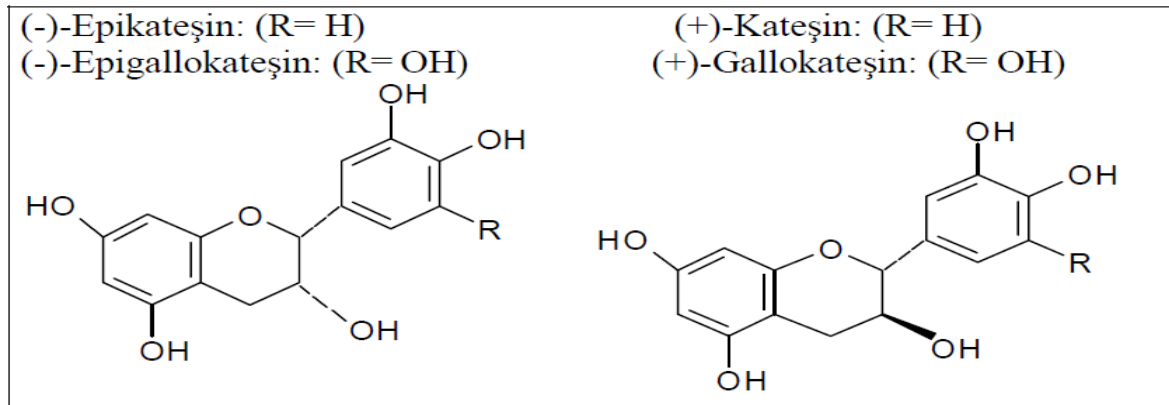


bitkide bulunmaktadır. Flavonoller gıdalarda yaygın olarak glikozid formunda bulunup başlıcaları kaemferol, kuersetin, mirisetin, isoramnetindir (Saldamlı, 2014, s. 571,572).

	Flavonollar (X = OH)	R1	R2	Flavonlar (X = H)	R1	R2
	Kamferol	H	H	Apigenin	H	H
Kuersetin	OH	H	Luteolin	OH	H	
Mirisetin	OH	OH	Krisoeriol	OCH ₃	H	
isoramnetin	OCH ₃	H	Trisin	OCH ₃	OCH ₃	

Şekil 8. Flavonollar ve flavonların kimyasal yapıları (Nizamloğlu & Nas, 2010)

Flavanonon glikozidleri özellikle turunçgil meyvelerinde yaygın bulunmaktadır. Başlıcaları naringin, naringenin ve hesperidindir (Nizamloğlu & Nas, 2010). Hemen her meyvede bulunan kateşinler gıdalarda en yaygın bulunan flavonoid grubunu oluştururlar. Bu grup (Şekil 9) hem kimyasal hem de enzimatik olarak hava oksijeni kolayca reaksiyona girerek kondanse proantosiyanidinleri oluştururlar (Saldamlı, 2014, s. 573,574).



Şekil 9. Yaygın olarak bulunan kateşinlerin kimyasal yapıları (Nizamloğlu & Nas, 2010)

Lökoantosiyanidinler gıdalarda serbest olarak bulunmazlar. Gıdalarda bulunan bu bileşiklerin proantosiyanidin olduğu bildirilmiştir (Saldamlı, 2014, s. 574). Proantosiyanidinler, kateşinlerden veya lökoantosiyanidinlerden oluşan polimerik yapılar olup sadece epikateşin/kateşin ünitelerinin kondensasyonu ile oluşuyorsa prosiyanidin, kateşin/gallokateşin ünitelerinin kondensasyonu ile oluşuyorsa prodelfinin olarak adlandırılmaktadır (Nizamloğlu & Nas, 2010).

3.2. Stilbenler (Resveratrol)

Bitki dünyasında oldukça yaygın olan bir diğer polifenol grubu stilbenlerdir. Stilben ailesine ait en yaygın bileşik resveratrol (3,5,4'-trans-trihidroksistilben)'dür. Resveratrol esas olarak üzüm kabuğunda ve tohumlarında oluşan, aynı zamanda şaraplarda ve diğer çeşitli bitki besinlerinde, özellikle yer fıstığı, çilek ve çayda bulunan doğal bir diyet bitki bileşiğidir. Çeşitli çalışmalarda anti-glikasyon, antioksidan, anti-inflamasyon, nöroprotektif, anti-kanser ve yaşlanma önleyici aktivite gibi geniş bir biyolojik aktivite taşıdığı belirtilmiştir (Galiniak ve ark., 2019).



3.3. Karotenoidler

Karotenoidler genellikle yağda çözünen bazı sebze ve meyvelere sarıdan kırmızıya kadar renk veren bileşiklerdir. Lutein, likopen, α -karoten, β -karoten, β -kriptoksantin ve zeaksantin en yaygın olarak bilinen karotenoidlerdir. β -kriptoksantin, α -karoten ve β -karoten A vitamini öncüsü olan karotenoidlerdir (Barut Uyar & Sürücüoğlu, 2010). Karotenoidlerin kaynakları Tablo 1'de gösterilmiştir.

Tablo 1. Karotenoidlerin alt grupları ve ana kaynakları (Barut Uyar & Sürücüoğlu, 2010)

KAROTENOİDLER	KAYNAKLARI
Likopen	Domates ve domates ürünleri, kayısı, kırmızı havuç, greyfurt, papaya, guava, kavun, karpuz, trabzon hurması
α -karoten	Havuç, mango, kırmızı biber, ıspanak, brokoli
β -karoten	Kayısı, brüksel lahanası, brokoli, karalahana, havuç, yeşil yapraklı sebzeler, guava, yenidoğruya, mango, şeftali, hurma yağı, tatlı patates, mısır
Lutein	Yumurta sarısı, ıspanak, brokoli, brüksel lahanası, bal kabağı, biber
Zeaksantin	Trabzon hurması, biber, balkabağı, tatlı mısır
β -kriptoksantin	Papaya, Trabzon hurması, mandalina, balkabağı, avokado, portakal

Bu bileşiklerin antioksidan, antikanserojen, immunomodulator etkileri bilinmekle birlikte yapılan bazı çalışmalar kanser, kalp hastalığı gibi kronik hastalıkların gelişim riski ile yaşa bağlı dejenerasyonu ve katarakt gelişme riskini azalttığını göstermektedir (Mares, 2016).

3.4. Glukosinolatlar

Glukosinolatlar, esas olarak Brassicaceae familyasında (kolza tohumu, turp, brokoli, lahana vb) bulunan ikincil metabolitlerdir. 120 çeşit farklı zincir uzunluğunda glukosinolat tanımlanmakta ve zincir uzunluklarına göre alifatik, aromatik ve indol olmak üzere üç ana grupta incelenmektedir. Glukosinolatların enzimatik hidrolizi ile izotiyosiyanatlar, indoller ve tiyosiyanatlar oluşmaktadır. Bu maddeler hardal, turp gibi bitkilerin karakteristik tadını sağlamaktadır. Hidroliz ürünlerinin yüksek miktarı bitkiye acı bir tat kazandırmaktadır. Glukosinolatların antifungal, antibakteriyel, biyoherbisidal, biyopestisidal, antioksidan, antimutajenik ve antikarsinojenik etkiler gösterdikleri bildirilmekte antikanserojen etkilerinin hidroliz ürünlerinden geldiği düşünülmektedir (Barut Uyar & Sürücüoğlu, 2010).

3.5. Lignanlar

Lignanlar sindirilemeyen karbonhidratların heteropolimerleri olarak bilinmekle birlikte bitkilerin köklerinde ve tohumlarında bulunan bir fenilpropil alkoldür. İntestinal bakteriler tarafından bitkisel lignanlar enterolignanlara dönüştürülerek antioksidan ve östrojenik aktivite göstermektedir. Dört farklı enterolignan bilinmektedir. Bunlar; secoiso-lariciresinol (SECO), matairesinol (MAT), lariciresinol (LARI) ve pinosinoldür (PINO). Tam tahıllar bazı meyve (çilek vb) ve sebzeler, fındık, keten tohumu vb yağlı tohumlar lignan kaynaklarıdır (Barut Uyar & Sürücüoğlu, 2010).

Lignan bakımından zengin gıdaların diyetle alınması belirli kanser türlerini (örneğin menopoz sonrası kadınlarda meme kanseri ve kolon kanseri) önleyebilmektedir. Kronik yaşam tarzı ile ilgili hastalıklarla ilgili olarak, bazı kanıtlar, lignan alımının daha düşük kardiyovasküler hastalık geliştirme riski ile ilişkili olduğunu göstermektedir (Rodríguez-García ve ark., 2019).



3.6. Organosülfür Bileşikleri

Sülfür esansiyel bir element olmakla birlikte sülfür içeren bileşikler hücre biyokimyasında önemli bir rol oynamaktadır. Bu bileşikler içerisinde yer alan ve doğal olarak oluşan organosülfür bileşikleri soğan, soğancık, sarımsak, pırasa gibi yiyeceklerde bulunmaktadır (İrkin & Değirmencioglu, 2006). Bazı organosülfür bileşikleri (Diallil sulfit (DAS), diallil disülfid (DADS), allisin, diallil trisülfid (DATS) ve diallil tetrasülfid (DATT)), sarımsak ve soğanın kendine özgü tat ve kokusunu vermektedir. Organosülfür bileşiklerini içeren besinlerin antioksidan, antibakteriyel, antiinflamatuvar, antikanserojen, antitrombotik, immunoregülatör ve antikarsinojenik etkileri olduğu belirtilmiştir (Barut Uyar & Sürücüoğlu, 2010).

3.7. Bitki Sterolleri

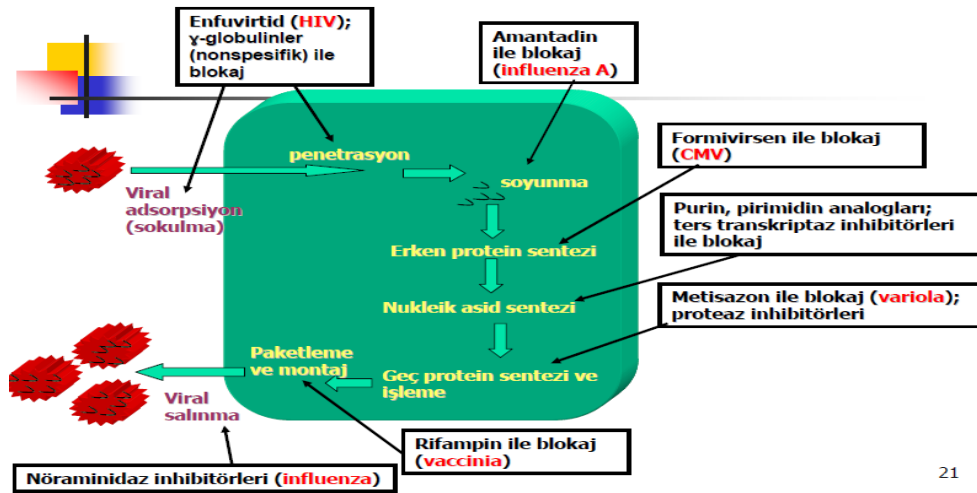
Bitkisel sterolleri (fitosterol) yapılarında kolesterolden farklı olarak ekstra bir etil veya metil grubu ile bir çift bağ bulundurlar (Barut Uyar & Sürücüoğlu, 2010). En yaygınları kampesterol (24- α -metilkolesterol), β -sitosterol (24- α -etil kolesterol) ve stigmasteroldür. En iyi kaynakları tam tahıllar, yağlı tohumlar (findık), bitkisel yağlar (kolza tohumu, buğday tohumu, mısır) sebze ve meyvelerdir. Çalışmalarda lipid bileşenlerinden LDL-K serum seviyelerini ve kolesterolün bağırsaktaki emilimini azaltarak düşürdüğü bildirilmektedir. Ayrıca, meme, mide, prostat vb. bazı kanser türlerine karşı koruyucu etkileri ile birlikte antibakteriyel, antifungal ve antiülser etkileri de olduğu bildirilenler arasındadır (Çekici & Yıldırım, 2019).

4. ANTİVİRAL ETKİLİ BİYOAKTİF BİLEŞENLER ve ETKİ MEKANİZMASI

Bugün mevcut olan farklı antiviral ajanlar HIV (insan immün yetmezlik virüsü), HSV (*Herpes simplex* virüsü), hCMV (insan sitomegalovirüsü), VZV (suçiçeği zoster virüsü), influenza virüsleri ve hepatit virüsleri gibi viral kaynaklı hastalıkları tedavi edebilmektedir. Ancak günümüzde pek çok tip veya virüs için tedavide onaylanmış az sayıda ilaç vardır. Aşılama ile hepatit A virüsü, kabakulak ve suçiçeği gibi ancak sınırlı sayıda hastalık tedavi edilebilmektedir (Nováková ve ark., 2018).

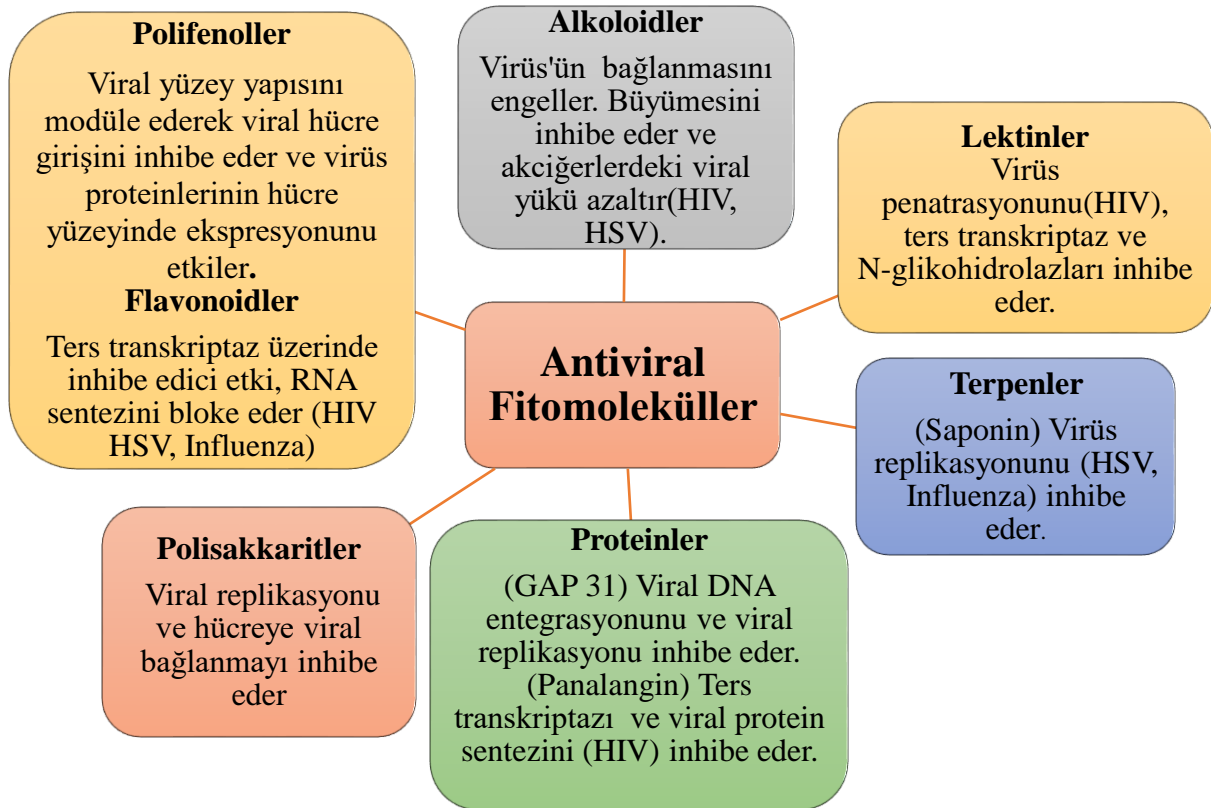
Ayrıca özellikle ilaç etkinliğini önemli ölçüde engelleyen viral enzime özgü inhibitörler kullanıldığında ilaca dirençli mutantların potansiyel gelişimi ile durum daha da kötüye gidebilmektedir (Sheu ve ark., 2008). Bu ajanlar maliyetlidir ve viral direnç nedeniyle zaman zaman beklenen etkiyi sağlayamamakla beraber bazı yan etkilere neden olabilmektedir.

Viral replikasyon; adsorpsiyon, penetrasyon, viral nükleik asitin çıplak kalması, nükleik asit polimeraz gibi regülatuar proteinlerin erken sentezi, DNA veya RNA'nın sentezi, geç dönem yapısal proteinlerin sentezi, viral proteinlerin montajı (matürasyonu), hücreden salınma gibi çeşitli basamakları içermektedir. Antiviral ilaçlar buradaki çeşitli basamaklarda etkili olmaktadır (Yıllar, 2006).



Şekil 10. Bazı antiviral ilaçların etki mekanizması (Yıllar, 2006)

Son yıllarda etkili antiviral ilaçlar geliştirmek için büyük çaba sarf edilmiştir, ancak birçok viral enfeksiyon, şimdiye kadar hala etkili antiviral tedavilerden yoksundur. Virüslerle savaşmak için doğal ürünlerin ilgili keşfi son yıllarda artmıştır. Yapısal çeşitlilik ve karmaşıklığa sahip doğal bileşikler, yeni antiviral ajanlar bulmak için büyük bir şans sunmaktadır. Özellikle bazı bitkisel ekstraktlar, güçlü antiviral yetenekleri ve benzersiz mekanizmaları nedeniyle büyük ilgi görmektedir. Polifenoller, alkaloidler, flavonoidler, saponinler, kinonlar, terpenler, proantosiyanidinler, lignanlar, tanenler, polisakkaritler, steroidler, tiyosülfonatlar ve kumarinler, viral enfeksiyonlarla savaşan başlıca biyoaktif fitokimyasallardır. (Kapoor ve ark., 2017). Aşağıdaki şekilde bazı antiviral fitomoleküllerin başlıca kullanımları gösterilmiştir (Şeki 11).



Şekil 11. Antiviral fitomoleküllerin başlıca kullanımları (Kapoor, Sharma, & Kanwar, 2017)



Viral replikasyonu inhibe etmek için fitokimyasallar tarafından çeşitli mekanizmalar benimsenmiştir. Örneğin, epigallokateşin gallat (EGCG), RNA polimeraz, proteaz ve ters transkriptaz gibi virüsün büyümesini destekleyen konakçı enzimi veya viral enzimi inaktive eder. Flavonoidler için benimsenen başka bir mekanizma, HIV'in replikasyonunu kısıtlayan proteinin fosforilasyonunu inhibe etmektir (Ghildiyal ve ark., 2020).

4.1 Antiviral Etkili Polifenolik Bileşikler

4.1.1 Fenolik asitler

Gallik asit, florogluslinik asit, kafeik asit ve gentisik asit antioksidan etkisi en yüksek olan fenolik asitlerdir (Kolaç ve ark., 2017). Yapılan bir çalışmada Brezilya yeşil propolisinin ana fenolik asit türevi bileşenlerinden biri olan dikaffeoilkinik asitin TNF ile ilişkili apoptosizi artırarak farelerde influenza A virüsünü bastırdığı belirtilmiştir (Takemura ve ark., 2012). Bir başka çalışmada ise kafeik asit türevlerini içeren Türk Hatay propolisinin *Herpes simplex* virüsü 1 ve 2 üzerinde etkili olduğu gösterilmiştir (Cornara, Biagi, Xiao, & Burlando, 2017). Fenolik asitler, flavonoidler ve alkaloidlerin antimikrobiyal ve antiviral aktivitesinin incelendiği bir çalışmada test edilen bileşikler arasında, atropin, gallik asit ve kinik asitin, güçlü bir anti-herpes aktivitesine; atropin, oktopamin ve gallik asitin ise güçlü anti-influenza etkisine sahip olduğu belirtilmiştir (Özçelik ve ark., 2011).

Dünya çapında insan coronavirüslerden biri olan NL63 (HCoV-NL63) burun akıntısı, öksürük, bronşiyolit ve zatürre gibi solunum yolu hastalıklarına neden olmaktadır (Weng, ve ark., 2019). Bir çalışmada mürver türü olan *Sambucus formosana* Nakai'nin kafeik asit, klorojenik asit, kumarik asit, ferulik asit, gallik asit gibi fenolik asit bileşenlerinin ve kök etanol özütünün anti-HCoV-NL63 aktivitesi incelenmiş, ekstrakta fenolik asit bileşenleri olarak kafeik asit, klorojenik asit ve gallik asit olduğu rapor edilmiştir. Kök etanol özütünün güçlü bir anti-HCoV-NL63 potansiyeli sergilediği belirlenmiştir. Ayrıca klorojenik asit ve gallik asitin, HCoV-NL63'e karşı antiviral aktivite gösterdiği saptanmış, kafeik asitin, anti-HCoV-NL63 aktivitesine sahip önemli bir bileşen olabileceği vurgulanmıştır. Buna ilaveten birkaç farklı çalışmada da kafeik asitin hepatit B ve C virüslerine, influenza A virüsüne ve *Herpes simplex* virüsüne karşı antiviral aktiviteye sahip olduğu bildirilmiştir (Weng ve ark., 2019).

Klorojenik asitin influenza A virüsüne karşı antiviral etkisinin ve potansiyel mekanizmasının araştırıldığı bir çalışmada bulaşıcı döngünün geç safhasında influenza virüsünü inhibe ettiği ve oseltamivire dirençli suşlara karşı da inhibitör olduğunu belirtilmiştir. Antiviral etki mekanizması nöraminidaz aktiviteyi inhibe ederek partiküllerin enfekte hücrelerden salınmasını engellemesi şeklindedir. Ratlarda intravenöz klorojenik asit enjeksiyonunun antiviral aktiviteye sahip olduğu H1N1 ve H3N2' ye karşı karşı ölümden %50-%60 koruma sağladığı virüs titrelerini azalttığı ve akciğer enfeksiyonunu etkili bir şekilde hafiflettiği söylenmiştir (Ding ve ark., 2017).

Zeytinin temel fenolik bileşiği olan oleuropeininde mononükleoz herpes, hepatit virüslerine, rotavirüslere, ve bazı hayvan virüslerine (rinovirüs, parvovirüs) karşı antiviral aktivite gösterdiği belirtilmiştir (Karaboğa Arslan ve ark., 2017).

Curcuma longa (zerdeçal) rizomlarının aktif bir bileşeni olan kurcumin, hidrofobik bir polifenoldür. Gıdalarda baharat olarak ve dünyada kozmetik ve ilaç endüstrisi gibi çeşitli amaçlarla kullanılmakla birlikte antioksidan, antikanser, antibakteriyel, antiviral ve antidiyabetik etkiler gibi çeşitli farmakolojik etkilere sahip olduğu belirtilmiştir. Kurcuminin COVID-19'u tedavi etmek için yararlı olabilecek tüm etkilerini inceleyen bir çalışmada; SARS-CoV replikasyonunu önlediği ve Vero E6 hücrelerinde 3Cl proteazı inhibe ederek SARS-CoV'nin sitopatojenik etkisine karşı önemli ölçüde inhibe edici aktiviteye sahip olduğu söylenmiştir. Ayrıca influenza A virüsü, HIV, enterovirüs 71 (EV71), *Herpes simplex* gibi



virüs (HSV), hepatit C virüsü (HCV) ve insan papilloma virüsü (HPV) gibi diğer virüslere karşıda çeşitli mekanizmalarla etkili olduğu belirtilmiştir (Babaei ve ark., 2020).

4.1.2 Flavonoidler

Rutin bitkilerde bulunan yaygın bir flavonoiddir ve HSV-1 virüsüne karşı antiviral etkisi olduğu gösterilmiştir (Orhan ve ark., 2010). Benzer şekilde kuersetin de bitkilerde yaygın olarak bulunmakta ve birçok virüse karşı (influenza, dang, poliovirüs, adenovirüs, solunum sinsityal virüsü) antiviral etkisi olduğu belirtilmektedir (Ege & Elmastaş, 2020).

SARS-Cov virüsüne karşı yapılan bir çalışmada 3 flavonun (kuersetin, apigenin, luteolin) 3CL proteaz inhibisyonu ile antiviral etkiye sahip olduğu tespit edilmiştir (Ryu ve ark., 2010). Mirsetin tıbbi bitkilerde, bal ve propoliste bulunan bir flavonoiddir. Yapılan bir çalışmada mirsetinin SARS-CoV helikaz proteininin ATPaz aktivitesine müdahale ederek virüsü inhibe ettiği gösterilmiştir. Bu çalışma sonucunda doğal olarak oluşan flavonoidlerin SARS-CoV kimyasal inhibitörleri olarak hizmet edebileceği düşünülmüştür (Yu ve ark., 2012).

EV71 ile enfekte edilmiş yeni doğmuş ratlarla bazı flavonoidlerin koruyucu etkinliğine dair bir çalışma yapılmış; apigenin, luteolin, kaempferol, formononetin ve penduletinin, ölümcül EV71 virüsüne karşı yaklaşık olarak sırasıyla %88.89, %91.67, %88.89, %75 ve %66.67 oranında koruma sağladığı belirtilmiştir (Dai ve ark., 2019).

Yeşil çay kateşinleri (GTC'ler) polifenolik bileşiklerdir. Son yıllarda, GTC'lerin çok sayıda hastalığa karşı çeşitli sağlık yararları sağladığı bildirilmiştir. Yapılan çalışmalarda, GTC'lerin, özellikle epigallokateşin-3-gallat (EGCG)'nin çeşitli virüslere (HBV, HSV, HIV, HCV, İnfluenza) karşı antiviral etkilere sahip olduğu gösterilmiş ve antiviral etkilerinin mekanizmaları da açıklanmıştır (Xu ve ark., 2017). Siyah çayda bulunan tannik asit ve 3-izothaeafavin-3-gallate bileşenlerinin SARS Cov üzerinde inhibe edici etkisi bulunmuştur. Bu çalışmada aynı zamanda siyah çay ile yeşil çayın inhibe etme aktiviteleri karşılaştırılmış siyah çayın daha güçlü inhibisyon gösterdiği belirtilmiştir (Chen ve ark., 2005).

Cistus incanus'tan (laden) polifenol bakımından zengin bir özütün (CYSTUS052 -%26 Flavan 3-ol, proantosiyanidinler), güçlü bir anti-influenza aktivitesi sergilediğini tespit edilmiştir. Antiviral etkiden sorumlu bileşikler 'epigallokateşin gallat' ve 'theafavin digallat' yüksek molekül ağırlıklı polifenol türevi olup influenza virüsü üzerindeki hemaglutinine bağlanarak virüsün aktivitesini engellediği belirtilmiştir. Ayrıca, spesifik olmayan ve geniş etkisi nedeniyle, virüs ilacı direncinin ortaya çıkmasına kolayca yol açmayacağı ve fırsatçı bakteriyel enfeksiyonlara karşı da aktif olabileceği söylenmiştir (Ehrhardt ve ark., 2007).

Randomize, plasebo kontrollü klinik bir çalışmada, üst solunum yolu enfeksiyonu olan 160 hastada bir *Cistus* ekstresinin (CYSTUS052) etkisi araştırılmış ve *Cistusun*, hastalarda plaseboya göre semptomların ortalama süresini ve şiddetini azaltmada daha etkili olduğu sonucuna ulaşılmıştır (Kalus ve ark., 2009).

Zengin bir flavonoid kaynağı olan mürverin, sitokin üretimini artırarak ve bağışıklık sistemini uyatarak influenza virüsüne karşı koruyucu etkiye sahip olduğu belirtilmiştir (Torabian ve ark., 2019). Bu konu ile ilgili farklı bir çalışmada ise, mürver flavonoidlerinin, influenza virüsünün hemaglutininine bağlanarak konak hücre reseptörlerine viral bağlanmayı önlediği ve mürverin ana antosiyaninleri olan siyanidin 3-glukozit ve siyanidin 3-sambubiosid, antiviral etkiler sergilediği belirtilmiştir (Mahboubi, 2020).



Tablo 2. Bazı flavonoidlerin sağlık etkileri ve antiviral aktiviteleri (Salvamani ve ark., 2014) (Kumar & Pandey, 2013)

Flavonoid	Sağlık Etkileri	Antiviral Aktivite
Kuersetin	Antiinflamatuvar, Antihipertansif, Anti-obezite	Repies, Herpes, Parainfluenza Polio, Mengo virüsü
Kemferol	Antihiplipidemik, Antiaterosklerotik Oksidatif stresi azaltıcı	-----
Mirisetin	Antihipertansif Anti-obezite ve Antihiperlipidemik	-----
Rutin	Antiinflamatuvar, Antihiperkolesterolemik, Obesite ve oksidatif stresi baskılar	Parainfluenza, influenza virüsü
Naringenin	Antihiperkolesterolemik, Antiaterojenik, Antiobezite, Antiinflamatuvar	Respiratuvar Sinsisyal virüs,
Kateşin	Antihipertansif, Antihiperkolesterolemik Antiaterosklerotik	-----
Fisetin	Antiproliferatif, Antioksidatif Antiinflamatuvar	-----
Gossypetin	LDL oksidasyonunu baskılar, oksidatif stresi azaltır, Antilipidemik Antiaterosklerotik	<i>Herpes Simpleks</i> virüs tipi

4.2 Fitoöstrojenler

4.2.1 Stilbenler

Koronavirüsler, insanlarda ve hayvanlarda genellikle gastrointestinal ve solunum yollarında rahatsızlığa neden olan, zarflı, tek sarmallı RNA virüslerinin çeşitli bir ailesini (Coronaviridae) temsil eder. Literatürde SARS-CoV inhibitörleri olarak test edilen doğal stilbenoidlerin bir örneği yoktur. Bununla birlikte, Li ve ark. (2006) yaptığı bir çalışmada bir dizi on iki sentetik resveratrol analogu hazırlanmış ve SARS-CoV replikasyonunun potansiyel inhibitörleri olması yönünden değerlendirilmiştir. Bileşik 5 ve 6'nın, > 2 mg/mL (8.2 mM) konsantrasyonda sitotoksikite göstermediği ve <0.5 mg/mL (2.05 mM) konsantrasyonda sitopatik etkiyi (CPE) inhibe edebildiği belirtilmiş ve olası daha düşük dozlar araştırılmamıştır (Matti ve ark., 2020). Orta Doğu Solunum Sendromu koronavirüsü (MERS-CoV), ciddi morbidite ve mortaliteye neden olan viral bir patojendir. MERS-CoV ile enfekte hastaları tedavi etmek için onaylanmış lisanslı bir aşı veya antiviral ilaçlar yoktur. Üzüm çekirdeği ve kabuğunda ve kırmızı şarapta bulunan doğal bir bileşik olan resveratrolün MERS-CoV enfeksiyonuna karşı antiviral aktivitelerini inceleyen bir çalışmada; resveratrolün MERS-CoV enfeksiyonununun sonra uzun süreli hücresel hayatta kalmayı önemli ölçüde inhibe ettiği saptanmıştır. MERS-CoV replikasyonu için gerekli olan nükleokapsid (N) proteinin ekspresyonunun resveratrol tedavisinden sonra azaldığı ve in vitro olarak MERS-CoV tarafından indüklenen apoptozu azalttığı belirtilmiştir (Lin ve ark., 2017).

Rotavirüs (RV), dünya çapında bebekler ve küçük çocuklar arasında viral gastroenterit için birincil ajandır. Günümüzde RV enfeksiyonunun tedavisi için klinik olarak onaylanmış ve etkili bir antiviral ilaç mevcut değildir. Yapılan bir çalışmada resveratrolün potansiyel anti-RV aktivitesi ve etki mekanizması araştırılmış, resveratrolün, RV RNA sentezini, protein



ekspresyonunu, viroplazma plak oluşumunu, döl virion üretimini ve RV'nin farklı suşlarından ve hücre dizilerinden bağımsız olarak RV kaynaklı sitopatiyi baskılayarak RV replikasyonunu önemli ölçüde inhibe ettiği belirtilmiştir. Bu çalışma, resveratrolün antiviral aktivite sergilediğini ve rotavirüs enfeksiyonu için umut verici bir tedavi olabileceğini ifade etmektedir (Huang ve ark., 2020).

Dört tür mevsimsel grip virüsü vardır, ancak yalnızca A ve B tipi insan enfeksiyonlarından başlıca sorumludur. İnfluenza A virüsüne karşı potansiyel aktiviteleri için belirli sayıda doğal stilbenoidin incelendiği bir araştırmada Hopeaphenol ve shoreaketon, antiviral aktivite sergilerken, vaticanol B, vaticanol G ve a-viniferin, İnfluenza A virüsüne karşı herhangi bir inhibitör etki göstermediği belirtilmiştir (Mattio ve ark., 2020).

Hepatit C virüsü (HCV), Hepacivirüs cinsindeki Flaviviridae ailesine ait, kanla taşınan pozitif bir tek sarmallı RNA virüsüdür. HCV, birkaç hafta süren (akut) hafif bir hastalık veya ömür boyu ve ciddi bir hastalık (kronik) olabilen hepatit C'ye neden olur. Hepatit C siroza dönüşebilir ve HCV, karaciğer kanserinin başlıca nedenidir (Mattio ve ark., 2020). Abba ve ark. (2015) yaptığı bir çalışmada resveratrolün anti-HCV aktivitesi ve etki mekanizması tanımlanmıştır (Abba, Hassim, Hamzah, & Noordin, 2015). Diğer doğal stilbenoitlerde etkili anti-HCV olarak tanımlanmıştır. Lee ve ark. (2019) yaptığı bir çalışmada *Vitis vinifera* köklerinden elde edilen bir ekstraktın HCV ile enfekte hepatokarsinoma hücreleri üzerindeki inhibitör etkisi araştırılmış ve HCV replikasyonunun baskılanmasından sorumlu olan beş oligostilben belirlenmiştir. Bu bileşikler iki resveratrol dimeri; ampelopsin A ve ε-viniferin ve üç resveratrol tetrameri; vitisin A, wilsonol C ve vitisin B'dir. Özellikle vitisin B, en güçlü oligostilben olarak ifade edilmiştir. İnsan immün yetmezlik virüsü tip 1 (HIV-1), şu anda 37 milyondan fazla insanı etkileyen edinilmiş immün yetmezlik sendromundan (AIDS) sorumlu olan Lentiviridae ailesinin zarflı tek sarmallı bir RNA virüsüdür (Mattio ve ark., 2020). Ma ve ark. (2016) yaptığı bir çalışmada, dut (*Morus alba* L.) yapraklarından izole edilen bazı stilben türevlerinin anti-HSV aktivitesini göstermişlerdir.

4.2.2 Lignanlar

Justicia procumbens (su söğüdü) Çin'de ateş ve iltihap tedavisinde popüler bir geleneksel ilaç olarak kullanılmaktadır. Bu bitkinin fitokimyasal keşfi sırasında, justisidin A ve B gibi bir dizi arilnaftalin lignanı elde edilmiş ve bu lignanların veziküler stomatit virüsüne karşı antiviral aktivite gösterdiği belirtilmiştir. Aynı çalışmada üç yeni dahil olmak üzere dahil olmak üzere yirmi bir lignan *Justicia procumbens*'ten izole edilmiş bu bileşikler anti-HIV açısından değerlendirilmiş yeni sekoizolarisiresinol dimetil eter asetat ve bilinen arilnaftalin lignan prokumbenosid A ve difilin bileşiklerinin HIV-1'e karşı inhibitör aktivite gösterdiği söylenmiştir (Xu ve ark., 2019).

Deve dikenli bitkisinin (*Silybum marianum*) tohumundan elde edilen silimarin, temel olarak antioksidatif, antiinflamatuvar immünomodülatör ve hepatoprotektif etkileri ile bilinen flavonolignandır. Yapılan son çalışmalarda silimarin ve türevlerinin flavivirüsler (hepatit C virüsü ve dang virüsü), togavirüsler (Chikungunya virüsü ve Mayaro virüsü), grip virüsü, insan immün yetmezlik virüsü ve hepatit B virüsü dahil olmak üzere çeşitli virüslere karşı antiviral aktiviteye sahip olduğu belirtilmiştir (Liu ve ark., 2019).

Yapılan bir başka çalışmada *Calototropis gigantea* (taç çiçek) bitkisinden elde edilen yeni bir lignan glikozit bileşiğinin ((+)-pinosinonol-O-β-D-glucopyranoside) insan influenza virüslerine karşı spesifik antiviral aktiviteye sahip olduğu ve anti-influenza virüsü aktivitesinin, NF-kB inhibe edici aktivitesi ile yakından ilişkili olduğu sonucuna varılmış, bu yeni lignan glikozitin özellikle insan influenza virüslerini hedef alan antiviral ajanların araştırılması ve geliştirilmesi için umut verici bir aday olabileceği ileri sürülmüştür (Parhira ve ark., 2014).



Schisandra sphenanthera'nın (Şizandra üzümü) meyveleri hem besleyici hem de lezzetli olduğu için popülerdir ve geleneksel Çin tıbbında kronik öksürük, sık idrara çıkma, ishal, diyabet ve uykusuzluğun tedavisinde sıklıkla kullanılmaktadır. *S. Sphenanthe*'nin meyvelerinden elde edilen onaltı lignanın HSV-2 ve adenovirüse karşı inhibe edici aktiviteleri araştırılmış içeriklerinden beş lignan bileşiğinin HSV-2 ve adenovirüse karşı inhibe edici aktivite sergilediği belirtilmiştir (Song ve ark., 2013).

4.3 KAROTENOİDLER

Etkili bir aşının bulunmasına rağmen, hepatit B virüsü (HBV) enfeksiyonu ve tedavisi, dünyadaki en önemli halk sağlığı sorunlarından biri olmaya devam etmektedir. Luteinin vitro anti-HBV aktivitesinin

in araştırıldığı bir çalışmada, anti-HBV aktivitesine sahip olduğu ve antivirüs etkilerini HBV transkripsiyonunun inhibisyonu yoluyla gösterdiği belirtilmiştir (Pang ve ark., 2010).

Son zamanlarda safran ve bileşikler farklı patolojik durumları tedavi etmek için kullanılmaktadır. Bir çalışmada İran safran özütünün ve suda çözünür bir karotenoid olan krosin ve pikrokrosin gibi ana bileşenlerinin anti-HSV1 ve anti-HIV-1 aktiviteleri araştırılmış, sulu safran özütünün HIV-1 ve HSV-1 viryonlarına karşı belirli dozlarda aktif olmadığı ancak krosin ve pikrokrosin bileşenlerinin önemli anti-HSV-1 ve ayrıca anti-HIV-1 aktiviteleri gösterdiği belirtilmiştir. Krosin karotenoidinin, hedef hücrelerde HSV penetrasyonunu ve ayrıca hücrelere girdikten sonra bozulmuş virüs replikasyonunu bastırarak pikrokrosinin ise virüs girişini ve replikasyonunu inhibe etmede etkili olduğu ifade edilmiştir (Soleymani, ve ark., 2018).

4.4 Glukosinolatlar

Isatidis radix'in (Isatis kök) güneşte kurutulmuş kökleri en sık kullanılan geleneksel Çin ilaçlarından biridir. Yüzyıllar boyunca bu bitki, virüs enfeksiyonu tedavisi için klinik uygulamada kullanılmıştır. Yapılan bir çalışmada, *I. radix*'den elde edilen glukozinolat izomerleri olan epiprogoitrin, progoitrin, epigoitrin ve goitrininin anti-influenza virüs aktivitesi in vitro/in vivo olarak değerlendirilmiş; *I. radix* türevi glukozinolat izomerleri ve bunların parçalanma ürünlerinin tümü, toksisite olmaksızın influenza A virüsüne (H1N1) karşı doza bağlı inhibisyon etkisi sergilemiş ve bileşenlerin antiviral potansiyeli progoitrin>goitrin>epigoitrin>epiprogoitrin şeklinde sıralanmıştır. Bu sonuçlar *I. radix*'in influenza virüsü enfeksiyonu için farmakoterapiye yardımcı olabileceğini göstermektedir (Nie ve ark., 2019).

Sampangi-Ramaiah ve ark. (2020) Hint ve diğer mutfaklarda kullanılan ve baharatlarda bulunan 27 fitokimyasal bileşiğinin viral replikasyon için gerekli olan SARS-CoV-2 6LU7 proteaz (3CLpro) ve 6Y2E proteaza bağlanmasını araştırmış; 27 bileşikten 15'i, her iki proteaz için eşik değerlerin üzerinde bağlanma afinitesi göstermiş, 6LU7 ve 6Y2E proteazlarına yüksek bağlanma afinitesine sahip anahtar bileşikler arasında koriandrin (hem kuzey hem de güney Hindistan'da Hint mutfaklarında yaygın olarak *Coriandrum sativum* uçucu yağının bileşeni), *Thymus vulgaris*'in (kekik) ursolik asidi, *Rosmarinus officinalis*'in (biberiye) rosmarinik asidi ve *Brassica juncea*'nın (hardal otu) bir gikosinolat bileşiği olan glukobrassisin bulunmuştur (Sampangi-Ramaiah ve ark., 2020).

4.5 Organosülfür Bileşikleri

Sarımsak, Coxsackievirus türleri, Herpes simplex virüs tip 1 ve 2, Influenza B, Para-influenza virüs tip 3, Vaccinia virüsü, Vesiküler stomatit virüsü, insan immün yetmezlik virüsü tip 1 ve insan rinovirüsü tip 2'ye karşı antiviral aktivite göstermektedir. Virüsidal aktivitesinin içerisinde bulunan ajoen, allisin, alil metil tiyosülfat ve metil alil tiyosülfat bileşenlerinden kaynaklandığı söylenmiştir (Fesseha & Goa, 2017).

Sarımsağın soğuk algınlığını önlediğini gösteren ilk klinik çalışma Josling ve ark., (2001) tarafından yapılmıştır. Bu çalışmada 146 gönüllü plasebo ve aktif olarak iki gruba ayrılmış ve



84 gün boyunca 180 mg allisin içeren sarımsak kapsülü verilmiştir. Aktif grupta plasebo gruba göre önemli ölçüde daha az ve daha kısa soğuk algınlığı gözlemlenmiştir. Günlük sarımsak takviyesinin viral enfeksiyonu ve yeni oluşacak enfeksiyonun azaltılabileceği ve bu durumun özellikle allisinin immuno-modüle edici aktivitesinden kaynaklanıyor olabileceği belirtilmiştir (Rouf ve ark., 2020).

Mohajer Shojai ve ark. (2015) sulu sarımsak özütünün koronavirüse karşı antiviral etkilere sahip olabileceğini ilk kez göstermiştir. Koronavirüs, kümes hayvanlarında ciddi enfeksiyonlara değiştirilmiş haliyle SARS, MERS ve COVID-19 dahil olmak üzere ciddi akut solunum yolu sendromlarına neden olan bir ajandır. Korona ile enfekte embriyonik yumurtalar üzerine sulu sarımsak ekstraktı uygulanmış embriyonik indekste önemli bir artış gözlemlenmiş bu durum sarımsak ekstraktının virüs replikasyonu üzerinde inhibe edici bir etkiye sahip olabileceğini düşündürmüştü fakat mekanizması belirtilmemiştir (Shojai ve ark., 2015).

Son zamanlarda araştırmacılar Mpro(kimotripsin benzeri proteaz (3CLpro)) olan SARS-CoV-2'nin ana proteazının yapısını fark etmişlerdir. Bu proteaz, SARS-CoV-2'nin proteolitik olgunlaşmasının bir sonucu olarak viral replikasyondan ve fonksiyonel protein üretiminden sorumlu olduğu için, viral poliproteinin bölünmesini engelleyerek enfeksiyon oranı önemli ölçüde azaltılabilir. Sarımsağın SARS-CoV-2'ye karşı inhibe edici etkisine ilişkin bir yaklaşımda, yedi organosülfür bileşiğinin; alliin, S- (alil / metil / etil / propil) -sistein, S-propil L-sistein ve S-alimerkaptosistein SARS-CoV-2'de bulunan bu proteazı inhibe edebileceği düşünülmüştür. Organosülfür bileşikleri arasında allininin COVID-19'u önlemek için daha yüksek antiviral potansiyele sahip olabileceği belirtilmiştir (Khubber ve ark., 2020)

4.6 BİTKİ STEROLLERİ

Burkea africana'nın (seringa ağacı) kökleri geleneksel olarak diş ve mide ağrısı tedavisinde, kabuğu ise kaynatılarak soğuk algınlığı ve öksürük tedavisinde kullanılmaktadır. Triterpen saponinler, büyük yapısal çeşitliliğe sahip bitki sekonder metabolitleridir. Antidiyabetik, antiinflamatuvar, antifungal, sitotoksik, hepatoprotektif, antikanser, kemopreventif, antialerjik, immünomodülatör, immünoestimülatör gibi çeşitli biyolojik ve farmakolojik özelliklere sahip olduğu çalışmalarda bildirilmektedir. Yapılan bir çalışmada *B. africana*'nın etanolik gövde kabuğu ekstresinden sekiz triterpen saponin (1-8) izole edilmiş bu bileşiklerin anti-influenza etkisi incelenmiş 7 ve 8'in en güçlü etkiye sahip olduğu belirtilmiştir (Mair ve ark., 2018).

Yapılan bir başka çalışmada *Aesculus hippocastanum* (at kestanesi) tohum özütünün en etkin saponin bileşiği türevlerinden olan b-escin HSV-1 replikasyonunda önemli rol oynayan NF- κ B aktivasyonunu inhibe ettiği hücre membranları ve kolesterol homeostazına müdahale etme yeteneği ile bağlantılı olabilecek geniş spektrumlu antiviral aktiviteler gösterdiği belirtilmiştir (Michelini ve ark., 2018).

Saikosaponin *Bupleurum spp.* türlerinde bulunan glikozitlerdir. *Radix bupleurum*'un ham özleri, tarihsel olarak akut solunum yolu enfeksiyonu ile ilişkili ateş ve ağrının yanı sıra kronik hepatit ve bazı otoimmün hastalıklar için destekleyici bir tedavi olarak reçete edilmiştir. Yapılan bir çalışmada saikosaponin A'nın influenza A virüsü enfeksiyonlarına karşı hem in vitro hem de in vivo anti-viral aktivite gösterdiğini Saikosaponin A'nın patolojik influenza virüsü enfeksiyonlarının tedavisi için yeni terapötik potansiyele sahip olduğu belirtilmiştir (Chen ve ark., 2015). Benzer bir başka çalışmada da *Bupleurum falcatum*'un (orak yapraklı tavşan kulağı) köklerinden elde edilen ve geleneksel Çin bitkisel ilacının (xiao-chai-hu-tang) bir bileşeni olan Saikosaponin B2'nin, viral giriş, replikasyon ve transasyonu, hepatit C'yi tedavi etmek için kullanılan daklatasvir dirençli mutant HCV suşlarını, özellikle daklatasvir ile kombinasyon halinde inhibe ettiği belirtilmiştir (Lee ve ark., 2018). Chen ve ark. (2006) yaptığı bir çalışmada da özellikle saikosaponin B2'nin güçlü antikoronaviral etkiye sahip



olduğunu viral bağlanma ve penetrasyon üzerinde viral replikasyonun erken safhasında inhibe edici bir etki gösterdiğini belirtmişlerdir (Cheng ve ark., 2006).

Brassinosteroidler (BR), hayvan steroidleri ile yapısal benzerliği olan doğal bir fitosterol koleksiyonudur. On yıldan fazla bir süredir BR'ler, hayvan sistemlerindeki çeşitli biyolojik aktiviteleri nedeniyle dünya çapında ilgi görmüş, son çalışmalar, BR'lerin antikanseröz, antianjiyojenik, antiviral, antijenotoksik, antifungal ve antibakteriyel biyoaktivitelerini göstermiştir. Ayrıca çok çeşitli BR'lerin (hem doğal hem de sentetik türevler) virüs replikasyonunu inhibe ederek antiviral aktivitelere sahip olduğu bulunmuştur (Kohli ve ark., 2020).

Glycyrrhiza radix'ten (meyan kökü) elde edilen Glisirizinin'de bir saponin türüdür ve bir süredir antiviral bir ajan olarak bilinmektedir, Glisirizinin anti-HIV aktivitesi için protein kinaz C ile etkileşime girerek hedef hücrelere viral adsorpsiyonun inhibisyonu veya bileşiğin viral ile spesifik olmayan etkileşimlerinin neden olduğu viral replikasyonun başlangıç aşamalarının bozması şeklinde iki farklı mekanizma öne sürülmüştür (Rezanka ve ark., 2009).

5.SONUÇ

Tıbbi bitkilerin viral enfeksiyonlara karşı tedavi edici ve koruyucu etkide oldukları pek çok çalışma ile gösterilmiştir. Bu nedenle yeni antiviral ajanları keşfetmek için iyi bir kaynak teşkil etmektedir. Bitkilerde bulunan biyoaktif bileşenlerin karakterizasyonu, antiviral etki mekanizmalarının tanımlanması ve potansiyel uygulamalarının değerlendirilmesi için yapılan klinik in vivo ve in vitro çalışmaların kalite standartları ve sayılarının artması gerekmektedir. Başta flavonoidler olmak üzere bazı fitokimyasalların antibakteriyel, antiinflamatuvar ve antiviral ajanlar olarak tıbbi etkinliği iyi bilinmektedir. Bu maddeler, gelişmekte olan ülkelerde daha yaygın olarak kullanılmaktadır. Yeni bileşiklerin terapötik kullanımı, spesifik biyokimyasal testler kullanılarak doğrulanmalıdır. Genetik modifikasyonların kullanılmasıyla, flavonoidleri üretmek artık mümkündür. Bu bileşiklerin antiviral etki mekanizmaları ile ilgili daha fazla araştırma yapılması pek çok bulaşıcı hastalığın tedavisi için yeni antiviral ajanların keşfine katkı sağlayacaktır.



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HASAT SONRASI SOĞUTMA METODUNUN FARKLI TAZE İNCİR ÇEŞİTLERİNİN DEPOLANMASI VE MİKROBİYAL KALİTESİ ÜZERİNE ETKİLERİNİN DEĞERLENDİRİLMESİ

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ÖZET

Doğal fonksiyonel gıdalar arasında yer alan incir sağlık açısından çok önemlidir. Ekonomik açıdan önemli bir ihracat ürünü olan incir, taze ve kuru olarak tüketilebilmektedir. Kuru incir ihracatı kadar taze incir ihracatı da önemlidir. Taze incir ihracatında raf ömrünün kısa olması önemli bir sorundur. Bu çalışma taze incirlerin yüzeyindeki mikrobiyal popülasyonun soğuk hava depolama süresince değişimini belirlemek ve uzun raf ömrüne sahip çeşitleri tespit etmek amacıyla yapılmıştır. Bu çalışmada, 10 farklı incir çeşidinin (Bursa Siyahı, Beyaz Orak, Siyah Orak, Morgüz, Yeşilgüz, 1066 Yediveren, Göklop, Siyah Kış, 208 Siyah ve 1100) iki farklı olgunluk düzeyinde toplanan meyve örnekleri çalışma materyali olarak kullanılmıştır. Farklı olgunluk düzeylerinde toplanan meyveler doğrudan depolanacakları ambalajlar (viyol) içerisine yerleştirilmiş ve 20 gün $3\pm 1^{\circ}\text{C}$ soğuk depoda tutulmuşlardır. Depodan her 5 günde bir alınan örneklerin toplam mezofilik aerobik bakteri sayısı ve toplam maya küf sayısındaki değişimler tespit edilmiştir. Yapmış olduğumuz çalışmada Bursa Siyahı çeşidinde toplam maya küf sayısı 2,93 log kob/g ile başlayıp depolama sürecinde hızlı bir şekilde 5,7 log kob/g'a kadar yükselmiştir. 1100 ve Siyah Orak çeşidinde, toplam mezofilik aerobik bakteri sayısının ve maya küf sayısının hem başlangıçta yüksek olması hem de depolama süresince çok hızlı yükselmesi raf ömrünün kısalmasına neden olmaktadır. 208 Siyah çeşidinin 1/3 olgun örneklerindeki maya küf sayısının, depolamadan 2 hafta sonra 2.8 log kob/g seviyelerinde olduğu belirlenmiştir. Göklop (olgun) çeşidinde depolama süreci sonunda maya küf sayısı 4,25 log kob/g, aynı depolama süresi sonunda Yeşilgüz ve Beyaz Orak çeşitlerinin yarı olgun örneklerinin maya küf sayısı 3,17 log kob/g ve 3,98 log kob/g olduğu belirlenmiştir. Bu veriler ışığında Yeşilgüz, Beyaz Orak ve Göklop çeşitlerinin raf ömrünün diğer çeşitlere göre daha uzun olması taze incir ihracatında önemli çeşitler olabileceği düşünülmektedir.

Anahtar Kelimeler: Bursa siyahı, yeşilgüz, beyaz orak, göklop, mikrobiyal yük, ihracat



EVALUATION OF POSTHARVEST COOLING METHODS ON THE MICROBIAL QUALITY AND STORAGE OF DIFFERENT FRESH FIG

ABSTRACT

Fig, which is among the natural functional foods, is very important for health. Fig, which is an economically important export product, can be consumed fresh and dried. In addition to dried fig export, export of fresh figs is important as well. Short shelf life is an important problem in fresh fig export. This study was carried out to determine the change of the microbial population on the surface of fresh figs during cold storage and to identify varieties with long shelf life. In this study, the fruit samples of 10 different fig varieties (Bursa Siyahı, Morgüz, Yeşilgüz, 1066 Yediveren, Göklop, Siyah Kış, 208 Siyah and 1100), collected at two different maturity levels, were used as study material. Fruits collected at different maturity levels were placed in packages (viols) where they were directly stored and kept in cold storage at 3 ± 1 ° C for 20 days. The changes in the total mesophilic aerobic bacteria count and total yeast-mold count of the samples taken from the storage every 5 days were determined. In our study, the total yeast-mold count in Bursa Siyahı variety started with 2.93 log cfu/g and quickly increased to 5.7 log cfu / g during the storage process. In 1100 and Siyah Orak varieties, the fact that the total mesophilic aerobic bacteria count and the yeast-mold count are high both at the beginning and during the storage period lead to a short shelf life. It was determined that the yeast-mold count in 1/3 mature samples of 208 Black variety was 2.8 log cfu/g, after 2 weeks storage. It was determined that the yeast-mold count of Göklop (ripe) variety was 4.25 log cfu/g at the end of the storage period, and the yeast-mold count of the hard-ripe samples of Yeşilgüz and Beyaz Orak varieties at the end of the same storage period was 3.17 log cfu/g and 3.98 log cfu/g. In the light of these data, it is thought that Yeşilgüz, Beyaz Orak, and Göklop could be important varieties in fresh fig export because their shelf life is longer than other varieties.

Keywords: Bursa siyahı, yeşilgüz, beyaz orak, göklop, microbial load, export



1. GİRİŞ

Türkiye’de incir, soğuk bölgeler haricinde tüm alanlarında doğal olarak yetişebilmektedir. Ülkemiz incir genetik kaynakları bakımından zengin bir varyasyona sahiptir. Ülkemizdeki bu zengin incir popülasyonunun değerlendirilmesi için Özbek (1949) tarafından başlatılan ve Eroğlu (1982), Aksoy ve ark. (1993) ve Kutlu ve Aksoy (1998)’un sürdürdükleri seleksiyon çalışmaları sonucunda 272 genotip belirlenmiş ve bunlar Aydın İncir Araştırma Enstitüsünün koleksiyon bahçesine dikilmişlerdir. Ayrıca 58 adet erkek incir çeşit veya tipi de İncir Araştırma İstasyonu koleksiyon bahçesinde mevcuttur.

Dünyadaki incir üretiminin %27 si 306 bin ton üretimle Türkiye gerçekleşirken, %17’si Mısır, %11’i Fas, %10’u Cezayir ve %5’i İran’da üretilmektedir (FAO, erişim tarihi 02.07.2020). İncir fonksiyonel gıdalar arasında yer almaktadır ve sağlık açısından çok önemlidir. Ekonomik açıdan önemli bir ihracat ürünümüz olan incir, taze ve kuru olarak tüketilebilmektedir. Kuru incir ihracatı kadar taze incir ihracatı da önemlidir. Günümüzde, sofralık incir ihracatımızın tamamına yakını ‘Bursa Siyahı’ çeşidi ile gerçekleştirilmektedir. Son yıllarda Bursa siyahı çeşidinin ekim alanları genişletilerek Akdeniz Bölgesi’ndeki Adana, Hatay ve Mersin illerinde hızla yetiştiriciliği yapılmaktadır. Bu bölgelerin erken yetiştiricilik özelliğinden yararlanılmaktadır.

2018 yılında **17 bin ton** olan taze incir ihracatımız 2019 yılında **20 bin tona**, maddi getiri olarak ise **39 milyon dolardan 49 milyon dolara** ulaşmıştır. 2018 yılında **2.296 \$/ton** olan ihracat birim fiyatı ise 2019 yılında **%5,4 artış** ile **2.421 \$/ton** olarak gerçekleşmiştir (TUİK,2019).

Ülkemizin incirlerinde çeşitlilik daha çok taze yemeklik incir grubunda kendisini göstermektedir. Bu çeşitler içerisinde sarımtırak, yeşil, mor, koyu siyahımtırak, mor ve mor çizgili olmak üzere renk bakımından birbirinden ayrılanlar bulunduğu gibi şekil, tat ve aroma bakımından da çeşitler arasında büyük farklar vardır (Özbek, 1978). Türkiye’nin sofralık incir ihracat potansiyeli henüz tam olarak kullanılamamaktadır. Türkiye’nin mevcut taze incir ihracatını arttırmak için ‘Bursa Siyahı’ çeşidi yanında, tüketici tercihlerine uygun, erkenci ve geççi yeni çeşitlerle derim periyodunun uzatılması gerekmektedir.

Sofralık incirlerin tatlılık oranı hafif tatlı, orta ve çok tatlı olarak gruplandırılmaktadır (Çalışkan, 2012). Tüketicilerin damak tadının farklılığı göz önüne alındığında taze incir ihracatında ihracatı yapılacak ürün yelpazesinin genişletilmesi elzemdir.

Taze incirler hasat sonrası 7-10 gün gibi kısa bir raf ömrüne sahiptirler. Taze incir ihracatında raf ömrünün kısa olması önemli bir sorundur (Karabulut et al., 2009). İncir oda sıcaklığında çabuk bozulur ve fungal çürüme üreticiler için büyük maddi kayıplara neden olmaktadır (Michailides et al., 2008). Bu çalışma ile tüketicinin damak tadına uyacak, aynı zamanda farklı hasat sürelerine sahip, raf ömrü uzun çeşitlerin tespiti hedeflenmiştir.

2. MATERYAL ve YÖNTEM

2.1 Materyal

Bu çalışmada, Aydın İncir Araştırma Enstitüsünün koleksiyon bahçesinden iki farklı olgunluk düzeyinde toplanan 10 farklı incir çeşidine ait (Bursa Siyahı, Beyaz Orak, Siyah Orak, Morgüz, Yeşilgüz, 1066 Yediveren, Göklop, Siyah Kış, 208 Siyah ve 1100) meyve örnekleri çalışma materyali olarak kullanılmıştır.

2.2 Yöntem

Bu çalışmada 10 farklı incir çeşidi ve iki farklı olgunluk düzeyi olmak üzere 20 örnek hasat sonrası depolanmış ve her bir örneğe ait mikrobiyal yükteki değişimler depolama süresince takip edilmiştir.



Farklı olgunluk düzeylerinde toplanan meyveler doğrudan depolanacakları ambalajlar (viyol) içerisine yerleştirilmiş ve 20 gün $3\pm 1^\circ\text{C}$ soğuk depoda tutulmuşlardır. Depodan her hafta alınan örneklerin toplam mezofilik aerobik bakteri sayısı ve toplam maya küf sayısındaki değişimler tespit edilmiştir.

Her bir meyve örneği grubuna ait üç incir numunesi tartılarak steril peptonlu su içerisine (0.1w/v%) transfer edilmiştir. Daha sonra manyetik karıştırıcıda karıştırılarak homojenize edilerek homojenat elde edilmiştir. Homojenattan on katlı sulandırılmalar hazırlanmıştır. Her bir dilisyon oranından 1 ml alınarak uygun besi ortamının yüzeyine yayma ekim yöntemi ile yayılmıştır. Toplam mezofilik aerofilik bakteri sayısının tespiti için Nutrient Agar (NA) kullanılırken, Toplam maya küf tespiti için pH'sı tartarik asitle düşürülmüş PDA kullanılmıştır. NA lar 30°C 'de 48 saat ve PDA ise 25°C 'de 3-5 gün inkübe edilmişlerdir (Messer et al. 2000). Çalışma iki tekerrürlü ve iki paralelli olarak gerçekleştirilmiştir. İnkübasyon süresi sonrası koloniler sayılarak mezofilik aerobik bakteri sayısı ve maya küf sayısı log kob/g olarak hesaplanmıştır.

3. SONUÇ ve TARTIŞMA

Aydın İncir Araştırma Enstitüsü koleksiyon bahçesinden toplanarak polipropilen viyollere yerleştirilen 20 farklı (10 çeşit ve iki farklı olgunluk dönemi) örnek 20 gün $3\pm 1^\circ\text{C}$ 'de soğuk hava depolarında depolanmıştır. 20 gün süren depolama çalışmalarında her hafta alınan örneklerle mezofilik aerobik bakteri sayısı ve toplam maya küf sayısı takip edilmiştir (Tablo 1 ve 2).

Tablo 1. 20 Farklı incir çeşidinin depo öncesi ve depo süresinde yüzeyindeki toplam mezofilik aerobik bakteri sayılarındaki değişim

İncir Çeşitleri	Mezofilik aerobik bakteri sayıları (log kob/g)			
	Depo öncesi	I.Hafta	II.Hafta	III.Hafta
Siyah Kış (2/3 olgun)	5,08	3,83	6,67	6,15
Siyah Kış (olgun)	5,56	4,86	6,65	6,47
Beyaz Orak (yarı olgun)	4,30	4,45	5,75	6,60
Beyaz Orak (olgun)	5,62	5,48	7,11	7,11
1100 (2/3 olgun)	5,53	5,79	6,24	7,05
1100 (olgun)	5,40	6,76	6,28	7,27
Siyah Orak (2/3 olgun)	6,02	4,46	5,94	7,26
Siyah Orak (olgun)	4,76	6,38	6,83	7,28
Yediveren (2/3 olgun)	4,90	4,31	5,68	6,52
Yediveren (olgun)	5,35	6,80	6,63	7,10
Bursa Siyahı (2/3 olgun)	4,79	4,84	5,92	6,40
Bursa Siyahı (olgun)	5,07	5,24	6,25	7,27
Göklop (yarı olgun)	4,68	4,08	6,21	5,30
Göklop (olgun)	4,80	6,20	6,48	5,88
Yeşil güz (yarı olgun)	4,17	3,78	6,37	6,34
Yeşil güz (olgun)	4,84	5,30	6,42	6,56
208 Siyah (2/3 olgun)	4,54	3,91	6,30	7,18
208 Siyah (olgun)	5,22	6,58	6,78	7,53
Morgüz (2/3 olgun)	5,21	6,07	6,01	7,40
Morgüz (olgun)	5,69	6,20	7,15	7,64



Mezofilik aerobik bakteri sayısının her bir örnekte genel olarak yüksek olduğu gözlenmiştir (Tablo 1). Toplam maya küf sayısı ise depo öncesinde 2 log kob/g ile başlayarak depo süresince 6 log kob/g'a kadar çıkan örneklerin olduğu tespit edilmiştir (Tablo 2). Siyah kış çeşidinin olgun örneklerinde depo öncesi 3.45 log kob/g olan toplam maya küf sayısının depo süresince 1000 kat artarak 6.06 log kob/g a kadar yükseldiği tespit edilmiştir. Elde edilen veriler hasat sonrası incirlerin raf ömrünün kısa olmasının nedeni olarak maya küf sayısındaki hızlı yükseliş olduğunu göstermiştir.

Tablo 2: 20 Farklı incir çeşidinin depo öncesi ve depo süresinde yüzeyindeki toplam maya ve küf sayılarındaki değişim

İncir Çeşitleri	Toplam maya ve küf sayıları (log kob/g)			
	Depo öncesi	I.Hafta	II.Hafta	III.Hafta
Siyah Kış (2/3 olgun)	2,99	2,74	3,06	5,99
Siyah Kış (olgun)	3,45	3,43	4,14	6,06
Beyaz Orak (yarı olgun)	3,14	3,57	3,69	3,98
Beyaz Orak (olgun)	2,66	4,60	3,95	4,98
1100 (2/3 olgun)	2,18	3,58	4,23	5,81
1100 (olgun)	2,66	4,02	4,35	5,88
Siyah Orak (2/3 olgun)	2,51	3,83	4,05	5,99
Siyah Orak (olgun)	2,78	5,01	4,09	5,89
Yediveren (2/3 olgun)	2,98	3,99	4,07	4,72
Yediveren (olgun)	3,08	3,84	4,49	5,35
Bursa Siyahı (2/3 olgun)	2,69	3,68	3,17	5,37
Bursa Siyahı (olgun)	2,94	3,35	3,43	5,73
Göklop (yarı olgun)	3,03	2,85	3,66	4,05
Göklop (olgun)	2,75	3,65	4,21	4,25
Yeşil güz (yarı olgun)	3,14	2,34	2,71	3,17
Yeşil güz (olgun)	2,67	3,02	3,90	4,75
208 Siyah (2/3 olgun)	3,05	2,69	2,82	5,32
208 Siyah (olgun)	2,33	3,32	3,31	5,31
Morgüz (2/3 olgun)	2,69	2,46	3,80	4,76
Morgüz (olgun)	3,88	2,77	4,60	5,61

Michailides ve ark. (2008), yapmış oldukları çalışmada fungal çürümenin büyük kayıplara neden olduğunu ve hasat sonrası fungal çürümeyi kontrol altına alabilecek metotların çok önemli olduğunu belirtmişlerdir.

Akdeniz kıyıları ve Güneydoğu Anadolu, taze incir üretimi için uygun koşullara sahiptir (Kaşka vd., 1990). Taze tüketim çeşitlerine olan talebin artması nedeniyle incir üretimini artırmak için herhangi bir yöntem değerli olacaktır (Aksoy ve ark, 1992). Türkiye'de en çok yetiştirilen incir çeşidi Bursa Siyahı'dır. Yapmış olduğumuz depolama çalışmasında Bursa Siyahı çeşidinin olgun örneklerinde toplam maya küf sayısı depo öncesi 2.93 log kob/g iken 20 günlük depo sonrasında 5.7 log kob/g olduğu belirlenmiştir. Siyah Kış çeşidinin olgun örneklerinde ise depo sonrası toplam maya küf sayısı 6.06 log kob/g a kadar yükseldiği görülmüştür.

Bursa Siyahı ve Siyah Kış çeşitlerinde görülen yüksek maya küf sayılarının aksine, depolama süresince daha düşük maya küf sayılarına sahip çeşitlerin olduğu görülmüştür. Yeşil Güz



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çeşidinin yarı olgun örneklerinde 20 günlük depo sonrasında toplam maya küf sayısının 3,17 log kob/g iken Beyaz Orak Çeşidinin yarı olgun örneklerinde 3.98 log kob/g olduğu tespit edilmiştir. Ayrıca Göklop çeşidinin yarı olgun örneklerinde, depolama süresi boyunca Bursa Siyahı çeşidinin aksine toplam maya küf sayısı 10 kat artarak 4.05 log kob/g'a kadar yükselmiştir (Tablo 2). Çalışkan ve ark. (2008) yapmış oldukları çalışmada Göklop çeşidini pomolojik karakterler açısından Bursa Siyahı ile karşılaştırdıklarında, sofralık incir olarak tüketilebilecek iyi bir alternatif olacağını vurgulamışlardır.

Yeşil Güz çeşidi aromatik bir tada sahipken, Beyaz Orak çeşidinin orta tatlı olduğu, Göklop çeşidinin ise hafif tatlı olduğu tespit edilmiştir (Çalışkan, 2012). Taze incir ihracatında önde olan Bursa Siyahı çeşidi ise üzüm gibi tatlı olduğu bilinmektedir. Taze incir ihracatında tek çeşidin önemli olması tüketiciye tat ve hasat süresi hakkında çeşitlilik sunamamaktadır. İncirin anavatanları arasında yer alan ülkemiz, iklim ve coğrafik özellikleri nedeniyle çok çeşitli sofralık incir yetiştiriciliğine uygundur. Bu hazinenin tam anlamı ile kullanılmadığı açıktır. Yaptığımız çalışmada Beyaz Orak, Göklop ve Yeşil Güz çeşitlerinin dış yüzeylerindeki toplam maya küf sayılarının soğuk hava deposunda depolama süresince Bursa Siyahı çeşidine oranla daha az arttığı dolayısı ile raf ömürlerinin daha uzun olduğu görülmüştür. Ayrıca bu çeşitlerin Bursa Siyahı'na oranla farklı tatlılık özelliklerine ve farklı hasat sürelerine sahip olmaları gibi nedenlerle sofralık incir ihracatında önemli çeşitler olarak değerlendirilebilecekleri düşünülmektedir.



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UTILIZATION OF DAIRY-BASED INGREDIENTS IN FURTHER PROCESSED MEAT PRODUCTS

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ABSTRACT

The incorporation of functional non-meat ingredients into processed meat formulations has long been applied as an effective strategy to obtain high-quality meat products. Dairy-based ingredients are one of the most utilized materials for formulating muscle foods since they show excellent functionality as well as they provide nutritional fortification, besides dairy sources are preferred for their ease of production. Skim milk powder, milk protein concentrate, caseinate, sweet whey, whey protein concentrate, whey protein isolate and hydrolysates are examples of non-meat additives widely used in the meat industry. The main functional properties of these proteins include water binding, gelation, whipping/foaming and emulsification. In addition, they have the potential to modify the quality characteristics of low-fat meat products. Dairy proteins are used in plenty of emulsified and comminuted meat products like sausages and coarse-ground meat products like patties and meatballs to improve moisture retention, fat retention, emulsion stability, texturization, and binding. In addition, they could increase binding strength and sliceability of restructured meat products including hams and rolls. Soluble dairy proteins such as partially hydrolyzed caseins and whey protein concentrate are utilized for marination of meat and could enhance water-binding and gelation properties. Some dairy-based ingredients such as partially hydrolyzed whey protein isolate are also associated with antioxidant properties that could be specifically used in pre-cooked products. Moreover, enzymatic hydrolysates of some milk proteins such as caseins contain physiologically functional peptides that show various bioactivity properties such as antihypertensive, antioxidative, antimicrobial, antithrombic, prebiotic, hypocholesterolemic activity. Recently, utilization of microparticulated whey protein has also been of great interest since it improves the technological, functional and sensory properties of low-fat emulsified meat products. However, the effects on the sensory quality and legal restrictions need to be considered when the appropriate amounts of the dairy-based additives are optimized. Considering all those aforementioned properties of dairy-based ingredients that highlight the potential benefits of these materials in meat products, current approaches would focus on identifying novel dairy sources for the design of functional and healthier meat product formulations.

Keywords: Milk proteins, dairy-based ingredients, non-meat proteins, reformulated meat products



INTRODUCTION

Non-meat ingredients are widely used in the meat industry to reduce production costs and to improve functional properties as well as nutritional content (Barbut, 2017). Over the years, a number of dairy ingredients, especially dairy proteins, have been used for their functionality, nutritional value and ease of production in the meat industry. Milk powder, caseinate, whey, whey protein concentrate, whey protein isolate and their hydrolysates are the most commonly used dairy ingredients included into the meat product formulations as dairy-based ingredients. They mainly enhance water binding, gelation and emulsification of products including sausages, meatballs, restructured meat products, etc. (Zorba et al., 1995, Xiong, 2009). These proteins can act as gelling and emulsifying agents by adsorbing at the interface, surrounding oil or air droplets, and stabilizing the dispersions because of their amphiphilic nature. They can also provide flexibility and binding strength for processed and restructured meat products. In this context, the present study deals with the potential usage and effects of dairy-based ingredients in several meat products.

DAIRY PROTEINS

Dairy proteins derived from dairy products (such as skim milk, cheese, etc.) are generally divided into two classes as caseins and whey proteins. Caseins constitute about 80% of total milk protein and whey proteins are the remaining 20% (Phadungath, 2005). In general, casein has a flexible random coil structure whereas whey protein is a typical globular protein. These two dairy proteins are distinctly different in their structural, physical, chemical, and functional properties. Differences in their characteristics can lead to change in functionalities.

Caseins are industrially produced either by isoelectric precipitation at pH 4.6 or proteolytic coagulation (Fox and McSweeney, 1998; Huppertz et al., 2018). Around 95% of casein in milk exists in the form of large aggregate colloids referred to as casein micelles, with a high proportion of calcium or inorganic phosphate (Phadungath, 2005; McMahon and Oommen, 2013). There are four sub-units in casein aggregates: α_{S1} -, α_{S2} -, β - and κ -casein, in the approximate ratio of 38%, 10%, 36%, and 12% of whole casein, respectively (Liang and Luo, 2020). α_S and β -caseins are located in the core and stabilized by κ -casein that coats the surface of the micelle. α_S and β -caseins contain multiple phosphorous groups, which forming complexes with calcium leading to precipitation. On the other hand, κ -casein has one phosphorous group that leads to less sensitivity to calcium ions. Especially, the C-terminal of κ -casein creates hair-like layers which interact with the aqueous phase, protect other caseins from precipitation and provide stability to the micelles (Marchin et al. 2007; Huppertz et al., 2018). Casein is a highly flexible and unstructured protein with high surface hydrophobicity due to its open structure. Casein molecules are linked together via protein-protein interactions and by the presence of calcium and phosphate (Imafidon et al., 1997). Due to the low levels of secondary and tertiary structure, it does not exhibit any thermal transitions during heating. However, its open structure can cause susceptibility to enzymes and pH changes. Casein is mainly used as a food additive, a binder and a source of carbohydrates, amino acids, calcium and phosphorous. However, caseins are insoluble in water. Therefore, caseinate, which has a high solubility index, can be produced to be used as an ingredient in the formulation by the addition of alkali to casein under suitable conditions. Although different types of caseinates such as sodium, calcium, potassium and ammonium caseinates can be obtained depending on the cation of alkalizing agent (El-Bakry, 2011), sodium caseinate has been widely used in meat formulations.



Whey protein, the liquid remaining after the process of curdling of milk and obtained as a by-product from the cheese and casein production, is widely used as an ingredient due to its unique functionalities and nutritional properties. Whey protein consists of β -lactoglobulin, α -lactalbumin, serum albumin, immunoglobulin and protease-peptones which have excellent proline amino acids and numerous disulfide bonds (Haque et al., 2016). β -lactoglobulin (18.4 kDa protein with 162 amino acids) accounts for approximately 58% of whey protein, and the second most prevalent component is α -lactalbumin (14.2 kDa globular protein with 123 amino acids) (Kilara and Vaghela, 2018). β -lactoglobulin has globular and spherical structures induced by tertiary structure and its iso-electric point is 5.1. α -lactalbumin, the second most prevailing protein in whey, contains four disulfide linkages and no phosphate groups and its iso-electric point is around 4.4. α -lactalbumin can unfold and refold by itself depending on environmental circumstances due to the stabilization by the disulfide bridge (Boland, 2011). Whey proteins have the ability to form thermally induced gels during heat treatment (above 70 °C) because sulfhydryl can react with one another, causing disulfide exchange and cross-linking reaction (Langley and Green, 1989; Boland, 2011). Acid whey, whey powder, beverages, lactic acid, etc. are some examples of valuable products obtained from whey (Bozanic et al., 2014). The recovered whey proteins such as whey protein concentrate (has protein content in the range of 65–70% and high levels of bioactive compounds), whey protein isolate (has protein content >90%), whey protein hydrolysate (has a protein content of 70–80%) can be also important for commercial interest (Sinha et al., 2007; Levin et al., 2016; Ganju and Gogate, 2017).

FUNCTIONALITY OF DAIRY INGREDIENTS FOR MEAT PRODUCTS

Several non-meat additives are used in the meat industry to improve the quality characteristics of the product. Dairy proteins such as skim milk powder, milk protein concentrate, caseinate, sweet whey, whey protein concentrate and whey protein isolate have been frequently used as non-meat additives in the meat industry. The utilization of dairy proteins as ingredients in meat formulations has been successfully evaluated to produce less expensive and more stable products. They are usually used as binders, fillers or extenders to improve the characteristics and to control production costs (Endres and Monagle, 1987; Smith and Rose, 1995; Barbut, 2002). The main functional properties of dairy proteins include water binding, gelation, whipping/foaming and emulsification (Xiong, 2009). In addition, they have the potential to modify the textural characteristics of low-fat meat products (Comer et al., 1986; Keeton, 1997). However, these functional properties are mainly related to the structural and conformational characteristics of proteins (Augustin and Udabage, 2007) and are influenced by several factors such as heat treatment, pH, salt concentration, etc. For example, heat applications cause the unfolding of the whey proteins, thereby increasing their water-binding capacity. pH and salt concentration are other factors that cause a more elastic and less permeable gel network of whey protein isolate (Foegeding et al., 2002). The functionality of several dairy proteins used in the meat products is presented in Table 1.



Table 1. Functional properties improved by the addition of dairy-based ingredients in various meat products

Dairy-based ingredients	Meat product	Highlighted results	Reference
Milk powder	Lean poultry meat model system	Reduced cook loss Increased hardness and fracturability Cost effective ingredient for improving moisture binding and texture	Barbut (2010)
Milk powder or calcium/potassium-enriched milk powder	Frankfurter-type sausage	Increased hardness and lightness Na:K ratio could be reduced from an unhealthy to a far healthier ratio. No alterations in sensory quality	Engeloug et al. (2017)
Sodium caseinate	Chicken döner kebab	Avoided the defect of non-uniform small pieces formation	Kilic (2003)
Casein peptides	Beef homogenates and mechanically deboned poultry meat	Inhibited lipid peroxidation	Rossini et al. (2009)
Liquid whey	Frankfurter-type sausage	Creation of a valuable product with minimal cost	Yetim et al. (2001)
Liquid whey	Nuggets	Increased the emulsion stability and yield Developed a highly acceptable and valuable meat product at a minimal cost.	Das and Sharma (2009)
Whey powder	Low-fat meatball	Increased fat and moisture retention and cook yield Had no detrimental effect on sensory properties	Serdaroğlu (2006)
Whey protein concentrate	Low fat ground beef patties	Increase in cooked yield with a linear decrease in shrinkage	Ramirez et al. (2006)
Whey protein isolate	Low-fat sausage	Improved emulsion stability, cooking loss and hardness	Kwon et al., (2021)
Whey powder and skim milk powder	Meat patties	Increased cook yield, moisture and moisture retention	Andiç et al. (2010)
Sodium caseinate and whey protein concentrate	Low-salt restructured meat	Increased cook yield, water binding and gelling capacity during heat treatment Improved mechanical and functional properties	Uresti et al. (2004)
Dry whole milk, skim milk, caseinate, regular and modified whey protein powders	Emulsified chicken meat batters	All proteins reduced cooking loss. The most cost-effective ingredient appeared to be the modified whey, which provided the best moisture retention.	Barbut and Choy (2007)
Caseinate, whole milk and skim milk powders, regular and modified whey protein concentrates	Chicken meat batters	All additives (except regular whey) reduced cook loss. Caseinate and modified whey formed distinct protein gel regions and enhanced textural properties. The most cost-effective ingredient and the best moisture retention for chicken batters was modified whey.	Barbut (2006)
Caseinate, milk protein isolates, whey protein isolates	Emulsified meat batters	All powders resulted in softer, lighter and less red products. WPI provided the best emulsifying and moisture retention.	Youssef and Barbut (2010)
Native and preheated whey protein isolates	Emulsified meat batters	Decreased cooking loss Resulted in lighter and less red products Decreased the fat globules agglomeration and protein aggregation.	Youssef and Barbut (2011)
Cheese powder	Emulsion sausage	Led to boost flavor and reduced salt content in cooked sausages No negative effect on saltiness or overall flavor.	Xiang et al. (2017)

Both caseins and whey proteins have been commercially used in frankfurters and bologna type sausages, meat patties and meatballs. They can improve the binding strength, firmness and



sliceability of restructured products, boneless ham and chicken rolls. Skimmed milk powder, produced from skim milk by condensing and spray drying milk, can be used as a neutral filler and enhance water-binding properties, emulsifying capacity and emulsion stability of meat products (Xiong, 2009). However, Maillard browning discoloration during heat application could be a problem due to its high lactose content (Xiong, 2009). The incorporation of caseinate has the ability to improve cooking yield, swelling ability and hydration of several meat products while contributing high-quality protein (Mittal and Osborne, 1985; Tsai et al., 1998; Atughonu et al., 1998; Joly and Anderstain, 2009). It can also act as an emulsifier due to the hydrophobic interactions with myosin. However, due to the low water-holding capacity, hydrolyses of caseins have for long been employed as sources in meat formulations. Casein hydrolysates obtained by the proteases trypsin and chymotrypsin exhibit antioxidant capacity to prevent oxidative damage, prevent off-flavor, improve textural characteristics and increase shelf life of muscle foods (Sakanaka et al., 2005; Feiner, 2006; Xiong, 2009; Rossini et al., 2009).

Since whey-based proteins have an excellent amino acid profile (particularly lysine) and cause a more balanced amino acid composition (Lee et al., 1980), they can partially replace meat protein and substitute binding agents, fillers, modified starch and hydrocolloids (Youssef and Barbut, 2011). They exhibit good solubility and water binding capacity, improve nutritional value, juiciness and palatable impressions during consumption (Hongprabhas and Barbut, 1999; Xiong, 2009). The water-binding capacity of whey proteins contributes to the prevention of weight loss during processing and storage and the juiciness of the product. In addition, they are surface-active globular proteins and adsorbed at the fat/water interface where they unfold, and potentially help stabilize the fat globules. Therefore, they can act as emulsifiers in meat emulsion systems to improve emulsification, water binding and texture. The emulsification properties of whey proteins are important for emulsified products such as hot dogs and bologna-type products (Prabhu, 2006). Also, they show antioxidant activities in meat products (Prabhu, 2006). Whey proteins are widely accepted in low-fat meat products due to their nutritional and functional properties including solubility, viscosity and water binding capacity (Frydenberg et al., 2016). Whey protein isolates, concentrates or hydrolysates have also been used as emulsifying, gelling and water binding ingredients. Most commonly, whey protein concentrates are used due to their ability to form heat-induced three-dimensional gel structures with increased water-holding capacity and potential texture modifying properties (Morr and Ha, 1993; O'Grady and Kerry, 2010). Recently, whey proteins have been used as sources of bioactive peptides. The incorporation of whey hydrolysate into pork frankfurters could be an option for providing antihypertensive peptides in food for health-oriented consumers (Barrón-Ayala et al., 2020).

CONCLUSION

The incorporation of dairy-based proteins into meat product formulations has a great potential to improve nutritional and techno-functional properties as well as to improve health profile without causing negative impacts on sensory quality. It is important to select and optimize the usage amounts of those ingredients by considering the production necessities, the interactions between the meat matrix and the additives, as well as the legal restrictions. Further investigations are likely to unveil the potential application of dairy-based proteins and their applications in formulation of various meat products.



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**THE EFFECTS OF DIFFERENT DILUTE ACID AND ALKALI PRETREATMENTS
ON FERMENTABLE SUGAR AND ETANOL PRODUCTION FROM
SWITCHGRASS (*Panicum virgatum* L.).**

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ABSTRACT

This research was conducted to evaluate the effects of different dilute acid (1, 2, and 3% sulphuric acid) and alkali (1, 2, and 3% sodium hydroxide) pretreatments on fermentable sugar and lignocellulosic ethanol production from switchgrass (*Panicum virgatum* L.). Pretreatments were carried out in an autoclave at 121 °C for 30 min. All pretreatment methods significantly affected all parameters (solid yield, cellulose, hemicellulose, and lignin contents, lignin removal, total reducing sugar content, enzymatic hydrolysis yield, and theoretical ethanol yield) observed in the study. Additionally, all pretreatment methods considered in the study significantly increased cellulose content of switchgrass in comparison to control, while an opposite trend was observed in hemicellulose content. On the other hand, sodium hydroxide (NaOH) pretreatment doses considerably decreased lignin content but the significant increases were achieved in lignin content as a results of sulphuric acid (H₂SO₄) pretreatments. Lignin removal ranged from 5.0 to 82.0% in the study. The significantly highest lignin removal was achieved with 3% NaOH pretreatment, whereas the lowest was in 1% H₂SO₄ pretreatment. However, there was no significant differences between H₂SO₄ pretreatments in terms of lignin removal. The contents of total reducing sugar (TRS) ranged between 156.0 and 594.6 mg/g in the study. 2% NaOH pretreatment provided the highest TRS content followed by 3% NaOH pretreatment with slight difference, while the lowest TRS content was observed in control. Enzymatic hydrolysis yields (EHY) obtained from pretreatment methods ranged from 20.9 and 62.2% in the study. 1 and 2% NaOH pretreatment methods gave the highest EHY, whereas the lowest was observed in control like in TRS content. Theoretical ethanol yield (TEY) ranged between 78.0 and 214.1 mg/g raw material in the study. 1% NaOH pretreatment provided the significantly highest value, while the lowest TEY was achieved with 3% H₂SO₄ pretreatment. The results obtained from the study showed that 1% NaOH pretreatment was the most promising option for the sustainable bioethanol production from switchgrass among the pretreatments tested in the study.

Keywords: Pretreatments, sugar, switchgrass, ethanol



1. INTRODUCTION

Growing concerns over greenhouse gas emissions and gradually declining petroleum sources have recently stimulated the global interest in renewable energy fuels (Keshav et al., 2018). In this regard, lignocellulosic biomass including perennial grasses, short rotation trees, and agricultural and forestry residues appears as the most suitable option for the production of second generation bioethanol because it has a low cost, wide availability and does not directly compete with food and feed applications (Menezes et al., 2014; Wells et al., 2020). Lignocellulosic biomass mainly consists of cellulose, hemicellulose and lignin (Menezes et al., 2014). In order to produce second generation bioethanol, structural carbohydrates (cellulose and hemicellulose) present in cell wall must be broken down into fermentable sugars (glucose, xylose, galactose, etc.) by means of enzymatic hydrolysis prior to fermentation process (Azelee et al., 2014). However, the presence of a lignin-hemicellulose complex hinders enzyme accessibility to cellulose resulting in a poor fermentable sugar yields, consequently bioethanol production from lignocellulosic biomass is significantly reduced (Wang et al., 2012; Menezes et al., 2014). Additionally, high degree of cellulose crystallinity is one of the main constraints that negatively affects enzymatic digestibility of biomass (Zhang et al., 2013). For this reason, in order to enhance enzymatic digestibility, a pretreatment step is necessary prior to enzymatic hydrolysis that makes cellulose more accessible to hydrolytic enzymes by removal of lignin and/or hemicellulose, reducing cellulose crystallinity, and increasing biomass porosity (Qi et al., 2009; Weerasai et al., 2014). Due to their easy applicability and low costs, chemical pretreatments, generally performed by dilute acid (H_2SO_4 , HCl etc.) and alkali ($NaOH$, lime, ammonia etc.) reagents, have been the most widely used pretreatment method in global bioethanol industry (Barcelos et al., 2013; Weerasai et al., 2014).

This research was conducted to investigate the effects of different dilute acid and alkali pretreatments on fermentable sugar and lignocellulosic ethanol production from switchgrass (*Panicum virgatum* L.).

2. MATERIAL and METHOD

2.1. Material

Switchgrass biomass was collected from the field trial established at the Agricultural Faculty of Cukurova University in Adana, Turkey. The biomass was dried in an oven at 105 °C for 24 h, and then milled and passed through a 1-mm screen.

2.2. Method

10 gr dry biomass samples were slurried in 1%, 2%, and %3 (w/v) H_2SO_4 and $NaOH$, solutions using 250-mL glass bottles with a solid:liquid ratio of 1:10 g/mL. Pretreatments were performed in an autoclave at 121 °C for 30 min. A non-pretreated sample was used a control in the study. After pretreatments, the samples were cooled to room temperature, the solid biomass was filtrated, then washed with distilled water until the pH became neutral. Finally, the pretreated samples were oven-dried at 105 °C for 24 h.

The cell wall composition (lignin, cellulose and hemicellulose) of the raw material and pretreated samples were determined in accordance with the method of Van Soest (1963). Additionally, the solids yield and lignin removal were calculated in accordance with the following equations (Yan et al., 2020):

Solid yield (%): $[\text{Pretreated biomass (g)} / \text{Raw material (g)}] \times 100$

Lignin removal (%): $100 - [\text{Pretreated biomass (g)} \times \text{Lignin content in pretreated biomass (\%)}] / [\text{Raw material (g)} \times \text{Lignin content in raw material (\%)}] \times 100$



2 g of pretreated and control samples were mixed in 100 ml of sodium citrate buffer (50 mM, pH: 4.8). In order to hydrolysis the polysaccharides, the cellulolytic enzyme "Accellerase 1500" was used at a dose of 0.24 ml/g biomass in accordance with the manufacturer's recommendations (Choudhary et al., 2012). Finally, sodium azide at a concentration of 0.02% was added to the solution to prevent microbial contamination (Niemi et al., 2017). Enzymatic hydrolysis was performed in a shaking incubator at 50 °C, 150 rpm for 72 h. Following the enzymatic hydrolysis, the liquid fraction was recovered by filtration. For reducing sugar analysis, approximately 20 ml of each sample was taken and stored at -20 °C. The total reducing sugars (mg/g pretreated biomass) were determined according to the 3,5-dinitrosalicylic acid (DNS) method (Miller, 1959). Finally, enzymatic hydrolysis yield (EHY) and theoretical ethanol yield (TEY) were calculated in accordance with the following equations (Chen et al., 2007; Pesce et al., 2020).

EHY (%): $[\text{Total reducing sugars (mg/g)} \times 0.9] / [\text{Total polysaccharides (mg/g)}] \times 100$

TEY (mg g^{-1} raw material): $\text{Solid yield (\%)} \times \text{Total reducing sugar (mg/g)} \times 0.51$

Here, 0.9 and 0.51 refer to the conversion factor of reducing sugar to holocellulose and ethanol, respectively.

2.3. STATISTICAL ANALYSIS

All of the treatments were conducted in triplicate. The data were analyzed according to a randomized plot design using an ANOVA model with JMP 8.0 statistical software. Separation of the significantly different means was performed at $P < 0.05$ using the LSD test.

3. RESULTS and DISCUSSION

All parameters (solid yield, cellulose, hemicellulose, and lignin contents, lignin removal, total reducing sugars, enzymatic hydrolysis yield, and theoretical ethanol yield) observed in the study were significantly affected by pretreatments.

Solid yield refers to differences between total solid and dry matter losses occurred during the pretreatment stage, mainly caused by hemicellulose and lignin removal. Solid yield ranged between 50.5 and 73.3% in the study (Table 1). 1% NaOH pretreatment produced the significantly highest solid yield, whereas the lowest was in 3% NaOH pretreatment. As expected, solid yield decreased with each increase in chemical concentration. These results coincide with those reported in agave (Lainez et al., 2018), switchgrass (Xu and Cheng, 2011) and giant reed (Jiang et al., 2016) in that increasing dilute acid or alkali concentrations significantly decreased solid yield.

Table 1. The effects of different dilute acid and alkali pretreatments on biomass composition of switchgrass.

Pretreatments (%)	Solid yield (%)	Cellulose (%)	Hemicellulose (%)	Lignin (%)	Lignin removal (%)
Control	-	40.7 E	26.6 A	8.1 C	-
1% NaOH	73.3 A	67.0 D	15.8 B	6.4 D	42.2 C
2% NaOH	54.8 D	73.9 B	12.2 C	3.3 E	77.6 B
3% NaOH	50.5 E	75.3 A	11.4 C	2.9 E	82.0 A
1% H ₂ SO ₄	61.0 B	67.9 D	3.6 D	12.7 B	5.0 D
2% H ₂ SO ₄	57.4 C	69.4 C	2.2 DE	13.2 A	6.9 D
3% H ₂ SO ₄	56.7 C	69.9 C	1.6 E	13.2 A	8.0 D
Mean	58.95	66.3	10.5	8.5	37.0



Cellulose content ranged from 40.7 to 75.3% in the present study (Table 1). 3% NaOH pretreatment induced the significantly highest cellulose content, while the lowest cellulose content was observed in control. All pretreatments considered in the study significantly increased the cellulose content of switchgrass. These results were in accordance with those reported in napier grass (Eliana et al., 2014), corn stover (Lee et al., 2015), miscanthus (Michalska et al., 2015), and agave (Lainez et al., 2018) which suggested that acid or alkali pretreatments significantly increased cellulose content.

The percentage of hemicellulose ranged between 1.6 to 26.6% in the study (Table 1). Control treatments led to significantly highest hemicellulose content, whereas the lowest was in 3% H₂SO₄ pretreatment. Unlike cellulose content, all acid and alkali pretreatments significantly decreased the hemicellulose content of switchgrass. Dilute acid pretreatments led to significantly lower hemicellulose content compared to dilute NaOH pretreatments, most likely due to their higher efficiency in the solubilisation of hemicellulose to xylose (Si et al., 2015). These results supported by Nazli et al., (2018) who reported that dilute H₂SO₄ pretreatments (1, 1.5, and 2.0% w/v) caused the significantly lower hemicellulose content in sweet sorghum bagasse in comparison to dilute NaOH pretreatments (1, 1.5, and 2.0% w/v).

Lignin content ranged between 2.9 and 13.2%, among the pretreatments (Table 1). The switchgrass biomass showed the significantly highest lignin content when it was subjected to 2 and 3% H₂SO₄ pretreatments, while the lowest lignin content was achieved with 3% NaOH pretreatment. NaOH pretreatments significantly decreased lignin content but an opposite trend was observed in H₂SO₄ pretreatments. These results were similar to those reported by earlier studies (Wang et al., 2010; Xu et al., 2010; Lainez et al., 2018) in different crops. On the other hand, lignin removal ranged from 5.0 to 82.0% among the pretreatments. Lignin removal significantly increased with each increase in NaOH doses. However, H₂SO₄ pretreatments provided the similar lignin removal in the study. Lignin removal was significantly higher in NaOH pretreatments than in H₂SO₄ pretreatments because they provided the significantly lower lignin contents. These results were probably associated to fact that alkali pretreatments disrupt the lignin structure and remove most of the lignin fractions from the biomass by cleaving the structural linkages between lignin and polysaccharides, while acid pretreatment mostly modifies the cell wall via hemicellulose removal, rather than delignification (Si et al., 2015; Phitsuwan et al., 2016; Santos et al., 2018).

Total reducing sugars (TRS) content varied between 156.0 and 594.6 mg/g in the study (Table 2). 2% NaOH pretreatment produced the highest TRS content followed by 3% NaOH pretreatment with slight difference whereas the lowest was in control. TRS contents were significantly higher in alkali pretreatments in comparison to acid pretreatments, probably because they led to higher cellulose and hemicellulose contents, and lignin removal. Additionally, NaOH pretreatments generate lower toxic by-products such as acetic acid, furfural and hydroxymethylfurfural (HMF), which are known to inhibit enzyme activity and have a higher efficiency in reduction of cellulose crystallinity compared to acid pretreatments (Chen et al., 2012; Menezes et al., 2014). These results in accordance with the those reported in napier grass (Eliana et al., 2014) and miscanthus (Si et al., 2015) in that NaOH pretreatments produced the significantly higher sugar yields compared to acid pretreatments.



Table 2. The effects of different dilute acid and alkali pretreatments on total reducing sugars (TRS), enzymatic hydrolysis yield (EHY) and theoretical ethanol yield (TEY) of switchgrass.

Pretreatments (%)	TRS (mg/g)	EHY (%)	TEY (mg/g raw material)
Raw material	156.0 F	20.9 F	79.9 F
1% NaOH	571.8 B	62.2 A	214.1 A
2% NaOH	594.6 A	62.2 A	166.6 B
3% NaOH	588.8 A	61.1 B	152.0 C
1% H ₂ SO ₄	408.7 C	51.4 C	127.4 D
2% H ₂ SO ₄	388.9 D	48.9 D	114.0 E
3% H ₂ SO ₄	269.5 E	33.9 E	78.0 F
Mean	425.5	48.7	133.1

EHY ranged from 20.9 to 62.2% in the study (Table 2). 1 and 2% NaOH pretreatments produced the significantly highest EHY, whereas the lowest was in control. NaOH pretreatments led to significantly higher EHYs than the acid pretreatments mainly because they produced the significantly higher reducing sugars. These results were comparable to those reported in cotton stalk (Silverstein et al., 2007) and sweet sorghum bagasse (Umagiliyage et al., 2015) in which NaOH pretreatment resulted in a higher EHY compared to acid pretreatment. On the other hand, EHY showed a significantly decreasing trend with each increase in H₂SO₄ concentration, mainly due to the significant reduction in TRS content.

TEY ranged between 78 and 214.1 mg/g raw material in the study (Table 2). All pretreatments considered in the study significantly increased the TEY except for 3% H₂SO₄ pretreatment. Despite 1% NaOH pretreatment produced the significantly lower TRS content than the 2% and 3% NaOH pretreatments, it led to significantly highest TEY in the study because it resulted the significantly highest solid yield. NaOH pretreatments exhibited the significantly higher TEY compared to H₂SO₄ pretreatments, primarily due to the fact that they produced significantly higher reducing sugars in the study. These results were confirmed by Zhang et al., (2020) who reported that. NaOH pretreatment resulted in a considerably higher ethanol yield than acid pretreatment in miscanthus.

4. CONCLUSION

The results obtained from the study showed that 1% NaOH pretreatment was the most promising option for the sustainable bioethanol production from switchgrass among the pretreatments tested in the study.



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DETERMINATION OF SOME CHARACTERISTICS OF CHICKEN NUGGETS COATED WITH CHIA MUCILAGE AND CORN FLOUR

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ABSTRACT

Nugget is a coated product consisting of chicken meat. In chicken products prepared by coating, especially the change in coating formulations helps to develop a new, different and healthy product. In fact, these products allow them to be used comfortably in the diets of gluten-sensitive and celiac patients. In this study, corn flour and chia mucilage were added to nugget which prepared from chicken meat instead of cereal flours used in the standard production method as coating product. The nugget dough, which prepared from a mixture of chicken breast, chicken thigh and skin, was treated with various spices (black pepper, cumin etc) and sauced, then deep fat frying was applied. Color determination (L^* , a^* , b^*), texture profile analysis (hardness, springiness, cohesiveness, gumminess, chewiness, resilience), mineral composition analysis and sensory analysis of produced nuggets were performed. According to the results, the lightness value (43.03) of the nuggets prepared by adding chia mucilage was found to be lower than the lightness value (55.42) of the nuggets prepared with corn flour ($P < 0.05$). When the texture profile analysis results of the samples were evaluated, the added chia mucilage and corn flour did not make a statistically significant ($P > 0.05$) difference on the textural parameters except the gumminess value. Calcium (Ca), Iron (Fe), Potassium (K), Magnesium (Mg), Phosphorus (P) and Zinc (Zn) values of nuggets prepared with chia mucilage were found to be higher than nuggets prepared with corn flour ($P < 0.05$). However, the color, taste-odor, crispness and general acceptability values of the nuggets with chia mucilage got higher scores. As a result; it can be recommended to consume nuggets prepared with chia mucilage.

Keywords: Chicken nuggets, gluten-free, chia mucilage, corn flour



1. INTRODUCTION

Nowadays, the importance of gluten-free nutrition has been increased all over the world. Gluten-free nutrition is used not only for celiac patients but also for diseases such as irritable bowel syndrome, autism, rheumatoid arthritis, schizophrenia, atopy, fibromyalgia, endometriosis, and chronic pelvic pain, athletic performance, and bodyweight-loss diets. In gluten-free diets, especially dietary fiber, vitamins, minerals, and protein can remain poor. Gluten-free products have been used in food technology to prevent these nutritional deficiencies. For example, Chia and cornflour with rich nutritional content are used in different food products.

There has been a severe trend towards ready-to-eat foods recently. Chicken nuggets are one of the foods that are liked and consumed, especially by young people and children. Alternative cereal flours have been used in the outer coating of nuggets. Chia (*Salvia hispanica* L.), which contains polyunsaturated fatty acids and has rich nutritional content, is functional. It consists of 15-25% protein, 30-33% fat, 26-41% carbohydrates, 18-30% high dietary fiber, 4-5% ash, minerals, and vitamins, and also contains a high amount of antioxidants (Guan Tan ve ark., 2012). As a result of treating the chia seed with water, it forms a gel called mucilage, and it is not easy to replace from the seed. This mucilage, which can create viscosity, hydrate, and preserves freshness, is widely used in functional foods, especially in bakery products such as cakes and cookies (Fernandes ve ark., 2017). The desired yellow color in the products coated with corn flour is provided due to the carotene pigment. The zein protein in corn flour has a hydrophilic feature, absorbing water and preventing the frying oil from passing into the product. For this reason, the inside of the product is juicy, and the outside is crispy (Akcan ve ark., 2016). Using various flours as coating material may cause changes in the appearance, texture, flavor, and chemical composition of the products (Hepsag ve ark., 2010.). In this study, chia mucilage and cornflour were used as a coating material in the chicken nuggets. Color, texture profile analysis, mineral composition, and sensory analysis were determined.

2. MATERIAL and METHOD

Chicken breasts, legs and skins were obtained from a local market (Metro, Konya, Turkey) and minced (Kitchen Aid, USA). Various spices (black pepper, cumin, salt, garlic powder, etc.) were mixed into the meats. The dough, which was formed into a round flat shape, was rested for 1-2 hours at the refrigerator. Nuggets treated with a liquid sauce made with the addition of water, spices, carboxy methyl cellulose (CMC) and flour in certain amounts. Then dry sauce with flour and spices were used to the nuggets and the samples were deep fried in sunflower oil. Color determination (L^* , a^* , b^*) and texture profile analysis (hardness, springiness, cohesiveness, gumminess, chewiness, recycling), mineral composition analysis, sensory analysis were performed in the nuggets.

The color (L^* , a^* , and b^*) values of the samples were determined using a (CR-400 Minolta Co, Osaka, Japan) chromometer (Hunt et al., 1991). A total of 3 measurements were made from the front and back of the nuggets.

While performing the texture profile analysis, the textural properties of each nugget sample (hardness, springiness, cohesiveness, gumminess, chewiness, and resilience) were evaluated with Texture profile analyzer (TA-HD Plus Texture Analyser, UK). A cylindrical 36 mm diameter probe was used in the tests.

One gram of samples was weighed and prepared for the mineral composition, and the necessary procedures were carried out for the mineral composition. Mineral contents were measured with ICP AES (Varian-Vista, Australia). Measurements of mineral concentrations were checked using the certified values of related minerals in the reference samples received from the



National Institute of Standards and Technology (NIST; Gaithersburg, MD, USA) (Skujins, 1998).

The sensory analysis was carried out by volunteer panelists in the Department of Food Engineering at Selcuk University. It was asked to evaluate the forms prepared with color, odor, flavor, texture, and general acceptability values from the nuggets presented in a randomly coded way in the presentation containers, on a scale of 1 to 9 (1: quite bad-9: excellent).

The data obtained for statistical analysis were subjected to analysis of variance using Minitab Statistical Software, Release 16.0 program. Mean values were analyzed using the Tukey Comparison Test to compare whether the differences between groups were significant ($P < 0.05$).

3. RESULTS and DISCUSSION

3.1. COLOR RESULTS

The results of color parameters of nuggets prepared by adding chia mucilage and corn flour are given in Table 1.

Table 1. Color analysis (L^* , a^* , b^*) results of nuggets prepared by adding chia mucilage and corn flour

	L^*	a^*	b^*
CM	43,03±0,35b	8,70±0,41a	17,65±2,25b
CF	55,42±0,06a	3,23±0,17b	22,95±0,85a

CM: Nuggets prepared by adding chia mucilage, CF: Nuggets prepared by adding corn flour.

a-b: The difference between the means with different letters on the same line is statistically significant ($P < 0.05$)

In this study, L^* and b^* values of chia mucilage added nuggets were lower than nuggets prepared by adding corn flour. However, the a^* value was higher in nugget with chia mucilage. Barros ve ark. (2018) reported that the L^* value of chicken nuggets decreased with chia flour. They stated that this situation was because chia flour had a dark color. In another study, Akcan ve ark. (2016) reported that chicken nuggets prepared by adding corn flour had the highest yellowness (b^*) values. According to the study conducted by Shekarchizadeh ve ark. (2018), a decrease was observed in the color analysis values, and it was stated that the lightness, redness and yellowness values decreased with the increase in the amount of amaranth flour added to the nugget.

3.2. TEXTURE RESULTS

Table 2 shows the hardness, springiness, cohesiveness, gumminess, chewiness, and resilience values of the chicken nugget samples.

Table 2. Texture profile parameters of nuggets prepared by adding chia mucilage and corn flour

	Hardness	Springiness	Cohesiveness	Gumminess	Chewiness	Resilience
CM	121,22±3,60	0,77±0,01	0,66±0,03	78,537±0,61a	60,51±1,48	0,263±0,01
CF	110,77±3,59	0,76±0,01	0,60±0,03	69,362±3,05b	52,52±4,86	0,256±0,01

CM: Nuggets prepared by adding chia mucilage, CF: Nuggets prepared by adding corn flour.

a-b: The difference between the means with different letters on the same line is statistically significant ($P < 0.05$)

As seen in Table 2, hardness, springiness, cohesiveness, gumminess, chewiness and resilience values were higher in chia mucilage nuggets than in corn flour nuggets. Therefore gumminess value was a significant effect ($P < 0.05$) on the samples.

Akcan ve ark. (2016) found that nuggets coated with cornmeal had a higher hardness value than nuggets coated with wheat flour. Felisberto ve ark. (2015) also reported that the texture of cakes in which they added chia mucilage was positively affected; this is due to the high water retention capacity of chia mucilage. In another study, hardness and chewiness values of nuggets increased due to the amaranth flour (Shekarchizadeh ve ark. 2018).



3.3. MINERAL CONTENT

Table 3 indicates the mineral contents of nuggets prepared by adding chia mucilage and corn flour.

Table 3. Mineral contents of nuggets prepared by adding chia mucilage and corn flour

	Ca	Fe	K	Mg	Na	P	Zn
CM	254,5±7,78a	10,0±0,00	3905,5±400,9a	341,0±22,63a	4487,5±365,6	3430,0±83,4a	9,50±0,70a
CF	90,0±1,41b	8,0±0,00	2376,5±265,2b	204,5±14,85b	3583,5±259,5	2693,0±43,8b	7,00±0,00b

CM: Nuggets prepared by adding chia mucilage, CF: Nuggets prepared by adding corn flour.

a-b: The difference between the means with different letters on the same line is statistically significant ($P < 0.05$)

As shown in Table 3, the mineral content of nuggets with chia mucilage addition is quite high. Koca ve ark. (1997) according to a study conducted by wheat flour and corn flour comparison of the mineral substance (P) phosphorus, (Fe) iron, (Zn) zinc and (Mg) magnesium values were higher. In our study, the addition of chia mucilage to nuggets affected ($P < 0.05$) the calcium, potassium, magnesium, phosphorus, and zinc content of nuggets compared to the addition of corn flour.

3.4. SENSORY ANALYSIS

Sensory analysis results of nuggets prepared by adding chia mucilage and corn flour are shown in Figure 1.

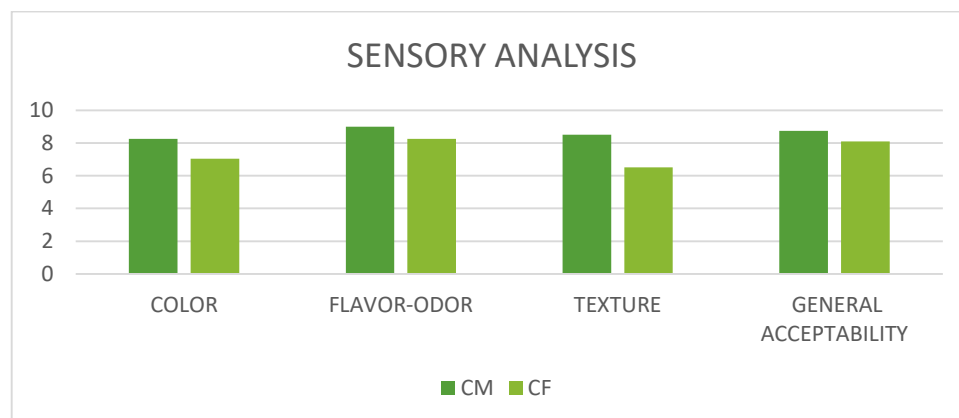


Figure 1. Sensory scores of nuggets prepared by adding chia mucilage and corn flour

It was determined that color, flavor, odor, texture, and general acceptability parameters of nuggets with chia mucilage added higher scores than nuggets prepared with corn flour.

4. CONCLUSIONS

In the study, it was determined that nuggets prepared with corn flour were lighter and more yellow. According to the mineral contents, it was determined that the amount of calcium, iron, potassium, magnesium, sodium, phosphorus and zinc elements of chia mucilage nuggets were higher than the addition of corn flour. The gumminess value is higher in chia mucilage samples ($P < 0.05$). In sensory parameters results, similar scores were obtained in both groups. As a result, as an alternative to normal standard production, corn flour and chia mucilage as coating materials can be applied to nuggets. Such studies are needed.



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THE USE OF LEGUMES IN INFANT FORMULAS AND DETERMINATION OF THE PROTEIN DIGESTIBILITY IN THE INFANT STATIC *IN VITRO* DIGESTION MODEL

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ABSTRACT

The demand for animal proteins has been expected to nearly double the current consumption in the 50 years. Hence, there has been a growing interest in the use of plant proteins as a source of protein in foods. Owing to high nutritional quality, good techno-functional properties, and acceptable costs, legume proteins (LP), such as soy, pea, chickpea, broad beans, or lupine proteins, constitute a potential alternative to proteins of animal origin. Legume proteins are used in many parts of the world as a meat substitute or have long been used as a primary and inexpensive protein source to reduce insufficient protein intake. Malnutrition and overnutrition can usually be seen in the 6-24 month period that is the most vulnerable in life due to the weaning of the baby from breast milk. Infants and young children are particularly affected by malnutrition during this period, as they have high growth rates. Protein intake in the early period of life is very important for babies to provide development, growth, body composition, neurodevelopment, and appetite, and also to maintain hormonal status. Infant formulations (IFs) containing essential amino acids close to the amount found in breast milk, which is considered the gold standard for babies, are being developed. It is known that food processing in formulations using legume combinations, positively affects digestibility and biological value of proteins, and net protein intake. The infant static *in vitro* digestion protocol is a new and simple method by which formulations can be examined in terms of composition, structure, or process. Concerning nutritional quality, most of the physiological characteristics of infant digestion are modeled in the *in vitro* static digestion model. Static *in vitro* infant digestion model can be suitable to show the efficacy of the functional properties of vegetable proteins which are close to reference milk-based formulations and infant physiological conditions. On the other hand, information on the digestibility of legumes, their behavior during gastrointestinal digestion, additionally the peptidomics characterization of resistant peptides is still limited. In conclusion, it seems possible to produce formulations in which cow's milk proteins are partially replaced by legume proteins without being too different from the reference milk formula according to the basic physicochemical criteria accepted as the standard for LP.

Keywords: Protein, Legume proteins, Infant formulations, Infant static *in vitro* digestion, Digestibility



1. INTRODUCTION

1.1. THE ROLE OF PROTEINS IN HEALTH AND SUSTAINABILITY

In today's health-based consumer-focused world and due to sustainable concerns, more and more research is being conducted in order to obtain knowledge about the effects of animal- and plant-based diets on human health. The projection of the Food and Agricultural Organisation (FAO) for the world population for 2050 and 2100 are 9.73 billion and 11.2 billion, respectively. However, it is underlined that protein deficiency will be the most important nutritional problem in the future, since a similar increase in protein sources is not foreseen in parallel with this population growth rate. Proteins provide indispensable (IAAs) amino acids necessary for maintaining body muscle and growth. Also, proteins play an important role in food as nutritional and techno-functional ingredients. Animal proteins, such as milk proteins and gelatin, are the most commonly used proteins in food applications. However, the increasing cost of and demand for proteins have led to an increased interest in utilizing plant proteins as partial replacers of animal proteins. Legumes are important plant-based sources of protein (18–41%) and IAAs such as lysine. The most consumed legumes are common beans (*Phaseolus vulgaris*), chickpeas (*Cicer arietinum*), lentils (*Lens culinaris*, *L. esculenta*), peas (*Pisum sativum*), broad beans (*Vicia faba*), peanuts (*Arachys hypogea*), and soybeans (*Glycine max*), the latter being the most produced and industrialized worldwide (Aviles et al., 2017 & Kashyap et al., 2019).

The increasing interest in plant proteins as a protein source due to both environmental and sustainability concerns in daily nutrition requires a better understanding of the digestion process of these proteins. However, legumes, and, thereby their proteins, are not similar. Moreover, the nutritional quality of proteins is not solely dictated by the amino acid (AA) composition, but important factors like digestion rate and digestibility in the gastro-intestinal (GI) tract, which in turn are determined by the protein structure and enzyme accessibility, are of utmost importance. Protein digestibility is affected by both endogenous and exogenous factors. Endogenous factors relate to the protein and protein structural characteristics, and how and to what extent food processing may affect this structure. Exogenous factors are related to the food matrix, and include protein interactions with other compounds like carbohydrates, lipids, and especially anti-nutritional factors (ANF). ANFs include the anti-nutritional proteins like trypsin inhibitors and lectins and anti-nutritional compounds like tannins, phytates, and polyphenols. Therefore, it may beforehand be expected that both different types of legume protein and different processing may result in a very diverse digestibility (Riboli et al., 2002).

1.2. EFFECTS OF FOOD PROCESSING METHODS ON THE DIGESTIBILITY OF LEGUME PROTEINS

Plant-based proteins have been widely investigated in order to understand the digestibility as such. Since it is well known that different processing procedures will affect both structure and functionality of proteins, it is expected that processing may also affect protein digestibility. Consumption of raw legumes is not recommended nutritionally due to their low protein digestibility. Therefore to improve the digestibility of the legume proteins has been an emerging issue in recent years. Several different types of legumes and processing techniques have been investigated to evaluate the potential improvement of nutritional value and protein utilization. Processing is the action of performing a series of mechanical or thermal operations on food in order to change or preserve it. It may involve soaking, cooking, microwave irradiation, baking, pressure-cooking, autoclaving, and extrusion (Öste et al., 1991 & Drulyte et al., 2019).



Table 1 Effects of food processing legumes' proteins

Processing methods	Effects	Reference
Pressure-cooked	Soaking prior pressure cooking in addition to reducing processing time, positively affected bean protein digestibility, since the <i>in vitro</i> protein digestibility (IVPD) were improved by 14–16% The digestibility of lysine from chickpea and yellow pea, measured by a dual stable isotope method in healthy South Indian adults, was found to be 60% and 62%, respectively, when pressure-cooked and eaten with rice.	<i>Negi et al., 2001</i> <i>Kasyhap et al., 2019</i>
Soaking, fermentation, germination, dehulling, boiling and roasting	Many of these processing methods are frequently used in domestic cooking, but they typically have a small impact (~10%) on the improvement of digestibility.	<i>Devi et al., 2018</i>
Extrusion	Extrusion processing enhanced IVPD in all studied legumes. The IVPD of faba beans increased from 75.4% in raw unsoaked seeds to 80.4% in soaked extruded seeds at 140 °C and 18% moisture content.	<i>Abd El-Hady and Habiba, 2003</i>
Microwave processing	Bitter and sweet lupin seeds were soaked 96 and 24 h, respectively, before microwave treatment. It was found that microwave processing significantly improved the IVPD by 2.5% and 1.5% compared to raw seeds.	<i>Embaby, 2010</i>
Ultrasound or high hydrostatic pressure (HHP)	Soaking under HHP for 1 h and subsequent heating at 98 °C for 30 min increased IVPD of legumes. Compared with raw legumes, the soluble protein concentrates exhibited 2–4% higher IVPD.	<i>Han et al., 2007</i>

Table 1 shows the effects of food processing on legume proteins. The results indicated that different types of food processing methods on IVPD of legumes displayed a negligible increase when compared to IVPD of raw legumes. As mentioned earlier, the nutritive value of legume proteins is limited by their digestibility, because of the complexity of plant cell walls and the presence of antinutritional factors (ANFs) such as phytates, select polyphenols, tannins, and trypsin inhibitors that can interfere with the digestive processes (Avilés-Gaxiola et al., 2018). Furthermore, in a food matrix containing starch and protein, basic AA such as lysine can be modified to unavailable forms when extended periods of high temperatures are used during treatment (Lund and Ray, 2017). The poor digestibility of legumes can be improved by reducing the effect of ANFs through different types of processing and preparations, such as soaking, fermentation, germination, dehulling, boiling, pressure-cooking, and roasting. For centuries, prior to human consumption legume seeds have been soaked and thermally treated by conventional cooking due to the simplicity in the execution and equipment. Many of these processing methods are frequently used in home cooking, but they typically have a small impact (~10%) on the improvement of digestibility. However, the drawbacks of cooking are a fairly uncontrolled and non-adjustable process and the potential loss of valuable nutrients like vitamins.



Therefore, other processing techniques are investigated in order to optimize protein digestion by better control of the thermal process. Extrusion, a commonly used treatment in the food industry, is a short-time, high-temperature, high-pressure process that converts raw seeds into a fully cooked food, while largely eliminating most ANFs, with a potentially greater improvement in protein digestibility. High pressure and ultrasound treatments are non-thermal technologies known to only affect non-covalent interactions in macromolecules. Therefore, the possible pressure-induced protein unfolding may enhance the access of the digestive enzymes to the cleavage sites in the protein, thus improving digestibility (Linsberger-Martin et al., 2013).

1.3. THE IMPORTANCE OF PROTEIN INTAKE IN EARLY LIFE

Protein intake, both quantity, and quality, during the first 2 y of life has important effects on growth, neurodevelopment, and long-term health. Protein requirements for infants are greater than for adults, with 1.5 vs. 0.8 g of protein per kg of body weight and per day (Heird, 2012). From a qualitative point of view, human milk is the gold standard for the newborn, and breastfeeding is highly recommended for the first six months of life (Victora et al., 2016). However, for several reasons, mothers may be unable to provide human milk and infant formula (IF) can be used instead. In the absence of breastfeeding, the nutritional requirements of infants must be satisfied by supplying IFs products until they become accustomed to complementary food (Agostoni et al., 2008; EU, 2016). For this reason, IFs are being developed instead of breast milk. IFs can be defined as substitutes for human milk, which are mostly spray-dried to a powdered form. IFs are prepared to closely mimic the nutritional composition of the benchmark human milk, comprising of macronutrients (carbohydrates, fat, and proteins) and micronutrients (minerals and vitamins), in order to provide the required nutrients for proper growth, body composition, neurodevelopment, appetite and hormonal regulation of the infants (Michaelsen & Greer, 2014). In addition, malnutrition could be related to the complexity of factors, causing inadequate feeding practices during the most vulnerable period of life, the weaning period, the age between 6 and 24 months in which the infant changes from breastfeeding to the complementary food (Shankar et al., 2018).

Therefore, IFs containing alternative protein sources with nutrients and functional properties similar to breast milk have been investigated. Due to high nutritive quality, good techno-functional properties, and acceptable cost, legume proteins, for instance, soy, pea, chickpea, faba bean or lupine proteins, represent a potential alternative to proteins of animal origin (Ainis et al., 2018; Alves & Tavares, 2019). According to the European regulation, the sources of proteins allowed for IFs are either cow milk protein, goat milk protein, soy protein isolate or hydrolyzed rice protein (European Union, 2016). Soy protein continues to dominate as an alternative plant protein to replace animal-based proteins (Schwartz et al., 2015). Ulloa et al., (1988) showed that chickpea protein was a potentially utilizable product as a milk substitute for children with gastrointestinal problems and demonstrated its good nutritional values that complied with the Codex Alimentarius Commission standards for IFs. Similarly, Malunga et al. (2014) designed, formulated, and determined the nutritional quality of chickpea-based infant follow-on formula that demonstrated to meet the minimum nutrition requirements of EU regulation on infant follow-on formula.



Table 2 Studies on legumes in infant formulas

Study	Methods	Result	Reference
Maize and grain legumes (soybean, cowpea, and groundbean) were pretreated and co-fermented for 28–36 h for production of high protein–energy legume-fortified weaning foods.	Legumes were dried at 60–66° C for 15 h and milled into flours.	Levels of protein and energy fluctuated between 15.55 and 19.30% and 17505.0 and 18726.4 kJ/ kg, respectively, and were higher than the recommended levels for weaning foods.	<i>Egounlety vd., (2002)</i>
The potential use of chickpeas in development of infant follow-on formula	Chickpeas were germinated for 72 h followed by boiling, drying and dehulling in order to minimise associated anti-nutritional factors.	The protein content (%) increased from 16.66 ± 0.35 and 20.24 ± 0.50 to 20.00 ± 0.15 and 21.98 ± 0.80 for the processed desi and kabuli cultivar compared to raw chickpeas, respectively (P < 0.05).	<i>Malunga et al., 2014</i>
The average energy and macronutrient compositions of commercial IFs were calculated.	IF were selected from available in the local supermarkets and food stores under the sections labeled “baby” or “infant” foods.	While the percentage of daily protein requirement (DV%) of one portion of special IFs (for 6-12 month babies) was 37.53%, DV% of IFs containing legumes was 17.27%. DV% for energy were 19.15% and 7.43%, respectively.	<i>Martin-Gomez vd., (2019)</i>
IF containing plant proteins partially replaced with dairy proteins	The IFs composition was identical. The exception is that 50% of the proteins were whey proteins in the “reference IF” (RIF), and pea or faba bean proteins in the “plant IFs” (PIF and FIF, respectively).	In comparison to RIF, PIF and FIF were difficult to disperse, thus conducting to remaining insoluble particles. Thus, the protein source greatly influences IFs properties, and process parameters need to be adapted for each formulation.	<i>Roux et al., (2020)</i>

Table 2 shows the studies on the incorporation of legumes into infant formulas. The authors studied the ability to use plant proteins in IFs. The majority of the studies were concerned with legume proteins only and some were focused on the encapsulation capacity of probiotics in follow-on IFs (for 6-12 months infants). Kent & Doherty (2014) discussed the use of pea protein as suitable for the microencapsulation of probiotics for follow-on IF application but did not mention its nutritional benefits. Similarly, Khan et al., (2013) used legume protein isolates (chickpea, faba, lentil, and pea proteins) as capsule wall materials for probiotics delivery in food and demonstrated their good protection capability and delivery of probiotics under simulated gastrointestinal conditions.

1.4. DIGESTIBILITY OF PROTEINS IN LEGUMES CONTAINING IFs AND IN VITRO INFANT DIGESTION METHOD

In vitro digestion methods are widely used to study the gastrointestinal behavior of food or pharmaceuticals. Although human nutritional studies are still being considered the “gold standard” for addressing diet-related questions, *in vitro* methods have the advantage of being more rapid, less expensive, less labour intensive, and do not have ethical restrictions. Simulated digestion methods typically include the oral, gastric, and small intestinal phases and occasionally large intestinal fermentation. These methods try to mimic physiological conditions



in vivo, taking into account the presence of digestive enzymes, their activities and their concentrations, pH, digestion time, and electrolyte concentrations, among other factors. Static models of human digestion have been used to address such diverse scientific questions as the digestibility and bioaccessibility (i.e. the amount of a compound that is released from the matrix and is considered to be available for absorption through the gut wall) of macronutrients such as proteins, carbohydrates, and lipids (Minekus et al., 2014).

The *in vitro* protein digestibility (IVPD) assay is the most used method for analyzing the digestibility of protein samples. The analysis is carried out by first preparing a multi-enzyme solution, usually including trypsin, chymotrypsin, and peptidase, with some exceptions using single trypsin or pepsin solution, or, sequentially, pepsin and pancreatin solutions. *In vitro* alternatives to clinical trials are used for studying human food digestion. For simulating infant digestion, only a few models, lacking physiological relevance, are available. Thanks to an extensive literature review of the *in vivo* infant digestive conditions, a gastrointestinal static *in vitro* model was developed for infants born at term and aged 28 days. Kinetics of digestion, as well as the structural evolution, were compared with those obtained while submitting the same formula to the adult international consensus protocol of *in vitro* static digestion. The kinetics of proteolysis and lipolysis differed according to the physiological stage resulting mainly from the reduced level of enzymes and bile salts, as well as the higher gastric pH in the infant model (Menard et al., 2018).

How do plant proteins modulate the digestibility of model IFs compared to a dairy reference model IFs? To answer this question, plant protein-substituted IFs were generated on a pilot scale and tested using an *in vitro* static digestion model developed on the basis of an extensive literature review of infant physiology. First, the physicochemical parameters of the produced IFs powders were evaluated and compared with the milk reference IFs to assess the functional quality of these new IFs. Roux et al. (2020) investigated the effect of IFs on digestibility, of which 50% contains pea, broad bean, rice, and potato proteins. The protein hydrolysis degree (DH) and amino acid bioaccessibility (AAB) were used as indicators of protein digestibility. Results showed that both DH and AAB were found to be similar in milk-reference IFs and pea and faba bean IFs, but these values were significantly lower for the rice and potato IFs. This study provided new insights into the impact of protein sources on IFs digestibility.

The effect of legume combinations and processing on the digestibility, biological value, and net protein intake is well known to yield positive results. Conducting a series of systematic studies on the digestion of IFs components will help to better understand the digestibility of these components and thus provide important information about the bioaccessibility of nutrients.

1.5. EFFECTS OF FOOD MATRIX ON THE PROTEIN DIGESTIBILITY

The lipolytic and proteolytic processes are highly dependent on the nature of the food emulsion, which can be significantly altered by the environmental and physicochemical conditions encountered in the gastrointestinal tract. Similarly, technological processes can severely affect the initial structure of IFs, gastric lipolysis, and proteolysis (Bourlieu et al., 2015). However, another important factor in protein digestibility is the food matrix in which the protein is found. In addition, during food processing, a change occurs in the microstructure of the food and therefore in the food matrix, and this change affects the transition of the protein from the food matrix to the free form, thus its digestibility. Examples of the three-dimensional structure of legume proteins, in comparison with that of well-characterized proteins from animal sources – myoglobin, bovine serum albumin, and β -lactoglobulin. In comparison with the structure of proteins of animal origin, it is evident that the structure of proteins from legume seeds is characterized by a high content in β -sheet conformation and a relatively low amount in α -helix,



a feature that is shared by other plant proteins, notably those from cereal grains (Carbonaro et al., 2012). Digestion of hydrolyzed and non-hydrolyzed dairy (casein and whey proteins) and soy proteins commonly used in infant formulations was studied under *in vitro* gastrointestinal (without lipases) conditions for 60 and 120 minutes in the stomach and small intestine, respectively. Soy protein fractions were partially hydrolyzed during digestion. While there was a slight decrease in protein aggregate sizes during gastric digestion. It has been stated that the hydrophobic β -sheet structure of soy proteins and the effect of heat treatment may be the reason for this effect (Nguyen et al., 2016).

2. CONCLUSION

There has been a considerable improvement through research and development to enhance both the nutritional and functional properties of plant proteins. For instance, the use of specific technological treatments can remove most of the anti-nutritional factors and thus improve the biological value and digestibility of such proteins. The digestibility of plant proteins is generally lower than that of animal proteins, which can be improved after food processing methods have been used. Digestibility can also be improved by removing plant cell wall components. For this, proteins are precipitated from legumes by ultrafiltration or isoelectric methods to produce protein fractions with high purity. These relevant studies on the ability to use plant proteins in IFs need to be further developed and complemented with other protein sources that will be suitable for infant needs directly from birth.

Many studies have been conducted on legume proteins related to the use of vegetable proteins in IFs. It is necessary to evaluate the results of studies dealing with the feasibility of producing plant protein-based IFs close to a reference dairy product in terms of physicochemical and functional properties. It seems possible to produce formulations in which cow's milk proteins are partially replaced by legume proteins without being too different from the reference milk formula according to the basic physicochemical criteria accepted as the standard for legume proteins.

Breast milk contains large amounts of prebiotics as breast milk oligosaccharides and lactose, which make up more than 50% of the dry matter content. This demonstrates the important role that breast milk plays in establishing and maintaining microbiota in infants and the stability. It should also be investigated whether formulations containing legumes as a daily complementary food from 6 to 12 months of age alter the intestinal microbiota in infants. From the 6th month when complementary feeding begins, all infants in rich countries have a protein intake that meets their physiological needs, as long as the diet is not excessive and infants are fed appropriate complementary foods. Emerging data suggest that high protein intake can have adverse effects, resulting in a higher growth rate, which can subsequently increase the risk of overweight and obesity. Agostoni et al., (2005) suggested a maximum acceptable protein intake level of 14% for infants aged 12 to 24 months.

The infant static *in vitro* digestion protocol is a new and simple method by which formulations can be examined in terms of composition, structure, or process. Concerning nutritional quality, most of the physiological characteristics of infant digestion are modeled in the *in vitro* static digestion model. Static *in vitro* infant digestion model can be suitable to show the efficacy of the functional properties of vegetable proteins which are close to reference milk-based formulations and infant physiological conditions. In infant digestion, gastric proteolysis is slower and a lower degree of hydrolysis is reached than in the adult stage. The amount of amino acids and peptides formed during *in vitro* digestion provides valuable information on where and to what extent protein is broken down. However, this information is still limited in the literature and further research is required to quantify and compare the amount of amino acids and peptides obtained during gastric and duodenal digestion steps.



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INNOVATIVE POTENTIAL OF PECTIN SUBSTANCES IN THE STRUCTURE OF FUNCTIONAL FOOD PRODUCTS

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ABSTRACT

The deterioration of the ecological and social situation in many regions of the world requires the search for effective multifunctional ingredients for functional food products, including the therapeutic and prophylactic direction for removing heavy metals, radioactive isotopes, pesticides, phenols and other industrial poisons from the human body. World practice has shown that the chemical preparations previously used to cleanse the body (activated carbons, zeolites, complexones) are not effective enough. Recently, a natural multifunctional ingredient - pectin, which has no side effects and is highly effective in various intoxications of the human body with industrial poisons, has acquired particular relevance. Pectin substances are today one of the most demanded and most widely used food ingredients, due to their versatility. Pectins are an integral part of human food at all stages of its evolutionary development, which led to an almost ideal adaptation of the human body to them. Gel matrices based on natural biopolymers, including pectin substances, are widely used in the food, agricultural and pharmaceutical industries as encapsulation systems with subsequent release of active substances. In this way, pectin substances, enhancing the barrier properties of the digestive tract, can be effectively used in the treatment of its injuries, as well as viral diseases. One of the innovative directions in the development of targeted functional products is the creation of an industry of functional drinks for general strengthening, prophylactic, adaptogenic and special purposes. To obtain commercial pectins, as a rule, use is made of waste from the production of citrus juices, apple juice, waste from the production of sugar from sugar beet and, to a lesser extent, waste from the processing of sunflower, cotton and other plant crops. Studies in this direction show that the use of commercial pectins in the formulations of functional products is limited due to their high cost, leading to an increase in the price of products of therapeutic and prophylactic direction. The results of the study of aqueous solutions of sodium pectate by the NMR method confirmed the coincidence of the proposed model of the secondary structure of pectin with the data obtained by hydrodynamic theory and molecular modeling. Analysis and assessment of the degree of esterification is one of the most important elements of structural studies of pectins. A promising direction of research, along with the search for pectin substances in unconventional raw materials with new structural elements (chemical composition, conformational features), should be considered the chemical modification of sufficiently thoroughly studied and available pectins from traditional pectin-containing raw materials.

Keywords: polysaccharides, pectin, technologies for producing activated pectin, structure and chemical composition of pectins, functional products.



1. ВВЕДЕНИЕ. В 1790 году французский химик Луи Никола Воклен, активно исследовавший объекты растительного происхождения, выделил из фруктового сока вещество, хорошо растворимое в воде и обладающее свойством желировать водные растворы. 40 лет спустя родилось современное название выделенного вещества – пектин (греч. Pektos – свернувшийся, застывший) [1]. Пектиновые полисахариды самые сложные по структуре и формированию биополимеры клеточных стенок растений, включающие различные полимерные цепи из гомогалактуронана, рамногалактуронана I, рамногалактуронана 2, арабигалактанов, арабинана и ряда других полисахаридов, связанных между собой и с другими полимерами растительных клеток [2]. Они играют важную роль в росте и развитии растений, морфогенезе, защите и адгезии клеток, связывании ионов, гидратации и развития плода. Основным исходным веществом для биосинтеза пектиновых веществ в растительной клетке является галактуроновая и глюкоурононовая кислоты, местом биосинтеза в растительной клетке считают аппарат Гольджи и эндоплазматическая ретикула [3], откуда совершается их переход в оболочки клеток для формирования и полимеризации компонентов молекулы биополимера. В онтогенезе растений происходит изменение содержания общего количества пектина и соотношения фракций растворимого пектина (гидропектин) и нерастворимого (протопектин), характерные для каждого вида растений. Гидропектин и протопектин локализованы в разных частях растительной клетки и выполняют различные функции. Протопектин входит в состав клеточной оболочки, из него в значительной мере состоят срединные пластинки, а гидропектин находится в соке вакуоли и межклеточных слоях растительной ткани. Общее содержание пектиновых веществ, соотношение гидропектина и протопектина, а также их локализация в растительной клетке различаются в зависимости от вида, возраста, условий роста и развития растений. Это обуславливает и различие в технологических параметрах извлечения пектиновых веществ и их физико-химических и технологических свойств [4].

2. ЦЕЛЬ РАБОТЫ. Исследование и идентификация инновационного потенциала пектиновых веществ, в структуре функциональных продуктов питания, приготовленных на основе дикорастущих плодов.

3. ОБЪЕКТЫ И МЕТОДЫ ИССЛЕДОВАНИЯ. Состав и структура пектиновых полисахаридов из растительного пищевого и непищевого сырья продолжает оставаться предметом углубленного изучения с применением широких возможностей современных инструментальных методов исследования [5]. Для определения первичной структуры применяют полный и частичный кислотный гидролиз, ферментативное расщепление, метод метилирования, все виды спектроскопии ИК и ЯМР. Для определения расположения углеводных цепей в пространстве успешно используется атомно-силовая микроскопия (AFM) [6]. Метод позволяет видеть молекулу пектина в целом - его основную и боковые цепи, AFM-изображение дает картину всех молекул сразу (рис. 1).

4. ЭКСПЕРИМЕНТАЛЬНАЯ ЧАСТЬ. Согласно сформировавшимся к настоящему времени представлениям, общая схема структурной организации пектиновых полисахаридов (яблочных, цитрусовых, свекловичных и других [8]) состоит из чередующийся линейной («гладкой») и разветвленной («волокнуистой») областей.



Линейная область гомогалактуронана состоит из 1,4-связанных остатков альфа-D-галактопиранозилурановой кислоты, которые соединяются между собой одним или двумя остатками альфа-L-рамнопиранозы, включенной в линейную цепь 1,2-связью, длина цепи зависит от вида пектинсодержащего сырья.

Разветвленная область состоит из рамногалактурона 1, содержащего линейную цепь галактуронана и боковые углеводные цепи из остатков галактозы, арабинозы. Кроме того, возможно наличие в разветвленной области фрагментов ксилогалактуронана, в котором в цепи галактуронана 1,3-гликозидной связью присоединены одиночные остатки бэта-D-ксилопиранозы, а также апиогалактуронана. В последнем одиночные 1,2- или 1,5-связанные остатки D-апиозы присоединяются 1,2-или 1,3 связями к остаткам D-галактуроновой кислоты главной углеводной цепи [5]. Структура молекулы свекловичного пектина отличается от приведенной выше модели тем, что она содержит значительное количество ацетильных и феруловых групп [9], последние связаны эфирной связью с арабанами и галактанами боковых цепочек пектина.

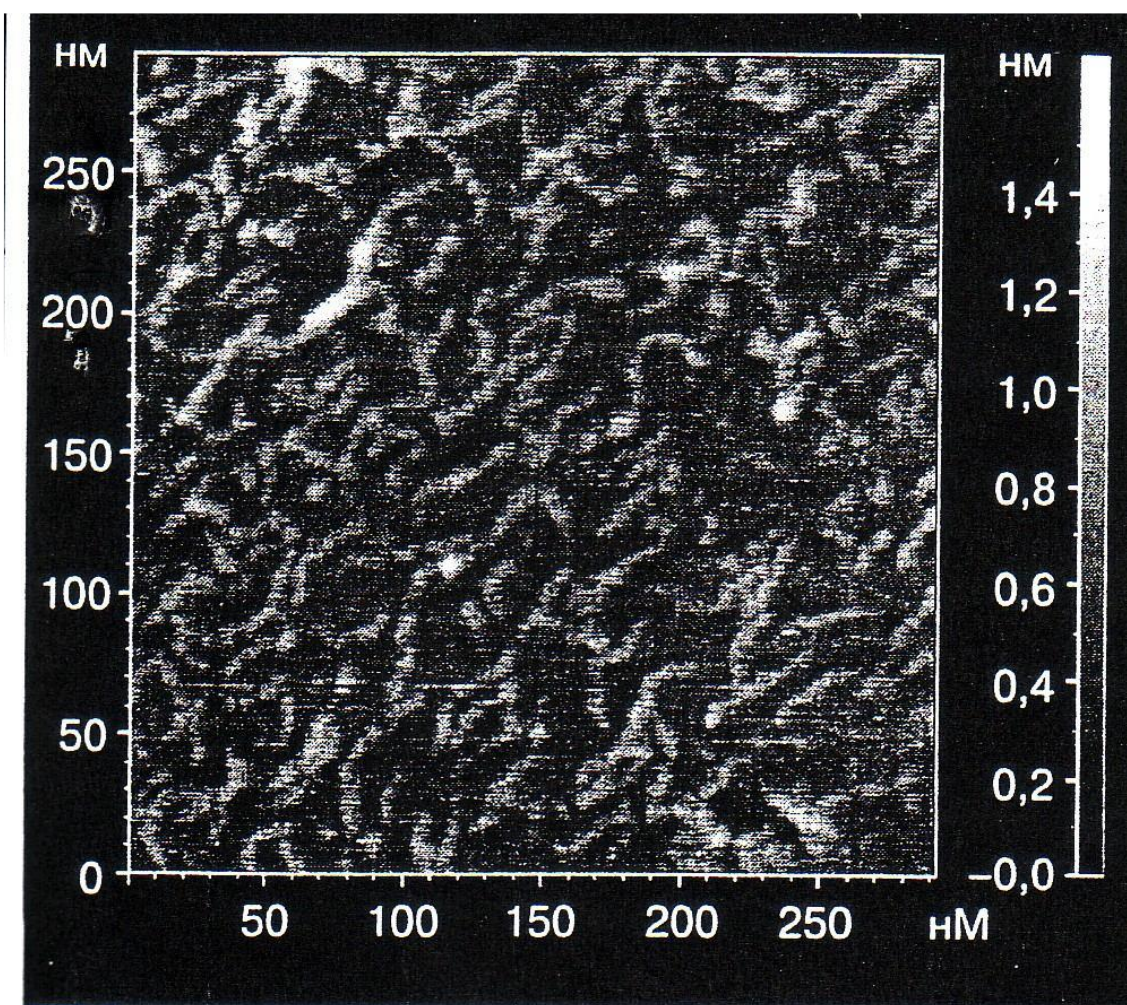


Рис.1. AFM-изображение галактуронана комурумана [7]

Можно сказать, что первичная структура пектинового биополимера изучена достаточно хорошо для различного пектинсодержащего сырья. Значительно меньше данных по исследованию вторичной, третичной и четвертичной структуры пектина в гелях или растворах. Структура и химический состав пектиновых веществ определяют



пространственную форму их биомолекул и характер взаимодействия с другими химическими соединениями. Кросс-связывание молекул пектина ионами металлов, в частности, ионами кальция играет большую роль в организации полисахаридов в стенках клеток растений. Структура агрегатированных цепей описывается моделью 'egg-box' [10], согласно которой соединяемые сегменты находятся на одинаковых цепях и зоны соединения образованы цепями галактуронана в 21-спиральной конформации (два моносахаридных остатка на поворот спирали), а ионы кальция размещаются в пространстве между соседними цепями полисахаридов, подобно яйцу в решетке, образуя комплексы с атомами кислорода [11].

Результаты исследования водных растворов пектата натрия методом ЯМР подтвердили совпадение предложенной модели вторичной структуры пектина с данными, полученными по гидродинамической теории и молекулярному моделированию. Оптимальная модель может быть описана как анизотропная реориентация двухскладчатого спирального сегмента, содержащего 29 моносахаридных остатков, а средняя аксиальная длина спирального сегмента равна 13 нм, поперечный гидродинамический радиус спирального сегмента равен 0,8 нм, ковалентный радиус - 0,4-0,45 нм [8].

Известно, что эфирные метильные группы сильно влияют на связывание ионов и проявление гелеобразующих свойств, они несут отрицательный заряд и стерически затрудняют образование агрегатированных цепей молекул пектина. Степень выраженности этого эффекта, а также геометрии связанных фрагментов в основном зависят от природы катиона, а также вида пектина [12]. Анализ и оценка степени этерификации – один из важнейших элементов структурных исследований пектинов вследствие тесной корреляции величины этого показателя, наряду с конформационными особенностями молекулы, с гелеобразующими свойствами и физиологической активностью пектинов и, следовательно, их пригодностью для пищевого и медицинского применения [13].

Пектины широко используются как желирующие агенты, стабилизаторы растворов, загустители, адгезивы и эмульгаторы во многих пищевых продуктах. В образовании пектиновых гелей важную роль играет величина степени метилэтерификации (DM), локализация сложноэфирных групп, pH среды, концентрация биополимера, концентрация сахарозы, ионов кальция, ионная сила раствора, температура и другие факторы [12]. По показателю DM пектины делятся на низкоэтерифицированный (DM=30-45%) – LM-пектин, среднеэтерифицированный (DM=45-60%) – MD-пектин и высокоэтерифицированный (DM=60-85%) – HD-пектин [4]. Вид пектинсодержащего сырья определяет не только этот показатель, но и содержание структурных галактурозных комплексов, соотношение фракций протопектина и гидропектина, и в целом обуславливает различие технологических параметров извлечения пектиновых веществ и их физико-химические, технологические свойства и физиологическую активность. Для получения коммерческих пектинов, как правило, используют отходы производства цитрусовых соков, яблочного сока, отходы производства сахара из сахарной свеклы и в меньшей степени отходы переработки подсолнечника, хлопка и других растительных культур. В последние годы получены интересные данные по свойствам пектинов из нетрадиционного растительного сырья, в частности, из тыквы [13], дикорастущих плодов шиповника [14], облепихи [15], боярышника [16], которые указывают на инновационную перспективу использования этих источников пектина.

Исследования в этом направлении показывают, что применение коммерческих пектинов в рецептурах функциональных продуктов ограничивается из-за их дороговизны,



приводящее к удорожанию и продуктов лечебно-профилактического направления [17]. В связи с этим вызывает значительный интерес к использованию технологий, предусматривающих модификацию технологических процессов получения биопродуктов из нетрадиционного пектинсодержащего сырья [18], в частности получение активных пектинов из протопектинов, содержащихся непосредственно в растительном сырье [19]. Известно, что эффективность диет на основе продуктов с активированным пектином в 12-18 раз выше по сравнению с аналогичными продуктами, приготовленными с добавлением коммерческих пектинов [13, 17]. Особую актуальность имеет задача улучшения потребительских и лечебно-профилактических свойств функциональных продуктов за счет использования биопродуктов и биодобавок на основе дикорастущего лекарственно-технического сырья [20].

Инновационная технология переработки пектинсодержащего сырья заключается в переводе путем гидролиза протопектиновой фракции пектиновых веществ непосредственно в исходном сырье и перевода пектиновых биополимеров в активное состояние с содержанием значительного количества функционально активных свободных карбоксильных групп. Как правило, в качестве гидролизующего агента используется лимонная кислота, которая является синергистом аскорбиновой кислоты, которая в свою очередь выполняет роль сильного восстановителя фенольных веществ и тем самым предотвращается потемнение овоще-фруктовых пюреобразных продуктов и паст при их производстве. Но основной практический эффект активирования пектина непосредственно в перерабатываемом исходном сырье заключается в том, что получаемые полуфабрикаты обладают высокой студнеобразующей способностью, это позволяют разнообразить ассортимент пектинсодержащих функциональных продуктов и снизить их себестоимость за счет отказа от использования коммерческих дорогих пектинов [21]. Использование полуфабрикатов с активированным пектином для получения желеобразной структуры мармеладных изделий и жележных конфет, конфитюров и джемов, а также стабилизации пенной структуры пастильных изделий и корпусов сбивных конфет позволяет получать прочные кондитерские студни, не влияя в тоже время на их вкус, запах и цвет готового продукта.

Натуральные фруктовые пасты из плодов дикорастущих плодовых растений применяют в производстве фруктовых наполнителей для йогуртов, образуя мягкую желированную структуру, достаточно плотную для равномерного распределения фруктовых частиц [22]. Для производства напитков применяют различное фруктовое сырье и соковые концентраты, в которых пектин и сахар обеспечивают полноту фруктового вкуса и насыщенность [23]. Не менее эффективным оказалось применение пектина в производстве хлебобулочных и макаронных изделий. Использование для этих целей различных видов пектина (яблочный, цитрусовый, свекловичный, тыквенный и др.) показало [24], что внесение в тесто пектиновых добавок в количестве 0.1-0.5 % к массе муки влияет на биологические, коллоидные и микробиологические процессы приготовления теста, при этом улучшаются такие практические показатели как объемный выход, пористость и сжимаемость мякиша, формоустойчивость. Кроме того, введение пектина в хлебобулочные изделия придает им и лечебные свойства, они обладают сорбционным, местным противовоспалительным и антиоксичным эффектом. Таким образом, являясь необходимым элементом питания, пектиновые вещества проявляют также разнообразную биологическую активность, благотворно влияя на метаболизм в организме человека. В последние годы появился большой объем экспериментальных и клинических исследований в области фармакологии и медико-биологического действия пектинов [5, 13, 20, 25, 26]. Широко изучена их способность



выводить из организма токсические соединения, в частности, связывать катионы поливалентных металлов и радионуклиды (цезий-137, стронций-90, рутений-106 и др.), а также токсичные фенолы и пестициды, в силу чего пектиновые вещества используются в качестве эффективных природных радиопротекторов и профилактических средств для нивелирования негативного влияния факторов окружающей среды и вредных производственных условий. Проявляя свойства пищевых волокон, пектиновые вещества улучшают моторику желудочно-кишечного тракта, изменяя характер всасывания питательных веществ, способствуя нормализации обмена веществ, понижению уровня холестерина в крови, улучшению его метаболизма в печени, снижению процессов перекисного окисления липидов [27].

Пектины обладают широким спектром физиологической активности, в том числе иммуномодулирующим действием, антиканцерогенным или антиметастатическим [28], выявленными на примере яблочного пектина в экспериментальных моделях карциногенеза кишечника и метастазов печени. Пектины являются неотъемлемой частью пищи человека на всех этапах его эволюционного развития, что обусловило практически идеальную адаптацию к ним человеческого организма. Объединенный комитет по пищевым добавкам FAO/ВОЗ разрешил применение пектина как пищевой добавки с установленной допустимой нормой приема «не определена», которая означает, что продукт не токсичен и ограничений по его использованию нет [29]. Гелевые матрицы на основе природных биополимеров, в том числе и пектиновых веществ, широко используются в пищевой, сельскохозяйственной и фармацевтической промышленности как системы инкапсулирования с последующим освобождением активных веществ. Одним из направлений в пищевой технологии является высвобождение из коллоидных растворов или гелей соединений, обладающих ароматом, в частности, гели высокометоксилированного цитрусового пектина при различных его концентрациях при консервации запаха лимонена (запах лимона) [30]. Обращает на себя внимание использование пектина в качестве матрицы-носителя биологически активных веществ или лекарственных препаратов. Для этих целей оказался весьма эффективен кросс-связанный пектин, менее растворимый и менее подверженный деградации в организме, который рекомендован для направленного введения лекарственных веществ в желудочно-кишечный тракт [31]. Таким путем пектиновые вещества, усиливая барьерные свойства пищеварительного тракта могут быть эффективно использованы при лечении его повреждений, а также вирусных заболеваний. Уникальные свойства физиологической активности пектиновых полисахаридов позволили разработать широкий ассортимент функциональных продуктов лечебно-профилактического питания [32], способное повышать защитные функции физиологических барьеров организма человека (кожа, слизистые желудочно-кишечного тракта, верхние дыхательные пути и др.) от неблагоприятного воздействия на него производственной и окружающей среды, регулировать процессы биотрансформации различных ксенобиотиков, оказывать благоприятное действие на авторегуляторные реакции организма, особенно на нервную, эндокринную и иммунную системы [33]. Одним из инновационных направлений в разработке функциональных продуктов направленного действия является создание индустрии функциональных напитков общеукрепляющего, профилактического, адаптогенного и специального назначения. Пищевая и биологическая ценность безалкогольных напитков обусловлена содержанием в них усвояемых сахаров (глюкоза и фруктоза), витаминов, минеральных веществ и других пищевых ингредиентов, содержащихся в исходном растительном сырье, в том числе и пектиновых веществ. Пектин в составе таких напитков находится в гидратированной форме и поэтому



оказывает на организм человека более эффективное физиологическое воздействие [34]. Разработаны технологии напитков на основе яблочного, томатного соков, а также на основе биодобавок из плодов дикорастущего сырья (боярышник, шиповник, барбарис) с использованием низкометоксилированного свекловичного пектина [35, 36], которые могут быть рекомендованы широким слоям населения, а также для работников занятых на вредных производствах (металлургия, атомная энергетика, химическая промышленность и др.). Пектины ряда дикорастущего лекарственно и технического сырья (элеутерококка, дудника, барбариса, боярышника и др.) стимулируют комплемент, способствуют продуцированию интерлейкина-2 и активизируют иммунный ответ [37]. Сравнительно недавно из листьев *Aspalathus linearis* был выделен пектин, ингибирующий размножение вируса ВИЧ [38], эксперименты *in vitro* показали, что он резко активизирует иммунный ответ и при коронавирусной инфекции SARS-CoV-2 [39].

ВЫВОД

Анализ рынка фармацевтических пектинсодержащих препаратов, функциональных пектинсодержащих напитков, а также их эффективности дает основание для вывода о том, что пектиновые полисахариды с учетом их физико-химических и фармакологических свойств могут успешно использоваться не только для лечения, но и для профилактики социально значимых для современного человеческого общества заболеваний. И одним из перспективных направлений исследований, наряду с поиском пектиновых веществ в нетрадиционных сырьевых источниках с новыми элементами строения (химический состав, конформационные особенности) следует считать химическую модификацию достаточно подробно изученных и доступных пектинов из традиционного пектинсодержащего сырья.



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THE POTENTIAL OF TRITICALE FORAGE AS A SOURCE OF ANIMAL FEED

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ABSTRACT

Field trials were conducted in 2014-2016 at the Ege University, Faculty of Agriculture, Department of Field Crops in Izmir-Turkey, to evaluate the forage and silage performance of triticale (*x Triticosecale*) cultivars under rain fed conditions. Five different triticale cultivars (Ege Yıldızı, BDMT06, Karma Tatlıcak-97 and Focus) were used as crop material. The crops were cut at milky-dough stages. Some traits were tested in the experiment such as dry matter (DM) yield, silage pH, contents of lactic acid, crude protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF). Results indicated that there were significant differences among the cultivars in terms of DM yields and silage quality. The year effect was also significant on all tested parameters in the experiment. Ege Yıldızı cv produced significantly higher DM yield ($12.85 \text{ t} \cdot \text{ha}^{-1}$) than the other triticale cultivars. Significant differences in CP content of silage (9.6-10.9%) were observed. Differences in ADF and NDF suggest that genotype selection in triticale for silage production should be based on quality in addition to yield. Based on these findings, Ege Yıldızı cv of triticale can be recommended for forage and silage production for the coastal part of Izmir region.

Keywords: Triticale, cultivars, DM yield, silage



1. INTRODUCTION

Annual cereals can provide an excellent source of supplementary forage, offering an extended grazing season and diversity in crop rotations. Due to its superior silage yield potential, triticale has proven to be very competitive with other cereals for yield and quality [10, 18]. Triticale (*x Triticosecale*) is a man-made species developed by crossing wheat (*Triticum* sp.) and rye (*Secale cereale*), has become an interesting alternative to wheat or barley as a feed grain in areas with unfavourable growing conditions or in low-input systems [3, 11]. Comparative trials involving various cultivars have shown that the biomass yield potential of triticale is similar to, or greater than other cereals. Triticale produces at least 20% more forage than wheat, and is higher in forage quality than rye or wheat [1, 13]. This makes triticale a viable alternative crop especially in nutrient-deficient environments with various biotic and abiotic stress factors [3]. Planting practices such as cultivar selection, planting and harvesting dates greatly influence triticale forage yields [4, 6, 10]. In recent years, triticale has gained significant interest from the agricultural industry because of its diverse end-use potential, which includes food grain for humans and feed grain and forage for livestock [5, 7]. Triticale can be successfully grown on a wide range of Turkey soils. The large number of commercially available triticale cultivars makes it difficult for livestock producers in Aegean Region in Turkey to select varieties most suited for forage production in their particular locality. The objective of this study was to evaluate forage yield and silage quality of triticale cultivars for forage in coastal part of in Izmir, Turkey.

2. MATERIAL and METHODS

Field experiment was carried out on the experimental area of Ege University, Faculty of Agriculture, and Department of Field Crops in Bornova-Izmir, Turkey at about 20 m above sea level with typical Mediterranean climate characteristics during the growing seasons of 2014-2015 and 2015-2016 (Table 1). Soil in a depth of 40 cm was sampled before the start of the experiment and was subjected to physicochemical analysis. The soil was loamy, light alkaline (pH 7.81), low in nitrogen (0.11%), phosphorus (0.39 ppm) and organic matter (1.15%), but rich in potassium content (397 ppm).

Table 1. Some meteorological parameters of experimental area at Bornova in 2014-2016

Months	----- Average temperature (°C) -----			----- Total precipitation (mm) -----		
	2014-15	2015-16	LYA	2014-15	2015-16	LYA
December	11.1	10.6	10.5	206.8	141.1	137.9
January	8.9	8.5	9.0	125.1	161.3	112.2
February	9.5	13.6	9.2	101.9	76.5	99.7
March	11.7	13.8	11.8	75.6	102.8	82.9
April	15.9	18.9	16.1	46.4	12.8	46.4
May	20.8	21.2	21.0	30.9	28.2	25.4
✕- Σ	13.0	14.4	12.9	587.0	522.7	504.5

LYA: Long Year Average, ✕: mean, Σ: total

Five triticale (*x Triticosecale*) cultivars were tested in the study (Table 2). The experimental design was a randomized complete block with four replications. Each plot was consisted of 10 rows with 20 cm apart and 5 m length (10 m²). All cultivars were sown by hand on 4th December in both years (2014-2015), at a density of 350 viable seeds m⁻², in to the field which preceding crop was forage turnip. The basic pre-sowing fertilization rates for all plots were 30 kg N ha⁻¹ and 70 kg P₂O₅ ha⁻¹; a top dressing of 120 kg N ha⁻¹ was applied as follows; ½ of total N at the



3-4 leaf stage and the remainder at the early stem elongation stage [5, 7]. 2,4-D (750 g ha⁻¹ of a.i.) was applied after 25 d from emergence to control broad-leaf weeds in both years. No evident crop diseases were detected.

Plots were harvested when each triticale cultivar reached the milky-dough stage, cutting mid six rows of plots in order to avoid border effects (net 3 m²), by cutting the plants leaving a 1-2 cm stubble height. Ten plants from each cultivars were randomly measured to determine plant height. Harvested fresh forage were weighed and dried to a constant weight at 105°C during 24 h. In each plot, fresh triticale samples were chopped using a static precision-chop forage harvester to give a chop length of 5–10 mm, then wilted for 24 h. Samples (250 g) were vacuum-packed into polythene bags with addition of 0.5% salt. No inoculant was applied to any combination. The vacuum bag silos were kept in storage (room temperature) without light for 40 days for anaerobic fermentation.

Table 2. Triticale cultivars tested in the field experiment and their sources or characteristics.

Cultivars	Sources	Characteristics
Ege Yıldızı	<i>Aegean Agricultural Research Institute</i>	Spring type, Mediterranean and Aegean coastal belt
BDMT06	<i>Bahri Dagdas International Agricultural Research Institute</i>	Winter type & facultative
Karma	<i>Eskisehir Anadolu Agricultural Research Institute</i>	Winter type & facultative
Tatlıcak 97	<i>Bahri Dagdas International Agricultural Research Institute</i>	Winter type & facultative
Focus	<i>Atakol Agriculture & Seed Company</i>	Winter type & facultative

pH value and lactic acid (LA) content of matured silage samples was also determined [2]. Matured silage samples of each component were dried at 65°C for 48 h. The dried samples were reassembled and ground in a mill passed through a 1 mm screen. The CP content was calculated by multiplying the Kjeldahl N concentration by 6.25. The NDF and ADF concentrations [17] were measured to Ankom Technology. All data were statistically analysed using analysis of variance (ANOVA) with the Statistical Analysis System [14]. Probabilities equal to or less than 0.05 were considered significant. If ANOVA indicated differences between treatment means, a LSD test was performed to separate them [15].

3. RESULTS and DISCUSSION

The forage and silage performance of the triticale cultivars evaluated in this study can be found in Table 3. ANOVA indicated that there were significant differences in all yield components, with the exception of CP content of silage, among four triticale cultivars. The year effect was also significant on all tested characteristics (Table 3).

Maturation period was affected by year-cultivar interactions. The shortest maturation period (122 d) was obtained from Ege Yıldızı in the second year, whereas the longest period (161 d) was from Focus cv in the first year. Year effect was also significant, and average maturation period of the first year (153 d) was higher than the second year (135 d) due to the total precipitation of the first year that was higher than second year (Table 1). Moreover, distribution of precipitation was more balanced in the first year. Tested cultivars in the study were different in the time to reach heading and maturity. **As it well known that selecting a cultivar of any crop that is well suited to the ecology enables the crop to move through its lifecycle efficiently in a way that best matches its environment. Knowing how a cultivar will work**



within a specific environment help strike a balance that will aid in procuring the highest potential yield for the crop [7,10].

Triticale cultivars had significant effect on plant height for both individual experimental years. According to two-year average, Ege Yıldızı cv had maximum plant height (120 cm), while Focus cv had minimum plant height (107 cm). Year effect was also significant and average plant height of the first year (118 cm) was higher than the second year (107 cm). It was concluded that climatic conditions during the growing period produced a significant effect upon plant height. These results agree with many previous findings [1, 7, 13].

Table 3. Yield and some silage performance components of different triticale cultivars.

Cultivars	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
	Maturation period for silage (day)			Plant height (cm)			DM yield (t·ha ⁻¹)			Silage pH		
Ege Yıldızı	145	122	134	126	115	120	13.89	11.81	12.85	4.24	4.26	4.25
BDMT06	146	123	135	114	104	109	12.66	11.13	11.90	4.32	4.31	4.32
Karma	155	131	143	120	108	114	13.18	11.13	12.15	4.34	4.32	4.33
Tatlıcak 97	157	148	153	119	109	114	12.90	11.15	12.03	4.30	4.33	4.31
Focus	161	152	157	113	102	107	11.61	10.69	11.15	4.29	4.34	4.31
Mean	153	135	144	118	107	113	12.85	11.18	12.02	4.30	4.31	4.30
LSD (0.05)	Y:0.8 C:1.3 YxC:1.9			Y:1.8 C:2.9 YxC:ns			Y:0.42 C:0.66 YxC:ns			Y:0.01 C:0.02 YxC:0.03		
	LA content of silage (%)			CP content (%)			NDF content (%)			ADF content (%)		
Ege Yıldızı	1.87	1.69	1.78	11.1	10.6	10.9	51.1	49.6	50.4	41.1	39.5	40.3
BDMT06	1.76	1.64	1.70	10.7	10.4	10.5	50.6	49.7	50.2	39.6	38.9	39.3
Karma	1.73	1.61	1.67	10.4	9.7	10.0	49.9	48.7	49.3	39.7	38.4	39.0
Tatlıcak 97	1.62	1.63	1.62	10.3	9.3	9.8	51.2	49.4	50.3	40.4	39.0	39.7
Focus	1.70	1.62	1.66	9.8	9.4	9.6	50.5	48.4	49.4	38.4	37.3	37.9
Mean	1.74	1.64	1.69	10.5	9.9	10.2	50.6	49.2	49.9	39.8	38.6	39.2
LSD (0.05)	Y:0.05 C:0.08 YxC:ns			Y:0.3 C:0.5 YxC:ns			Y:0.5 C:0.8 YxC:ns			Y:0.4 C:0.7 YxC:ns		

Y: year, C: cultivars, YxC: year-cultivars interaction, ns: not significant

There were statistically significant differences in DM yield among the cultivars, both for individual experimental years. The highest DM yield was obtained from Ege Yıldızı cv with 13.89 t·ha⁻¹ in 2015 and 11.81 t·ha⁻¹ in 2016, respectively. The lowest DM yield was obtained from Focus cv with 11.61 t·ha⁻¹ in 2015 and 10.69 t·ha⁻¹ in 2016, respectively. Year effect was also significant and average DM yield of the first year (12.85 t·ha⁻¹) was higher than the second year (11.18 t·ha⁻¹). It is concluded that differences in DM yield among the cultivars resulted from genetic capacity of the cultivars and environmental factors [7, 14]. Many researchers have emphasized that the yield of cereals grown under rain fed conditions is closely related to air temperature and rainfall distribution [1, 9].

Triticale cultivars had significant effect on pH values of silage for both individual experimental years. According to two-year average, Ege Yıldızı cv had minimum pH value (4.25), while Karma cv had maximum pH (4.33). Year effect was also significant and average pH value of the first year (4.30) was lower than the second year (4.31). The most important physicochemical parameter for the evaluation of silage quality is a pH below 4.5, which was observed for all the silages tested [12]. The silage quality was especially confirmed by the proportion of fermentation products at the end of the storage period [19]. Our results indicating the parameter were in agreement with those of many researchers [4, 7].

There was a significant effect on LA content of silage among triticale cultivars during the study (Table 3). According to two-year average, the highest average LA content (1.78%) recorded in



Ege Yıldızı cv, whereas the lowest LA content was 1.62% in Tatlıcak-97 cv. Mean LA content was significantly higher in 2015 (1.74%) than the following year (1.64%) which was significant differences among them. Silage quality characteristics (pH and LA content) indicated that all tested triticale cultivars possess good quality silage in the experiment, generally [12, 19].

Triticale cultivars had significant effect on CP content of silage for both individual experimental years. According to two-year average, Ege Yıldızı cv had the highest CP content (10.9%), while Focus cv had the lowest (9.6%). Year effect was also significant and average CP content of the first year (10.5%) was higher than the second year (9.9%). CP contents of triticale silages in the study were very similar to values reported by many researchers [7, 8, 11].

There were statistically significant differences in NDF and ADF content of silage among triticale cultivars, both for individual experimental years. According to two-year average, the favorable (low level) NDF content (49.3%) was recorded in Karma cv, whereas the highest NDF content (50.4%) was in Ege yıldızı cv. On the other hand, the lowest ADF content (37.9%) was measured in Focus cv, whereas the highest ADF content (40.3%) was in Ege yıldızı cv. Mean NDF and ADF content were significantly higher in 2015 (50.6% and 39.8%, respectively) than the following year (49.2% and 38.6%, respectively) which were significant differences among them. Those ratios are in close agreement with previous studies [5, 8]. As it well known, the cell wall components reflect the potential intake of forage. Numerous researchers have reported that the most important factor affecting the digestibility of forages is genotype and harvesting time [6, 8, 9, 16]. In addition, some researchers [13, 18] have reported that balanced fertilizers in cereals affected the chemical composition of fodder positively. Many research workers [10, 18] emphasized that triticale silage is a good option to feed livestock due to the acceptable quality and higher biomass yield. Differences in NDF and ADF suggest that cultivar selection should be based on quality in addition to yield.

4. CONCLUSION

Triticale is a potentially promising cereal for forage and silage production during the winter period under rain fed conditions. Triticale produces satisfactory yields of forage, as well as protein, than the traditionally used barley and wheat. The study revealed significant differences in forage DM yield and silage quality among triticale cultivars. Silage quality (pH, LA, CP, ADF, NDF contents) of these cultivars was also comparable and some times better than that of the other cultivars. Based on these findings, we recommend planting Ege yıldızı cv for forage and silage production in coastal part of in Izmir, Turkey. Further animal growth evaluation would be valuable in confirming their actual nutritive values.



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TORSIONAL VIBRATION ANALYSIS OF PROTEIN MICROTUBULES WITH ELASTIC BOUNDARY CONDITIONS

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ABSTRACT

The mechanical behaviour of biological nanostructures such as microtubules made of protein based materials is important due to two reasons. One of them is that the biological structures of organisms are affected by their dynamical properties such as their resonance torsional natural frequencies and elasticity modulus. Atomistic modeling and experiments displays that there are some deficiencies in the modelling of the behaviours and mechanical properties of protein microtubules with classical elasticity theories. The reason of this is that classical continuum mechanic theories is not include the size parameters, that is critical for understanding of the protein microtubules and represent the interaction between molecules and atoms. The characteristics and dynamical behaviours of protein microtubules may be utilized as a clue to examine the functionality of a organism. In this paper, two elastic torsional springs are attached to a protein microtubules at the ends. A mathematical transformation is used to work out the Fourier sine series for the protein microtubules with deformable torsional boundary conditions. The theoretical model proposed in this work is very important between free and clamped boundary conditions, that can be significance for the application of the higher order elasticity theory effects to protein microtubules. The calculated coefficient matrix can be useful in the theoretical investigation of torsional vibration problem of, that leads to the determinant of a 2x2 matrix. The free torsional frequencies of microtubules are strongly effected by the small effects and boundary conditions.

Keywords: Protein microtubules, coefficient matrix, torsional vibration



1. INTRODUCTION

Protein microtubules are the one of the main components of the cytoskeleton, play a important role in many chemical and biological processes such as cell division, intracellular transport, cell motility, movements of motor formation and proteins of the cores of cilia and flagella. To construct the mechanical responses of protein microtubules a isotropic continuum (Timoshenko or Euler–Bernoulli) beam has been used to investigate in one dimension rod-like deflection of protein microtubules, such as column-like stability and beam-like free vibrational response, from that the bending rigidity and Elasticity modulus of protein microtubules are estimated.

Even though classic elasticity have been widely used to define protein microtubules' mechanical behaviors, but these elasticity theories are inadequate for the mechanical analysis of nano-/microstructures since these classic elasticity theories can not capture the size effect of dynamical or mechanical response. Experimental studies at the nano sized machines and structures are difficult and atomistic studies of these type of structures remains relatively expensive for atomic structures. Therefore continuum elasticity theories play an essential role in the investigate of microstructures (protein microtubules) such as carbon nanotubes or microtubules. The size effect of nanotechnology makes the applicability of local or classical elasticity theories questionable. Classical elasticity theories do not include a size parameter in the governing equations of inhomogeneities and inclusions.

Given the lack of material size parameters, classical elasticity theories fail to model size effects. To solve this type of size dependent problems, various higher order elasticity theories such as couple stress elasticity [9, 10], nonlocal elasticity [8], surface elasticity [12] and strain gradient elasticity [11], that can overcome size effects, have been utilized to research the elastic response of nano-sized structures. The modified couple stress, nonlocal elasticity theory, strain gradient elasticity and doublet mechanics theories have been widely used to research the stability, static, and vibration analysis of nanobeams [17-23].

on-local elasticity theory states that stresses at a reference point are a function not only of the strains at that point but also a function of the strains at every points in the domain [11]. This theory is a popular technique for modelling mechanical behaviour of carbon nanotubes (CNT) [12, 13]. Reddy and Pang [14] have presented Timoshenko beam and the Euler-Bernoulli theories using the non-classical constitutive relations of Eringen [11]. Some of researchers have investigated the static behaviours of single walled, double and multi-walled CNT such as [15, 16]. Pradhan and Murmu [17] have presented a single non-local beam model to investigate the static and dynamic characteristics of a nanocantilever beam. Dynamical behaviour of CNT embedded in an elastic medium has been examined by some researchers such as [18, 19]. Free vibration behaviour of CNTs have been considered by some researchers [20, 21]. Free axial vibration of the nanorods has been considered by Aydogdu [22]. The small size effects on free axial vibrations of heterojunction CNTs based on the classical and non-classical rod theories have been investigated by Filiz and Aydogdu [23]. In this study, the free torsional vibration of microtubules are researched based on a doublet mechanics theory and using the Fourier sine series. The size effects on protein microtubules with boundary condition is explicitly displayed for different functionally graded material parameter by numerical simulations and theoretical analyses. The present paper reveals the significance of the size effects on the torsional vibrational response of FG nanobeams (protein microtubules), the boundary condition effects and FG index on free vibration response of microtubules. It can be seen that the proposed method in this study reveals an effective and simple new approach to exploring free torsional vibration response of protein microtubules.



2. FORMULATION

The well-known fourth-order differential equation, which is torsionally vibrated and expresses the rotation according to the doublet mechanics theory, is given below.

$$GJ \frac{\partial^2 \theta}{\partial x^2} + s^2 GJ \frac{\partial^4 \theta}{\partial x^4} - \rho J \frac{\partial^2 \theta}{\partial t^2} = 0 \quad (1)$$

$$s^2 = \frac{\tau^2}{12}$$

(1a)

where GJ torsional rigidity and s and $\frac{\tau^2}{12}$ expresses the small scale parameter in doublet mechanics theory. Angular rotation function can be defined as follows [13].:

$$\varphi(x) = \varphi_0 \quad x=0 \quad (2)$$

$$\varphi(x) = \varphi_0 \quad x=L \quad (3)$$

$$\varphi(x) = \sum_{k=1}^{\infty} A_k \sin\left(\frac{k\pi x}{L}\right) \quad 0 < x < L$$

(4)

A_k is the Fourier coefficient in Equation and will be derived from the equation governing the problem. Choosing the Fourier sine series of the displacement function has nothing to do with the simple support of the problem. The Fourier cosine series could also be chosen, since the Stoke transform will be done in the next steps. Fourier sine series was chosen for this study [13].

$$A_k = \frac{2}{L} \int_0^L \varphi(x) \sin\left(\frac{k\pi x}{L}\right) dx \quad (5)$$

The partial derivative of the above equation is taken :

$$\varphi'(x) = \sum_{k=1}^{\infty} \frac{k\pi}{L} A_k \cos\left(\frac{k\pi x}{L}\right) \quad (6)$$

is found. Eq. (6) can be represented by the Fourier cosine series[13].

$$\varphi'(x) = \frac{B_0}{L} + \sum_{k=1}^{\infty} B_k \cos\left(\frac{k\pi x}{L}\right) \quad (7)$$

The coefficients in equation (7) are as follows [13].

$$B_0 = \frac{2}{L} \int_0^L \varphi'(x) dx = \frac{2}{L} [\varphi(L) - \varphi(0)] \quad (8)$$

$$B_k = \frac{2}{L} \int_0^L \varphi'(x) \cos\left(\frac{k\pi x}{L}\right) dx \quad k=1,2,\dots \quad (9)$$

The above equation is partially integrated, the following expressions are obtained [13].

$$B_k = \frac{2}{L} \left[\varphi(x) \cos\left(\frac{k\pi x}{L}\right) \right]_0^L + \frac{2}{L} \left[\frac{k\pi}{L} \int_0^L \varphi(x) \sin\left(\frac{k\pi x}{L}\right) dx \right] \quad (10)$$

$$B_k = \frac{2}{L} [(-1)^k \varphi(L) - \varphi(0)] + \frac{k\pi}{L} A_k \quad (11)$$

The higher order derivatives can be found by making similar transformations as follows [13].



$$\frac{d\varphi(x)}{dx} = \frac{\varphi_L - \varphi_0}{L} + \sum_{k=1}^{\infty} \cos(\alpha_k x) \left(\frac{2((-1)^k \varphi_L - \varphi_0)}{L} + \alpha_k A_k \right) \quad (12)$$

$$\frac{d^2\varphi(x)}{dx^2} = -\sum_{k=1}^{\infty} \alpha_k \sin(\alpha_k x) \left(\frac{2((-1)^k \varphi_L - \varphi_0)}{L} + \alpha_k A_k \right) \quad (13)$$

Functional graded material

In this study a model with functionally graded material is implemented. The following functional graded parameter is used in this work:

$$G[r] = [(G_i - G_0) \left(\frac{r_0 - r}{r_0 - r_i} \right)^\beta + G_0] \quad (14)$$

$$\rho[r] = [(\rho_i - \rho_0) \left(\frac{r_0 - r}{r_0 - r_i} \right)^\beta + \rho_0] \quad (15)$$

by using the above two relation, the polar moment of inertia and the mass of the functionally graded material can be expressed as follows:

$$J[r] = 2\pi \int_{r_i}^{r_0} [(G_i - G_0) \left(\frac{r_0 - r}{r_0 - r_i} \right)^\beta + G_0] \cdot r^3 dr \quad (16)$$

$$m[r] = 2\pi \int_{r_i}^{r_0} [(\rho_i - \rho_0) \left(\frac{r_0 - r}{r_0 - r_i} \right)^\beta + \rho_0] \cdot r^3 dr \quad (17)$$

Eigen value approach

By using the deformable boundary conditions and Stoke's transformation [13], following systems of equations obtained:

$$\left(-\frac{J[r]}{L} - S_1 + \sum_{k=1}^{\infty} \frac{2J[r]L(-12L^2 + \tau^2 k^2 \pi^2)m[r]\omega^2}{-12J[r]L^3 k^2 \pi^2 + J[r]\pi^4 \tau^2 k^4 + 12L^4 m[r]\omega^2} \right) \varphi_0 + \left(\frac{J[r]}{L} + \sum_{k=1}^{\infty} \frac{2J[r](-1)^{1+k}L(-12L^2 + \tau^2 k^2 \pi^2)m[r]\omega^2}{-12J[r]L^3 k^2 \pi^2 + J[r]\pi^4 \tau^2 k^4 + 12L^4 m[r]\omega^2} \right) \varphi_L \quad (18)$$

$$\left(\frac{J[r]}{L} + \sum_{k=1}^{\infty} \frac{2J[r](-1)^{1+k}L(-12L^2 + \tau^2 k^2 \pi^2)m[r]\omega^2}{-12J[r]L^3 k^2 \pi^2 + J[r]\pi^4 \tau^2 k^4 + 12L^4 m[r]\omega^2} \right) \varphi_0 + \left(-\frac{J[r]}{L} - S_2 + \sum_{k=1}^{\infty} \frac{2J[r]L(-12L^2 + \tau^2 k^2 \pi^2)m[r]\omega^2}{-12J[r]L^3 k^2 \pi^2 + J[r]\pi^4 \tau^2 k^4 + 12L^4 m[r]\omega^2} \right) \varphi_L \quad (19)$$

In which S_1 and S_2 are the elastic spring parameters at the ends. The above systems of equations can be defined an eigen value problem and the eigen values of coefficient matrix give the torsional vibration frequencies.



RESULTS

In this study inner radius is taken as 5nm, outer one is 10nm, inner material parameter is taken as $G_i=105.7$ GPa, outer material parameter is $G_o=151.0$ GPa. And also ($\rho_i=4429$ kg/m³; $\rho_o=3000$ kg/m³)

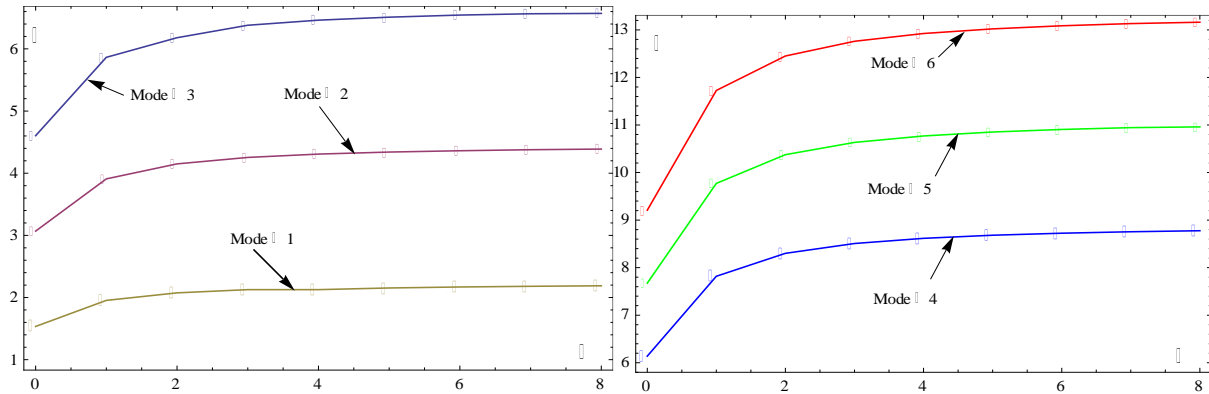


Figure-1. Effect of FG index on the first six mode of torsional vibration frequencies for $L=100$ nm

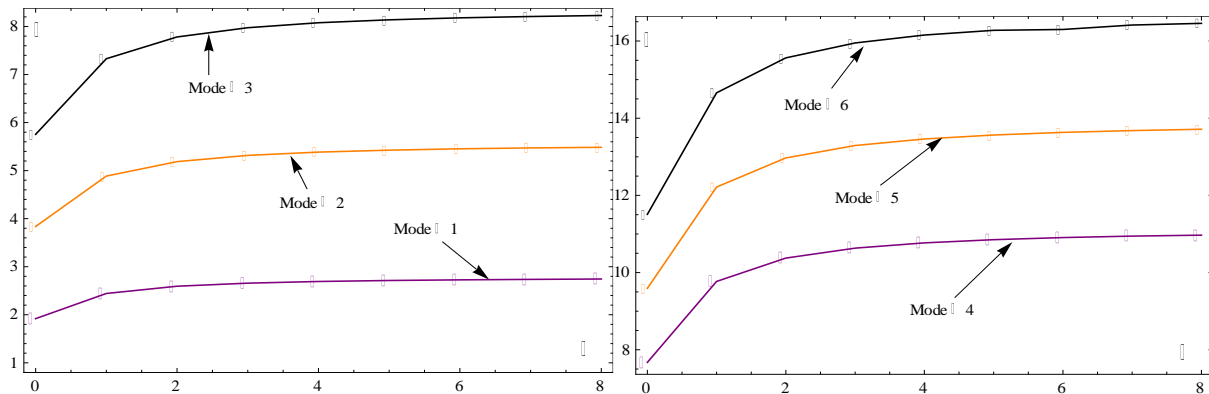


Figure-2. Effect of FG index on the first six mode of torsional vibration frequencies for $L=80$ nm

To investigate the effects of the functionally graded index on the free torsional vibration of the microtubules Figures 1-2 are plotted. Figures 1 and 2 show the variation of the first six free torsional vibration frequencies with the FG index of the microtubules for various length (Fig 1 $L=100$ nm and Fig 2 $L=80$ nm). For these Figures, small scale parameter and symmetrical torsional springs are selected as 0.1421 nm and 10^8 , respectively. While FG index values are changed from 0 to 8. It is seen from the Figures that with the enhancement in the FG index, the free torsional frequencies increase in all length scales and modes. Also, it can be concluded from these figures that the influence of the change in length on the torsional vibration response of the microtubules is more sensitive for low FG index (between 0 and 1). Another inference to be made from these Figures is that as the L increases, the free torsional vibration frequencies decrease for all modes.



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LANDSCAPE ARCHITECTURE VISUAL ARTS AND ITS TRANSITION OVER THE AGES OF MUSLIM ERA

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ABSTRACT

In this paper the authors would try to highlight the visually perceptible arts by comparative studies of landscape architecture that has been propagated in due course of time in different Islamic regions on the basis of their extraordinary belief. Each resulting in unique style of textures, lines and forms. Visual arts that has been developed over the ages in different regions of Islamic world. It is basically a reflection of the Islamic preoccupation with the transitory nature of being. All Muslims in spite of national and ethnic differences and conflicts, felt themselves to be Muslim first and foremost. This strong sense of identity and endurance tended towards a high degree of social and artistic conservatism. As a result, many forms and artistic concepts remained unchanged over the centuries, instead the Islamic art amalgamate with nature simplicity and has persistently established its capacity for the creative reinterpretation of accepted forms. In fact, it is the reason that the word, expressed in diverse landscape styles, gardens, calligraphic variations, and artistic elements resulting in blending of softscapes and hardscapes which always conveys the impression of micro environment that it is more enduring than the objects on which it is inscribed.

Keywords Visual arts, softscapes, hardscapes, calligraphy



1.1. INTRODUCTION

Since the era of ancient Greece, the essence of art has been the subject of philosophical attention. However, the experience of art and the perception and evaluation of art seem to be particularly difficult to understand within a scientific framework. Thinking has gone a long way towards psychological understanding of artistic perception and aesthetic appreciation. (Funch, 1997). Cognition depends on age, health, hunger and social, cultural, differences depend on various physiological factors such as social role and self-concept. The perception of art itself is generally culture (Dutton, 2013). The art is perceived dynamically by the people who saw it. Its image formation is influenced in individual mind is also reflected by the existing set information stored in individuals mind.

1.1.1 Visual art

Visual arts, according to Bourdieu, is one of the areas in which culture is used to recreate the structure of lessons. As with other items in the cultural repertoire, as a major example of visual arts, figures represent social division, with the participation of artists, critics and audiences. (Silva, 2006). It affects the cultural and transformation in culture is followed by it. This happen by the exchange of ideas, migration and techniques. It is an art that evokes sensibilities by eye contact using expressions of technology and imagination. It includes the oldest forms such as conversational drawings and art born of technological developments such as sculpture, prints, photography, and installation art, the latter being a combination of several creative expressions. Beauty is in the eyes of the beholder, but in various eras of art history, it has a unique, richly decorated Baroque taste that defines beauty. (Encyclopædia Britannica, 2021). Thus, Visual art comes in formed by mind which is influenced by the existing environment by incorporating thoughts which is shaped by the mind and is visually appreciated.

1.1.2 Landscape Architecture

Landscape Architecture is research and practice for designing environments that include elements of landscaping art, architecture, engineering and sociology. The designer develops the space such that it creates and connects the life of physical space and outdoor space. Building participation to distance, roads, shared paths, residential estates, apartment estates, shopping malls, squares, squares, gardens. (Damian Holmes, 2021). The scope of work is designing, managing and bringing up natural habitat in built environment with aiming to improve individual and environmental health universally. (Asla, 2021) They develops parks, campuses, streets, avenues, plazas, dwellings and other projects that enhance communities. Landscape designing impacts beyond design to create frameworks and policies for places and cities where authorities can create sustainable places. In terms of urbanist we can say that it is the designing of void spaces which are functionally related to solid spaces. The void spaces are mostly the breathing space for solids and are essential part for the complete physical structure.

1.1.3 Importance of Visual arts in Landscape Design

Visual arts play important role in determining the image of a landscape design in the mind of perceiver. The artistic elements used in the physical form and techniques reflects the cultural background and practices of that place in the design of landscapes. We can say this as ancient

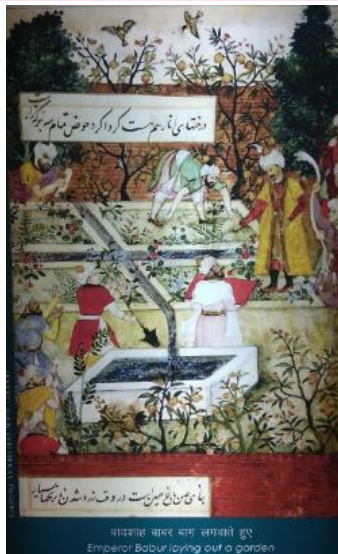


Fig 1. Emperor Babur Laying out Garden (Lisa Owen, 2012)

Caves of India namely Ellora Caves display the timeline of the historical times by incorporating statues performing activities of that time. (Lisa Owen, 2012). Open air courtyard in these caves also determines the functionality in it. The Mughal miniature by Victoria and Albert also displays the activities of that time. (AS Mittman, 2019).

Artistic features determines the style and design of the form and spaces of the landscape. The features can be perceived in qualities of visual image of line, form, colour, texture, and form. The principles are the fundamental concepts of composition proportion, order, repetition, and unity that determines that to arrange or organize the features by forming an aesthetically appealing landscape. (Hansen, 2010). Therefore these spatial characteristics of landscape are important and are determined with elements of arts. The features are used in combination and permutation with each others. The intent of the designer is just to play around these principles. The proportion is important in many cases as a ruler may create a monumental structure in case of public places to private spaces to show its superiority. The cases may be different for others principle but are aesthetically determined by functions.

1.2 Islam

Islam means “surrender” and its central idea is a surrendering to the will of one supreme god, Allah. In less than 200 years Islam went from non-existing to being the religious and political organizing principal of one of the largest empires in the world. Story begins in 7th century when the angel Gabriel appeared to Muhammad (saw) at the age of 40, who made his living as a caravan trader and told him to read. Initially, this freaked Muhammad (saw) but slowly he came to accept the mantle as prophet. “Islam originated in Arabia in 610ad”. There are couples of themes on which Islam focuses; one is strict monotheism and other is the importance of taking care of the one less fortunate than you. In Islam, the believers have to follow the five basic commandments (arkan) which are; the belief in one god; pray five times a day; alms giving; fasting during Ramadan and pilgrimage to Mecca at least once a lifetime.

1.2.1 Spread of Islam

After the prophet Muhammad, Islam spread across globally by his companions and followers. The preaching was carried out by his companions who were faithful to him. This Preaching was performed in the form of trade, military conquest, pilgrimage and building imperial Structures. Most of the significant expansion occurred during the reign of the Rashidin from 632 to 661 CE, which was the reign of the first four successors of Prophet Muhammad. The caliphate



system of governance was a new Islamic political structure formed and evolved becoming more vital during the Umayyad and Abbasid caliphates. (Stelios Michalopoulos, 2018)

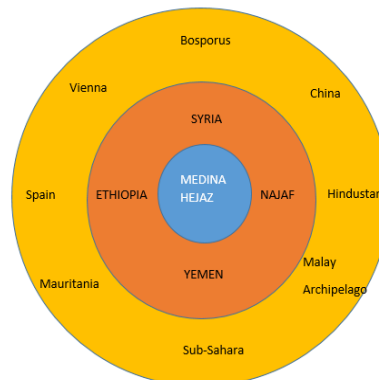


Fig 2. Spread of Islam during Prophet Mohammad (sav) in orange circle and after him, by his companions in yellow circle.

1.2.2 Perception of Arts in Islam and its Evolution

Arts doesn't exist as in physical form in Islam but developed with Blending of cultures and evolves as Islam doesn't prohibits arts and limits it under principles. Elements Can be described as below

Table 1. Comparison of Natural elements with the Islamic ideology (Ali, 2000)

S. No	Principle	Descriptions
1	Climate	The climate is a cool and refreshing shade (Qur'an, 4:57). There is neither burning sun nor bitter cold (Qur'an, 76:13).
2	Soil	The soil is a fine white powder of pure musk (Bukhari and Muslim). Its pebbles are pearl and rubies, and its soil is saffron (At-Tirmizi and Ad-Daarimi).
3	Smell	Paradise is filled with pure and beautiful fragrance, which can be discerned from a great distance (Ahmad, an-Nasaa'ee, Ibn Maajah and al-Haakim).
4	Colour	Green as the colour of cushion covers (Qur'an, 55:76) and clothes of the people of Paradise (Qur'an,76:21). And dark green is the colour of the condensed trees in Paradise (Qur'an, 55:64).
5	Tree	Grape yards (Qur'an,78:32), date palm (Qur'an,55:68), pomegranate (Qur'an,55:68), lotus or sidratul muntaha (Qur'an,56:28), acacia (Ibn Kathir, 4098) and tooba (huge tree) (Ahmad Ibn Jareer and Ibn Hibbaan)
6	Flower	Aromatic plants called rayhaan (Qur'an,56:89) and henna (Bukhaari and Muslim)
7	Sound	Mostly from water that trickles, gushes forth and drips (Qur'an, 55:66 and Qur'an, 76:6). No idle talk only greetings among its people (Qur'an, 56:26 and Qur'an, 56:25).
8	Spatial element	There are 9 elements mentioned which are rivers (Qur'an,2:25), springs (Qur'an,15:45), raised thrones (Qur'an,54:54-55 and Qur'an,76:13), lofty palace (Ibn Kathir, Ahmad and Ibn Hibban), gates (Qur'an,13:23), vessels of silver, crystal clear cups, jugs, glass (Qur'an,56:18, 76:15-16, 76:17), buildings (at-Tirmizi and ad-Daarimi), tents (Bukhari) and pavilions (Qur'an,55:72)
9	Animal	Fowls (56:21), birds (at-Tirmizi) and camels (Muslim)

Islam is the natural of way of living encompassing the elements. It deals the issue from day to day life activities to administration. The arts is inspired by the natural environment and scenario which is perceived by one mind. Islamic way of living when adopted in day to day life forms the artistic appearance encompassing its jurisdiction lead to formation of Islamic arts. These



arts lead to shape the cultural and society to forms its identity. Other factors which shaped the arts include the geolocation and existing craftsmanship. These aspects redefined by artistic image also results in the fused artistic work.

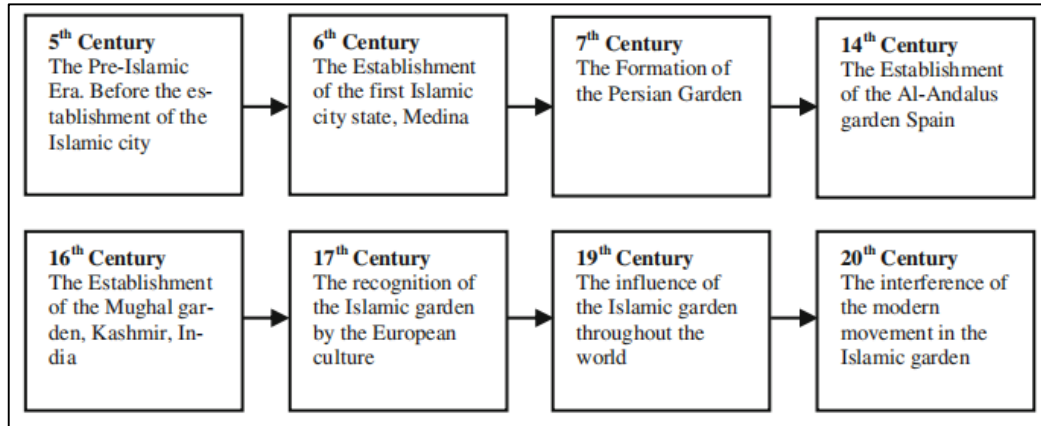


Fig 3. Transformation of Islamic Garden in the centuries(Latiff et al., 2016)

1.3. Persian Garden

Cyrus II born in late 500 Common Era founded the Achaemenian Empire. He entered Persia and comprising the Near East from the Aegean Sea eastward to the Indus River.(Richard N. Frye, 2020). The Royal Garden was a new concept in the Near East region during the reign of Cyrus the Great. He decided to build his new capital, Pasargadae, 546 BC, in the highland valley of the southwest (figure). In effect, it consisted of an extensive and productive royal garden. The loosely spaced main palaces and pavilions, with more trees, shrubs and pools, were the first to see the deeply shaded entrance of an elegant, often sloped building. (Stronach, 1994).These sloped were used in the buildings to pass water through canals. Water although a rare feature in Iranian Region but when found on high elevation was incorporated in landscaping.

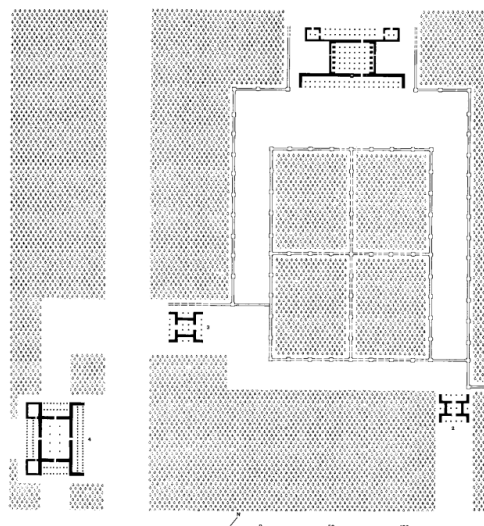


Fig 4. Plan of Pasargadae Garden (Stronach, 1994)

A sketch plan of the Royal Garden at Pasargadae, Finely dressed stone watercourses Originally defined the plan of this 'inner garden,' which is flanked by Palace at top Pavilions, the external throne seat of Cyrus stands on the long axis of the garden, at the mid-point of the south-east



portico of Palace , A second garden, without stone channels, appears to have been viewed with particular advantage from the north-east portico of Palace S (4),(Stronach, 1994)

The caliphate was an Islamic governing body. The capital of the caliph was at Damascus in 661, and moved to Iraq in 750. A new capital in Baghdad was built on the outskirts of the ancient capitals of Seleucia and Ctesiphon. The Arab governor-general dispatched by the Caliph ruled Iran to the parts of Fars and Khurasan. There were many local capitals. Most Iranians converted to Islam for the three centuries. And the first generation of Muslims are assimilated into the culture of the Arab conquerors and later adopted and the native culture.(Bulliet, 2021) Hafiz Shirazi a poet from Shiraz also talks about the garden and trees to enhance the beauty of his poetry.(Daniel Ladinsky, 2019) The water flowing through arched physical from surrounded by the trees is well describe in his works. The portrayal of the Visual Imagination of Natural elements in artistic approach of influencers in that era highlights the Persian approach towards the perception of Garden. Persian Garden are the foundation for Islamic landscaping as the Arab lands were mostly desert and they haven't evolved techniques of the landscaping the garden. Bagh-e-Fin was originally built in Kashan in 1504. The design patterns are mostly elaborate geometric proportions, forming sidewalks and waterways. Trees and plants are freely planted in various places without any direction of appearance. Driven by the form of cultivation, the shape, not the plant, defines the setting and structure of the garden. Water canals flow around four gardens and these gardens depict the four rivers of paradise described in Islam as river of water, milk, honey and wine.

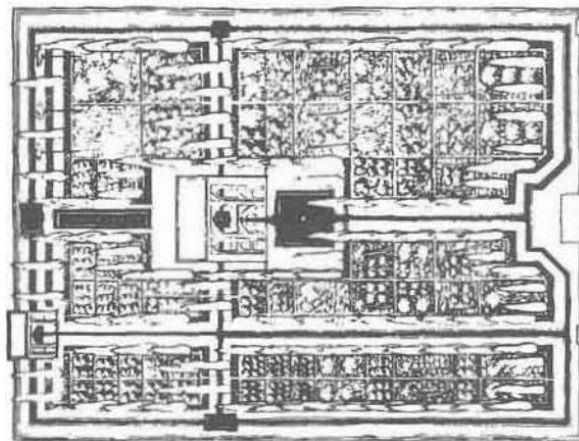


Fig 5. Courtyard plan of Bagh-i-Fin, Kashan. Iran. Reprinted with permission

From Ardalan and Bakhtiar, *The Sense of Unity*, University of Chicago Press. 1973.

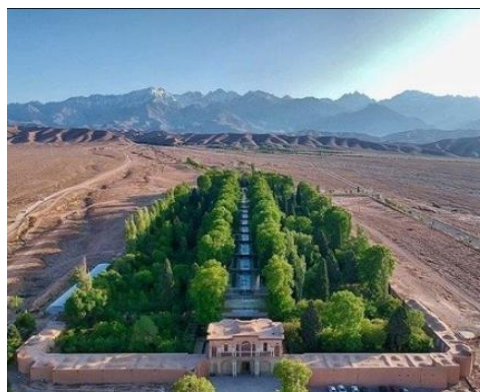


Fig 6. Shahzade Garden in Iran (Tannaz Akbari, n.d.)



Shahzade or prince garden is located in the dry deserted area of Iran which receives less rainfall and is heavily depended on natural spring for the use of water. Gardens developed around this region due to two factors which were functional and décor. As these areas is dry so to irrigate the spring water and two nourish the plants and trees. This was done by directing the water through channel and canals. The contour is utilized for the slope of the channel.

The Aesthetics were also important feature for the gardens to be perceived pleasantly by the viewer. The Persian Gardens have various decorative aspects such as jets, fountains, pools, waterways and waterfalls, achieving more water volume and symphony than. The quality of water is in the garden and offers a variety of opportunities. Pools containing fish and ducks in promote plant growth, and each of these factors contributes to subtle water movements. Tanks and channels with fountains are flashy and captivating. Also, the spray action and water droplets falling on the surface of the water cause pleasant sounds.(Göker, 2017) Once you enter the garden, you can see the scenery of various elevations throughout the space along the main axis. This long landscape is covered by the gigantic size of the main structures, and is reinforced by trees on both sides that have different colors for each season.(L. Tajaddini, 2008)

1.4 Mughal Gardens

Buddhism was the oldest religion in Indian Subcontinent. It was symbolized by Lumbini Garden now in Nepal. Later with the spread of Hinduism garden started to be developed around the temple as they played vital role in the royal court. The kings adopted the Brahmanical Culture and so their peoples. Tamils Indian temples shows the ancient Indian landscaping with the main building at monumental scale at the beginning followed by the garden. The entrance gate way showed similar characteristics to main buildings but were less dominant.(Anuradha Goyal, 2019)



Fig 7. Arunachaleswarar Temple, Tiruvannamalai

Muhammad bin Qasim first introduced Islam to India at Sindh area now in Pakistan in the centaury and paved the way for the spread of Islam. He fought Raja Dahir Singh who was the ruler of Sindh Area in the battle and defeated him. The victory streak continued to Sikka fort, areas of Brahmanabad, Alor, Multan and parts of Gujarat. Until his discharge Islam reached till Punjab And Kashmir. Muslims came into the power in these areas. After death of Hajjaj who was the king of Muhammad bin Qasim, he returned back to Yemen.(Hamidi, 1997)

Mughal Dynasty was formed by Emperor Babur in 15th Century who was descendant of Ghenghis Khan and belong to Turkic areas. He belongs to Chaghtai clan. Babur met Maharana Pratap at various battle at Haldighati in India and defeated him. This resulted in formation of Mughal Empire which lasted till 18th Century. He was followed by Humayun and Akbar.



Origins of Mughal led to the techniques and craftsmanship exchange from Persian Empire and led to the new era of Islamic gardens. Mughal had good diplomatic ties with Rajput rulers who were Hindus which were portrayed in the Amer Fort garden. (Spear, 2021)

The cultural exchange between Mughal led to exchange of ideas and artwork. The acceptance of both cultures impacted on their growth and they emerged stronger. The Charbagh Concept at Rajput fort of Amer in Rajasthan resulted similar as Shahzade garden at Kerman in Iran. The contours and geolocation of both these gardens are in deserted areas.

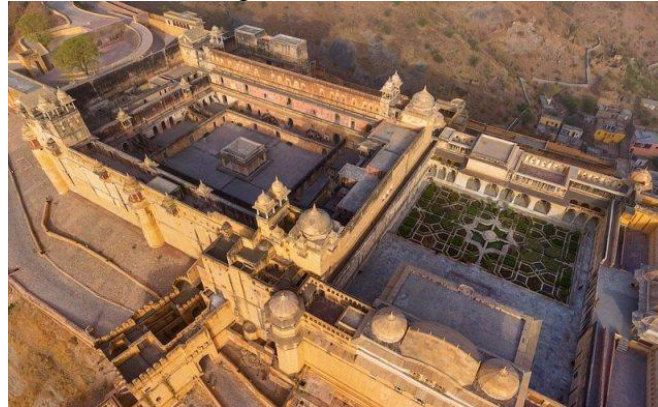


Fig 8. Amber fort of Rajput Rulers (Government, 2017)



Fig 9. Humayun's tomb in Delhi taken by Pushpendra dream

Humayun Tomb Garden has a symmetrical plan. It makes the perception of the as a classic Mughal example as it is early structure from them. Since the word "charbagh" etymologically means 'four gardens'. However, it is unlikely that the Persian themselves that influenced this pattern were symmetrical. Humayun's tomb comprised a very well chosen rich red gravel used for the paths. Fountain, water flowing through a stone-linked waterway, a planting towering above and under the sidewalk.

1.5. Chinese Gardens

Chinese gardens were found out in the valley of the river Yellow by the Shang Dynasty which ruled from sixteenth hundred B. C. to early thousand. The kings and royal's society used these grounds as their hunting spot and their gardens for fruits and vegetables. At the beginning of Eastern civilization, religion developed according to the beliefs of animism. Mountains, sky, sea, rivers, and rocks were materialized spirits that had to be worshiped. Against this background, the Chinese philosopher Lao Tzu began teaching Taoism by teaching people how to integrate themselves into the rhythm of life. This has led to the importance of manners for nature conservation.

One of the most astonishing features of Chinese garden architecture is its conceptual nature. According to Lou, that the hills, lakes, plants and buildings, and the spaces formed between them, create not only a material surrounding but also a spiritual atmosphere.(Cecilia Mello,



2013). The apparent simple appearance of Chinese garden resulting in the irregularity and the arrangement of natural elements incorporating forest, river and mountains.(Bianca Maria Rinaldi, 2011) . The Shang (1600-1046 BC) and Zhou (1045-256 BC) dynasties developed garden as a functional and visually appealing addition to the emperor's settlement. The garden was designated as a home for animals used for hunting and to surround the outside land for the emperor. The garden after Han Rule (BC 206-AD 220) was the place where the emperor took a rest and regenerated energy. Thus, the garden was called the imperial garden.



Fig 10. Pavilion of One Thousand Autumn built in the Ming Dynasty (1368-1644) (Olivier Noguès, 2013)



Fig 11. Yuyuan Garden in Shanghai(Baruch Boxer, 2019)

Islam spread in china through Silk Road. Silk Road was not a road, it was an overland route where merchant carried goods for trade. Saad Bin Abi Waqas who the prophet's companion was send by the Osman Bin Affan who was the caliph at that time as an official delegation to Tang Dynasty in China in AD 651 who welcomed the official envoy. After assassination of Caliph Osman internal politics resulted in riots among and Saad bin Abi Waqas migrated to China where he silently continued spreading and practicing his faith. He has the honor of introducing and establishing Islam in China.(Candice Song, 2021)



Fig 12. Gate at Xian Mosque (Omar Shafi Khan, 2018)



Fig 13. Main Prayer Hall at Xian Mosque(Omar Shafi Khan, 2018)

This led to migration of people of different type's merchants, artisans and people knowing traditional knowledge leading to exchange of culture, ideas & techniques. After the absorption and blending by the Chinese artisans through ages, mosques in china reached a matured architectural style in Ming and Qing dynasties with distinctive Chinese characteristics. This complex occupies an area of 12,000-meter squares. It has layout of a quadrangular courtyard, each with own characteristics buildings. This first courtyard has a wooden archway, the second a stone memorial gateway, the third courtyard a self-examining tower, the fourth courtyard an unmatched pavilion. Together with the gate, corridor, hall and pavilion the layout is one of the series if courtyards, leading to form each other, finally ending in hall of worship, the main building of whole mosque.(Steinhardt, 2008)

1.6 Diversity in visual arts & landscaping elements and pattern.

1.6.1 Landscaping

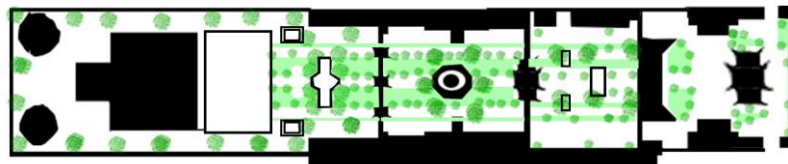


Fig 14. Landscape Plan of Xian Mosque

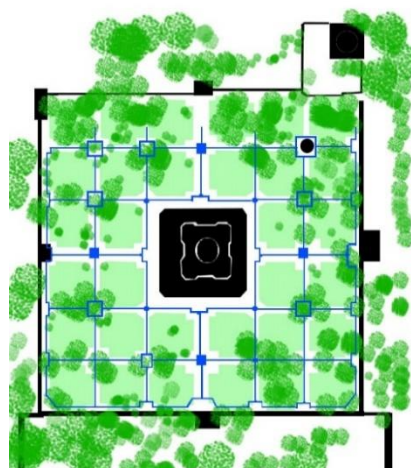


Fig 15. Landscape plan of Humayun Tomb

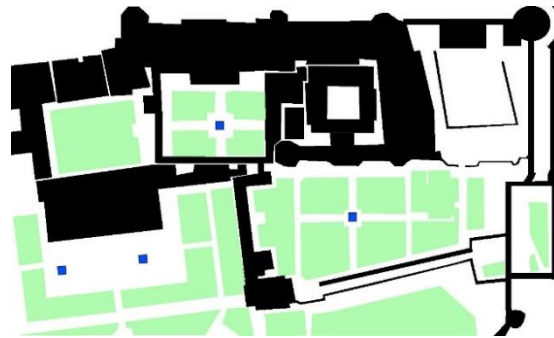


Fig 16. Landscape Plan of Agra Fort

Major Force determining from of garden were the softscapes and hardscape ratio and their juxtaposition which was influenced by geography of the existing area. The enclosed garden found in Mughal Garden is similar to the Persian Garden. Chinese structures were influenced by the imperial garden characters.



Fig 17. Sketch of Melaka Old Mosque in Malaysia



Fig 18. Sketch showing Mughal Monument in India



Fig 19. Sketch of Xian Mosque in China



Fig 20. Sketch portraying African mosque of Djenne

When talking of physical forms in Landscape design we have seen a wide diversity in style and form. The Chinese Xian Mosque physical forms in not much influenced by the perception of Islamic thoughts. The traditional roof and wooden structure is retained followed by the gate which style is trace back. The use of physical forms of living beings is minimized to a very large extent whereas in Persian and Mughal and Malaysian Style, it is completely absent. The tower which is transformed into minaret is observed similarly in Malaysian context. The boldness and juxtaposition of minaret is identical in Chinese Style. The Concept Charbagh is found in Persian and Mughal Style of Gardens. In Chinese Context the concept of Visual Vista in Garden is created by using multiple gate at the joining of garden in a serial way. The rest house as laid in ancient Chinese Garden for kings are transformed into functional hall for mosque such prayer, Shrines, Imam Chamber, Madarsa and Library halls. Trees with dense foliage are used at the entrance gate which joins the garden to obstruct the Vision and in Mughal Gardens trees are used to direct the vision and Visual Obstruction is created with physical form around periphery of the gardens. Similarity is observed in Mughal Style & Persian Style in the Concept of Four Garden and flow of Water using contours. Similar feature was used in ancient Persian Pasargadae Garden built by Cyrus. The Onion Shape dome is distinctive physical feature of Persian garden found in Mughal Structures. Linkages of Water though canals id observed in Humayun's tomb and Taj Mahal but that's absent in Chinese style. African Style also don't show water canals due to their geolocation. The introduction of gothic arches to Indian subcontinent was done by Mughal and it replaced the existing Trabeated Beam System which were used in Ancient Indian Structures. Similarly, the statues of Animals and Human used as orientation was replaced in the garden.

1.6.2 Calligraphy



Fig 21. Khat Thuluth Style Found in Melaka Mosque in Malaysia

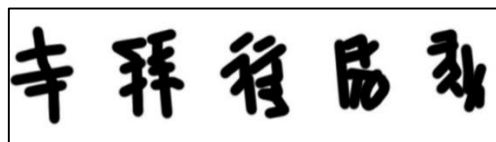


Fig 22. Impression of Chinese calligraphy derived from gate of Xian Mosque



Fig 23. Impression Nastaliq Script Found in Ottoman Empire and Persian Empire

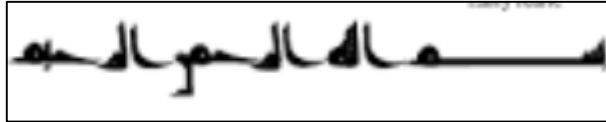


Fig 24. Kufic Script Found in Early Islam during Abbasids Rule.

The Islamic era also leads into transformation of calligraphy of Arabic verses of Quran. These verses were carved on stones and were used as visual artistic feature in physical structures of Islamic Gardens and Mosques. The various era of ruler lead to formation of innovative styles in the Arabic calligraphy. During early times of Islamic rules Kufic styles were widely used and with spread into changed into Thuluth style. When the Islam was introduced to the areas of Turkey and Iran it lead to a new style which is called Nastaliq style. An Exception is found in china were they used traditional Chinese Calligraphy supported by Thuluth style.(Rafiq Elmansy, 2014)

Conclusion

The visual art in Gardens of Islamic Style were shaped by existing Cultural Styles, techniques and perception of Islam by the Rulers which lead to formation of the diverse style of garden. The interpretation of Islamic thoughts and Values in the formation of visual artistic image was the driving force which is solemnly responsible for the diversity. Persians blended the Islamic thoughts completely into their style of Landscaping. Similarly, Mughals were influenced by the Persians and adopted similar strategy. They resulted into the formation of new style which influenced the existing Hindu Rajput Style but were not able to change the existing one completely due to their diplomatic nature with Hindu Allies. On the Contrary Chinese interpreted Islam more in their way of life as they built Mosque but retained the existing Chinese Style of forms influencing their garden style.



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SATER VE LAVANTA ESANS YAĞLARININ *Fusarium solani* ÜZERİNDEKİ MİSELİYAL GELİŞİMİ ENGELLEYİCİ AKTİVİTESİNİN DEĞERLENDİRİLMESİ

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Özet: *Fusarium* spp, ekonomik açıdan önemli birçok kültür bitkisinde ciddi kayıplara neden olan başlıca fitopatogenik mikrofungus suşlarından biridir. Toprak kaynaklı patojen *Fusarium solani*, tarihsel olarak dünya çapında ciddi bir ajan olarak kabul edilir ve agroekonomik ürünlerde vasküler solgunluk ve kök çürümesi sergiler ve sonunda bitki ölümüne yol açar. Lavanta (*Lavandula officinalis* L.) ve Sater (*Satureja hortensis* L.) bitkilerinden elde edilen esansiyel yağlarının 3 farklı konsantrasyonu (1 µl, 2 µl, ve 4 µl) ayrı ayrı PDA besi ortamına karıştırılmış ve *F. solani*'ye karşı antifungal etkisi *in vitro* koşullarda araştırılmıştır. Deneme sonuçları istatistiki olarak değerlendirildiğinde, Sater esansiyel yağının artan konsantrasyonlarında denemeye alınan fungusun miselyal gelişimini baskıladığı belirlenirken, lavanta yağının kullanılan dozlarda olumlu ya da olumsuz herhangi bir etki sağlamadığı belirlenmiştir. Sater yağının *F. solani* üzerine inhibisyon etkinliği 1 µl, 2 µl, ve 4 µl konsantrasyonlarında sırasıyla % 43, % 53 ve % 90 olarak hesaplanmıştır. Bu çalışmayla sater yağının minimum dozda dahi tarımsal açıdan önemli solgunluk etmenine karşı gösterdiği olumsuz etki rapor edilmiştir. Bu kapsamda sater esansiyel yağı vasküler kaynaklı fungal hastalıkları önlemek için çeşitli fungusit ilaçlar geliştirilmesine aday olan umut vaadedici doğal bir maddedir.

Anahtar Kelimeler: Lavanta ve sater esansiyel yağı, inhibisyon, *F. solani*



EVALUATION OF THE FUNGICIDAL ACTIVITY OF SUMMER SAVORY AND LAVENDER ESSENTIAL OILS AGAINST *Fusarium solani*

ABSTRACT

Fusarium spp is one of the major phytopathogenic microfungus strains causing severe losses in many economically cultivated crops. The soil-borne pathogen *Fusarium solani* has historically been considered a serious agent across the globe, exhibiting vascular wilt and root rot in agro-economic crops, eventually leading to plant death. Three different concentrations (1 μ l, 2 μ l, and 4 μ l) of essential oils (EO) extracted from lavender (*Lavandula officinalis* L.) and summer savory (*Satureja hortensis* L.) plants were mixed separately into PDA medium and its antifungal effect against *F. solani* was investigated in vitro. When the results of the experiment were evaluated statistically, it was determined that the increasing concentrations of summer savory essential oil repressed the mycelial growth of the fungus, while lavender oil did not have any positive or negative effects. The inhibition activity of summer savory EO on *F. solani* was calculated as 43, 53, and 90% at concentrations of 1, 2, and 4 μ l, respectively. In this study, the negative effect of summer savory EO against agriculturally important wilt factors was reported, even at a minimum dose. In this context, summer savory EO is a promising natural substance that is a candidate for the development of various fungicide solutions to prevent fungal diseases caused by vascular origin.

Keywords: Lavender and summer savory essential oils (EOs), inhibition, *F. solani*



GİRİŞ

F. solani, saprofitik ve parazitik formlarda değişen alt türlerle dünyanın her yerinde bulunabilen iyi bilinen bir fırsatçı etmen, hayvanlarda ve insanlarda fungal enfeksiyonunun nedenidir (Brayford, 1993; O'Donnell ve ark., 2015; Tuxbury ve diğerleri, 2014). Toprakta yıllarca hayatta kalan ajan, rüzgar, tarımsal ekipman ve sulama yoluyla uzun mesafelere yayılabilir ve bitkilerde genellikle solma, geri ölme, kök ve meyve çürümesi gibi geri dönüşü olmayan ağır semptomlar oluşturur (Al-Sadi ve diğerleri, 2014; Bueno ve diğerleri, 2014; Yaseen ve D'Onghia, 2012). *F. solani*, küresel ölçekte geniş bir konukçu aralığına sahiptir ve Türkiye, Çek Cumhuriyeti, Japonya, Hindistan, İran, Amerika Birleşik Devletleri, Irak, Malezya ve Almanya dahil olmak üzere birçok ülkedeki varlığı rapor edilmiştir (Kurt ve ark., 2020; Ondřej. ve diğerleri, 2008; Sugiura ve diğerleri, 2003; Ramteke ve diğerleri, 2019; Abedi-Tizaki ve diğerleri, 2016; Romberg ve Davis, 2007; Hafizi ve diğerleri, 2013; Farahani-Kofoet ve diğerleri, 2020).

Uçucu yağlar aromatik bitkilerin yapraklarından, meyvelerinden, kabuklarından veya köklerinden elde edilen doğal bir maddedir. Oda sıcaklığında sıvıdırlar, kolayca kristalleşirler, genellikle renksiz veya açık sarıdırlar ve güçlü bir kokuya sahiptirler. Damıtma, ekstraksiyon ve presleme yöntemleri bu yağları elde etmek için yaygın olarak kullanılan yöntemlerdir. Bugüne kadar uçucu yağlarda başta terpenler, fenilpropanlar ve az miktarda alkol, aldehit, ester, fenol, azot ve kükürt içeren bileşikler olmak üzere 2000'den fazla kimyasal bileşenin bulunduğu rapor edilmiştir (Çelik ve Çelik, 2007; Kılıç, 2008). Uçucu yağlar, sahip oldukları aktif bileşiklerin hücresel düzeyde fizyolojik etkilerinden dolayı aromaterapi ve endüstri alanlarında tek başına veya karma olarak yaygın olarak kullanılmaktadır.

Literatürdeki önceki çalışmalar, uçucu yağların antimikrobiyal işlevselliği ve içerikleri hakkında geniş kapsamlı bir dokümantasyon sağlar. Bu yağlar, bitki ve hayvan kaynaklı birçok viral, bakteriyel ve fungal patojene karşı antagonistik etki göstermektedir ve Gram (-) ve Gram (+) bakteriler de dahil olmak üzere birçok mikroorganizma üzerindeki antibakteriyel etkisi kapsamlı bir şekilde ele alınmıştır (Nostro ve diğerleri, 2000; El-Shazly ve diğerleri, 2002; Al-Howiriny, 2003). ; Sartoratto ve diğerleri, 2004; Chouhan ve diğerleri, 2017; Gadisa ve diğerleri, 2019; Man ve diğerleri, 2019; György ve diğerleri, 2020). Diğer çalışmalar ise bu yağların antiviral aktivitelere odaklanmıştır. Bammi et al. (1997) ve Bishop (1995), bu yağların sırasıyla Epstein-Barr virüsünün (EBV) ve Tütün mozaik virüsünün (TMV) replikasyonuna karşı etkili inhibitörler olduğunu rapor ettiler Bugün, uçucu yağların SARS-CoV-2, Influenza A/WS/33 ve herpes simplex virüs tip 1 (HSV-1) enfeksiyonlarına karşı inhibisyon etkisi hakkında kapsamlı bir dokümantasyon bulunmaktadır.

Bu çalışmada, sater ve lavanta esansiyel yağlarının *F. solani*'ye karşı artan dozlardaki anti-fungal aktiviteleri laboratuvar koşullarında araştırılmıştır.

MATERYAL ve YÖNTEM

Bitki Materyali

Denemede, kullanılan kekik (*Satureja hortensis*) ve Lavanta (*Lavandula officinalis* L.) bitkilerinin uçucu yağları özel bir firmadan temin edilmiştir.

Çalışmada Kullanılan Fungal İzolat

Bingöl ilinden temin edilen fasülye bitkisinin hastalıklı kısımlarından izole edilen *Fusarium solani* çalışmanın patojen izolatu olarak kullanılmıştır.

Kültür Ortamlarının Hazırlanması

Patojen fungal izolatuının saflaştırılması ve çoğaltılmasında funguslar için genel besiyeri olan Patates Dekstrozu Agar (PDA) ve dH₂O kullanılmıştır. Hazırlanan besiyeri otoklavda 121°C'de



15 dk steril edilmiş ve steril 100 mm'lik cam petri kaplarına aktarılmıştır. Uygulama grupları, kekik (*Satureja hortensis*) ve Lavanta (*Lavandula officinalis* L.) yağları 1 µl, 2 µl ve 4 µl oranlarında steril edilmiş ortamlara eklemeleri yapılarak oluşturulmuştur.

İnokulum İçin Patojen Fungusun Hazırlanması

Fasulye bitkisinden izole edilen patojen fungal izolatın 100 mm'lik cam petri kaplarında hazırlanan besiyerine inokulumu yapılmış ve 25°C de 7 gün inkübasyona bırakılarak geliştirilmiştir. Antifungal aktiviteyi test etmek için kültürlerden 8 mm diskler fungus delici yardımıyla hazırlanmıştır.

Antifungal Aktivitenin Değerlendirilmesi

PDA otoklavda 121°C'de 15 dakika sterilize edilip soğutulduktan sonra kekik ve lavanta uçucu yağları 1 µl, 2 µl ve 4 µl oranlarında ilave edilmiştir. Sterilize edilen karışımdan her bir steril petriye (100 mm çap) 20 ml dökülmüştür. 8 mm'lik fungal diskler hazırlanan PDA besi ortamlarının bulunduğu petrilerin tam ortasına, fungus besi ortamına temas edecek şekilde yerleştirilmiş ve petrilerin etrafı parafilm ile kaplanmıştır. Petriler 24±1°C'de 7 gün inkübasyona bırakılmıştır. Kontrol grubu olarak kullanılacak petrilere ise uçucu yağlardan arı sadece PDA ortamı aktarılmıştır. 7 gün sonra fungal koloni çaplarının kumpas ile ölçümleri yapılmış, elde edilen fungus çapları kaydedilmiştir. Fungal koloni çaplarının ölçümü koloni çaplarının birbirine dik ve ayrı yönde ölçülmesiyle yapılmıştır (Benjilali ve ark. 1984). Yapılan ölçümlerden inkübasyon için aktarılan 8 mm fungal diskler ölçümlerden çıkarılmış ve bu doğrultuda hazırlanan solüsyonların % engelleme oranları belirtilen formül yardımıyla hesaplanmıştır (Deans ve Svoboda 1990). Denemeler 5'er tekerrürlü olarak yapılmıştır.

$$\text{Engelleme (\%)} = \frac{g_c - g_t}{g_c} \times 100$$

g_c = inokulum disk çapı çıkarılarak inkübasyon süresinden sonra kontrol setinde ölçülen miselyal koloninin çapı.

g_t = inokulum disk çapı çıkarılarak inkübasyon süresinden sonra ölçülen miselyal koloninin çapı.

İstatistik Analiz

Uygulanan solüsyonlar arası farklılıkları belirlemek için varyans analizi (ANOVA) kullanılmış, verilerin varyanslarının homojen olup olmadığı test edilmiş ve test sonucunda varyansların homojen olduğu ve parametrik testlerin uygulanabilir olduğu sonucuna varılmıştır. Ortalamalar DUNCAN testi kullanılarak karşılaştırılmıştır.

Bulgular

Fasulye üretim alanlarında yaygın şekilde görülen kök çürüklüğü etmeni *Fusarium solani*'ye karşı *Satureja hortensis* ve *Lavandula officinalis* L. uçucu yağlarının üç farklı (1 µl, 2 µl, 4 µl) dozlarının *in vitro* şartlarda misel gelişimleri üzerindeki engelleme zonlarını ve yüzde engelleme değerlerini belirlemek amacıyla deneme kurulmuştur. Elde edilen sonuçlar çizelge 1 de verilmiştir.

Tablo 1. *Satureja hortensis* ve *Lavandula officinalis* uçucu yağlarının *F. solani*'ye karşı antifungal aktivitesi için yürütülen istatistiksel analiz

Ekstrakt	Doz	İnhibisyon (%)	İnhibisyon zonu (mm)
<i>S. hortensis</i>	4 µl	90	10.75 ^a
	2 µl	53	33.25 ^b
	1 µl	43	39 ^c
<i>L. officinalis</i>	4 µl	3.0	60,75 ^d
	2 µl	3.0	61,00 ^d
	1 µl	3.0	62,00 ^{de}
NC	-	-	62.75 ^c

*a, b, c, d, e, f, g, h: Aynı sütunda aynı harflere sahip ortalamalar arasındaki fark anlamlı değil, farklı harflere sahip olanlar anlamlıdır. (p<0.05); NC: Uygulama yok



Denemede kullanılan *S. hortensis* fungal etmen üzerinde en etkili sonuçları vermiştir. *S. hortensis*'in 4 µl dozu misel gelişiminde %90.0 engelleme oranı ve 10.75 engelleme zonu ile istatistiksel olarak en yüksek değerleri vermiştir. *S. hortensis*'in 2 µl dozu %53.0 engelleme zonu 33.25 engelleme oranı ve 1 µl dozu %43.0 engelleme oranı 39.0 engelleme zonları ile misel gelişimini engellemede iyi değerler vermiş istatistiksel olarak ise farklı gruplarda yer almışlardır. *L. officinalis*'in uygulanan üç farklı dozunda %0.3 inhibisyon oranı ve 60.75 engelleme zonu vererek negatif kontrole yakın bir değer vermiştir. Test edilen uçucu yağın misel gelişimindeki etkileri değerlendirildiğinde aralarında ki tanımlayıcı istatistik hesaplamalarında yapılmış ve önemli farklılıkların olduğu değerlendirilmiştir.



Şekil 1. *S. hortensis* esansiyel yağının (4 µl) PDA ortamı içeren cam petri kaplarında *F. solani*'ye karşı antifungal aktivitesi. A: *S. hortensis* uçucu yağ uygulaması, B: *L. officinalis* uçucu yağ uygulaması C: NC (Uygulamasız kontrol)

Sater uçucu yağıyla ilişkili fungal inhibisyon sonuçları minimum dozlarda dahi çarpıcı sonuçlar vermiştir. Daha önce yürütülen çalışmalar *Satureja hortensis*'in potansiyel fungus önleyici aktivitesini desteklemiştir. Sater esansiyel yağı, başta fenol türevi karvakrol, sikloheksan, simen ve timol olmak üzere antimikrobiyal ve gıda koruyucu özelliklere sahip aktif maddeler içerir (Özkalp ve Özcan, 2009).

Şahin et al. (2003), 55 bakteri türü ve 1 maya ve 4 mantar türünün 31 izolatına karşı sater yağını test etmiş ve çok çeşitli test mikroorganizmaları için toksik olduğunu belirlemiştir. Özellikle *Alternaria alternata*, *A. flavus*, *Fusarium oxysporum* ve *Penicillium* spp. Fungusları için daha toksik olduğu rapor edilmiştir. Bizim çalışmamızın sonuçları Dikbaş ve ark. (2008)' nın yürüttüğü çalışmanın sonuçlarını desteklemiştir. Bu çalışmada sater esansiyel yağının fungal etmenin (*A. flavus*) gelişimini *in vitro* olarak düşük konsantrasyonlarda (25, 12.5 ve 6.25 µl/mL) bile azalttığını bildirmişlerdir. İnhibisyon etkisine yönelik çalışmamızın sonuçları, Özcan ve Boyraz (2000) gibi altı küf için (*F. oxysporum* f. sp. *phaseoli*, *Macrophomina phaseoli*, *B. cinerea*, *Rhizoctonia solani*, *A. solani* ve *A. parasiticus*), Usanmaz Bozhüyük ve diğerleri. (2015) tarımsal patojenik mantar grubu için (*Botrytis* spp., *F. equiseti*, *Nigrospora oryzae*, *P. capsici* ve *R. solani*) ve Usanmaz Bozhüyük ve ark. (2019)'nın sekiz *Fusarium* türü için (*F. avenaceum*, *F. culmorum*, *F. equiseti*, *F. graminearum*, *F. oxysporum*, *F. sambucinum*, *F. semitectum* ve *F. solani*) gerçekleştirdiği çalışmaların sonuçları ile uyumludur.

Lamiaceae familyasına ait olan lavanta ise, iki önemli antimikrobiyal kimyasal bileşiğe sahiptir: linalil asetat ve linalool (Śmigielski ve ark., 2013). Antibakteriyel, antifungal ve iyileştirici özelliklerinden dolayı *Lavandula* cinsinin bazı türlerinden elde edilen uçucu yağlar günümüzün popüler konularından biridir. Lavanta uçucu yağları, *Escherichia coli*, *Salmonella typhimurium*, *Staphylococcus aureus*, *S. epidermidis*, *Bacillus cereus* ve *Listeria monocytogenes* ve *L. innocua* gibi gıda kaynaklı patojenler ve diğer bakteriler (*Clostridium perfringens*) üzerinde güçlü bir antimikrobiyal etkiye sahip olduğu için yaygın bir şekilde kullanılmıştır.



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Pseudomonas aeruginosa, *Proteus vulgaris*, *Enterobacter aerogenes*) (Dadalioglu ve Evrendilek, 2004; Nikolis ve diğlerleri, 2014; Djenane ve diğlerleri, 2012; Varona ve diğlerleri, 2013; Viuda-Martos ve diğlerleri, 2011).

Uçucu yağların fungusit potansiyeli *A. citri*, *Alternaria spp.*, *Bipolaris sorokiniana* ve *Acremonium sclerotigenum* gibi insan ve bitki fungal patojenlerine karşı da gösterilmiştir (Yazdanpanah ve Mohamadi, 2014; Mafakheri ve Mirghazanfari, 2018).

Sonuç olarak, her şeyden önce, uçucu yağlar agrokimyasal pestisitlere kıyasla daha az toksik ve çevre dostudur. Hem çalışmamız hem de mevcut literatür, sater uçucu yağının antifungal etkinliğini kanıtlamıştır ve gelecekteki tarım uygulamalarında anti-fusarium ajanı olarak kullanılabilirliğini göstermiştir.



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**A PRELIMINARY STUDY ON THE EFFECT OF DIFFERENT NITROGEN LEVELS
ON THE GRAIN YIELD AND SOME AGRONOMICAL COMPONENTS OF
TRITICALE (*x Triticosecale* Wittmack)**

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ABSTRACT

Triticale (*x Triticosecale*) is designed as a species in which good quality grain yields are combined with tolerance to abiotic and biotic stresses, in other words, to obtain a plant suitable for cultivation in unfavorable conditions where the yield of typical cereals is somewhat limited. Triticale, a hybrid species created by the hybridization of wheat and rye, is a promising species that has an important place in both plant and animal production. Although it is primarily grown as animal fodder, triticale is also a useful feedstock for bioethanol and biogas production. One of the major agro technical factors, which affect grain yield and enable producers to take advantage of the high production potential of cereals is nitrogen fertilization. The present investigation aimed to determine the effect of different nitrogen levels (0-40-80-120-160-200-240-280 kg·ha⁻¹) on triticale grain yield and some yield characteristics. This study encompassed the results of a nine-months (from October 2018 to June 2019) pot experiment conducted at the research area in Field Crops Department, Faculty of Agriculture, Ege University, Izmir, Turkey. Rate of nitrogen had a significant effect on all of the measured traits (plant height, ear length, number of grain per ear, biological yield, and grain yield) and the grain yield of triticale. Calculated statistics between the level of nitrogen and grain yield shows that the maximum yield of grain in a pot experiment with the variety 'Ege Yıldızı' can be achieved at 200 kg N·ha⁻¹.

Keywords: *x Triticosecale*, nitrogen, grain yield



1. INTRODUCTION

Triticale (*x Triticosecale* Wittmack), a man-made genotype designed by crossing wheat (*Triticum* spp.) and rye (*Secale cereale* L.), is a promising species that takes a significant place in both crop and livestock production (Ayalew et al., 2018). Triticale inherited the ability of the rye to survive the high frosts, but has a higher protein value than rye, while higher grain yields and increased tolerance to diseases were inherited from wheat. This combined plant a viable alternative crop especially in nutrient-deficient environments with various biotic-abiotic stress factors and has better adaptation to waterlogged soils, alkaline, acid soils, and nutrient deficient soils than other cereals (Blum, 2014). On the other hand modern cultivars of triticale can be used for ethanol production (Gowda et al., 2011) Cultivars of triticale are distinguished by their high genetic potential for yield and are therefore considered to be a perspective plant species in terms of climate change, which has an even more intense impact on cultivated crops, especially through increased temperatures and drought. For this reason, it is necessary to spread species, such as triticale, that are more tolerant to stress conditions, in the production (Lalević et al., 2019).

Proper nitrogen management is important for obtaining optimum crop yields and positive economic returns while limiting negative environmental impacts of crop production. N is a primary nutrient limiting the grain yield of triticale and represents a significant cost for the growers (Gibson et al., 2007). Therefore, the objectives of this study were to quantify the variation in grain yield of triticale across different N-fertilization levels in order to improve triticale production under agro ecological conditions of Izmir.

2. MATERIALS and METHODS

This study was conducted as a pot study in outdoor conditions on the experimental area of Field Crops Department, Faculty of Agriculture, Ege University, Izmir, Turkey from October 2018 to June 2019 with typical Mediterranean climate characteristics. Some meteorological data from the experimental area in Bornova-Izmir and some characteristics of the experimental soil are presented in Table 1 and Table 2, respectively.

Ege Yıldızı cultivar of triticale was used as crop material. The seeds were sown in a plastic pots filled with 17 kg loamy experimental soil on 24th October, 2018. Eight rates of nitrogen (0, 40, 80, 120, 160, 200, 240 and 280 kg N ha⁻¹) were used as randomized complete block design with four replications. Half a dose of nitrogen fertilizer (urea), 80 kg ha⁻¹ P₂O₅ (triple superphosphate) and 100 kg ha⁻¹ K₂O (potassium sulphate) were applied with sowing, and the rest of nitrogen [(NH₄)₂SO₄] was applied at the end of tillering stage. There were no problems with pests and diseases during the experiment. Weeds were manually removed from the pots; no herbicide was used to control weeds.



Table 1. Some meteorological data of experimental area in Bornova, Izmir, Turkey in 2018-19

	2018-2019		Long Year Average	
	Temperature (°C)	Precipitation (mm)	Temperature (°C)	Precipitation (mm)
October	19.4	40.4	19.1	43.2
November	15.1	58.1	13.8	109.7
December	8.7	83.5	10.5	137.9
January	8.7	369.3	9.0	112.2
February	9.8	106.3	9.2	99.7
March	13.2	37.8	11.8	82.9
April	16.3	55.2	16.1	46.4
May	21.9	2.3	21.0	25.4
June	26.1	2.9	26.0	7.5
Total-Mean	15.4	755.8	15.1	664.9

Table 2. Some characteristics of the experimental soil

Sand (%)	80.2	CaCO₃ (%)	0.82
Clay (%)	1.8	Organic material (%)	1.27
Silt (%)	18.0	Total N (%)	0.092
Texture	Loamy	P (ppm)	1.14
pH	5.83	K (ppm)	40
Total salt (%)	0.03	Ca (ppm)	1450

The plants were harvested for grain at physiological maturity stage (~13% moisture) by hand. Morphological characteristics (structure element of the yield) were measured: Plant height (cm); 5 plants were measured from the soil surface to the top level of the plant before harvest. Ear length (cm); the ear of plant was measured from the origin of ear (not including the awns) to the tip part. Number of grain per ear; the number of grains in each ear was calculated. Biological yield (g pot⁻¹); after the harvesting, total above-ground biomass (with grains) was measured. Grain yield (g pot⁻¹); the grains were weighted from each pot after harvesting. The obtained data were statistically processed by analysis of variance (ANOVA) with the Statistical Analysis System (SAS, 1998). If ANOVA indicated differences between treatment means, a LSD (Least Significant Difference) test (0.01) was performed to separate them (Stell, 1997).

3. RESULTS AND DISCUSSION

Data presented in Table 3 shows that nitrogen levels had a significant effect on the all of tested characteristics in the experiment. Results showed that all N levels significant increased the plant height as compared with control (N0). N160 gave the highest plant height (102.5 cm). And also, there was no statistical difference among N80, N120, N160, N200, N240 and N280. The lowest plant height (66.2 cm) was measured in N0. Cells protein content increase as the application of nitrogen increase and size of plant cell increases, as a result of that leaf area and photosynthesis rate rises which ultimately make the plant taller (Wysocki et al., 2007). Mut et al. (2005) pointed out that nitrogen application had a significant effect on plant height for which the highest values were found for the highest N level in triticale (180 kg N ha⁻¹). Basbag et al. (2006) found that plant height of triticale increased with increasing N fertilization level (0, 40, 80, 120 kg N ha⁻¹) from 0 (74.5 cm) to 120 (84.1 cm) kg N ha⁻¹ and also plant heights did not differ statistically among 40, 80 and 120 kg N ha⁻¹. These results were similar to the our findings.



Table 3. Effect of different nitrogen levels on the grain yield and some yield characteristics of triticale

N levels	Plant height (cm)	Ear length (cm)	Number of grain per ear	Biological yield (g pot ⁻¹)	Grain yield (g pot ⁻¹)
N0	66.2 c	6.2 d	8.6 d	10.8 g	3.95 d
N40	74.6 bc	8.8 c	8.8 d	19.6 f	5.32 d
N80	88.7 ab	8.9 c	12.0 c	23.5 e	9.26 c
N120	94.0 ab	9.0 bc	12.9 bc	26.8 d	11.57 b
N160	102.5 a	10.1 ab	14.3 b	37.8 a	15.88 a
N200	97.6 a	10.4 a	19.5 a	39.5 a	16.80 a
N240	90.7 ab	9.9 abc	13.7 bc	34.6 b	15.39 a
N280	89.5 ab	9.2 bc	13.1 bc	29.5 c	12.47 b
Mean	88.0	9.1	12.9	27.7	11.33
LSD (%1)	20.6	1.1	2.2	2.3	1.9

N levels had significant effect on the ear length of triticale (Table 3). Numerically, the highest ear length (10.4 cm) was recorded at N200 level, whereas the lowest ear length (6.2 cm) was observed at N0 level. Moreover, there were no statistical difference among N160, N200 and N240. Gerdzhikova (2014) reported that ear length of triticale was statistically significant increased by increasing nitrogen level (0, 60, 120, 180 kg ha⁻¹), and also N fertilization increases the length of ear with 12.19% compared to non fertilization. Dobrova et al. (2018) have shown that the highest fertilization rate (180 kg ha⁻¹ N) increased the ear length of triticale by 26.0% compared the control level (0 kg ha⁻¹ N). Our findings are totally in accord with those results. Number of grain per ear was also significantly increased by the high levels of nitrogen level (Table 3). Maximum no of grain per ear (19.5) were recorded from N200 while minimum no of grain per ear (8.6) was observed from no nitrogen applied treatment (N0). Nitrogen fertilizer applied in optimum dose decrease the chance of seeds to deteriorate in the spikes otherwise in case of seed deterioration grain yield reduced (Seiling et al., 2005). On the another study in triticale, a significant increase in the number of grain per ear from dose of 0 kg N ha⁻¹ continued up to the nitrogen dose of 40 kg N ha⁻¹, and above this amount the said increase was small and the difference was statistically insignificant (Bielski et al., 2020). This result is not very parallel with the present study.

The biological yield in triticale was differentiated by the applied nitrogen fertilization (Table 3). Increasing nitrogen levels increased biological yield. The lowest biological yield of triticale (10.8 g pot⁻¹) was measured in N0 and the highest was (39.5 g pot⁻¹) in N200. In addition, there were no significant differences between N160 and N200. More application of nitrogen gave tall plants, more grain yield, and number of tillers per unit and total dry matter, which collectively resulted in higher biological yield. As a result of more biological yield a plant with its large canopy is able to intercepts more sun radiation and produce more assimilates. There are many studies which revealed that with increasing the nitrogen rate biological yield increased (Ewert and Honermeier, 1999; Raun and Johnson, 1999; Vats et al., 2016).

The results indicate that nitrogen application had positive effect on grain yield and caused significantly increased of yield compared with the control treatment (Table 3). Numerically, N200 gave highest grain yield (16.80 g pot⁻¹) but the lowest grain yield (3.95 g pot⁻¹) was obtained in N0. Moreover, there were no statistical differences among N160, N200 and N240. Voica et al. (2006) reported that grain yield of triticale genotypes was significantly influenced by nitrogen rate under optimum fertilizer application. Researchers found also that the highest grain yield were obtained when triticale was supplied with 90 kg N ha⁻¹. Our results for these



parameters were in similar trend with those of many other researchers (Soares and Restle, 2002; Mut et al., 2005; Basbag et al., 2006).

4. CONCLUSION

These results were obtained from the pot trial conducted on loamy type of soil using the cultivar Ege Yıldızı, application of the higher rates of N levels increased the above mentioned traits compared to the control treatment. It can be recommended from the experimental traits of triticale grown at the Mediterranean ecological conditions that maximizing grain yield could be obtained by adding 160 kg N per hectare. However, field experiments in the coastal part of the Aegean region under Mediterranean climate still need to confirm practical recommendations to farmers.



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**RESPONSE OF LENTIL (*Lens culinaris* MEDIK.) TO ABIOTIC STRESS FACTORS:
DEFICIENCY & TOXICITY OF MICRONUTRIENTS**

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ABSTRACT

Lentil (*Lens culinaris* Medik.) is a major winter-sown legume crop with grains rich in carbohydrates, proteins, minerals, vitamins, phytochemicals and fibres. Lentil encounters numerous abiotic stresses such as nutrient element deficiency and toxicity. Apart from that, micronutrient malnutrition, especially selenium, iron and zinc deficiencies are major global health problems. Correct fertilization of lentils may improve grain and straw yield; improve grain quality in a wide spectrum including biofortification option and reduce health problems of the main consumer of grains of lentils; low income communities. Here, reader may find a review of electronic English articles on micronutrient applications on lentils.

Keywords: Lentil, secondary, micro, nutrient deficiency, nutrient toxicity



1. INTRODUCTION

Lentil (*Lens culinaris* Medik.) is a major cool-season grain legume grown in South Asia, West Asia and North Africa (Singh et al., 2017) and has considerable importance as food, feed, and fodder (Oweis et al., 2004). It is highly nutritious with an sufficient quantity of carbohydrates and high amount of proteins, minerals, vitamins, phytochemicals and fibres (Joshi et al., 2017). Lentil is a nutritious food for millions of people. They are not only a good source of energy but also a range of prebiotic carbohydrates (Migliozzi et al., 2015). Epidemiological studies suggested that lentils through a numerous biological activities including antioxidant, anticancer, angiotensin-converting enzyme inhibition, as well as reducing blood lipid and the risk of cardiovascular diseases admit protection against chronic diseases (Kalantari et al., 2017). Lentil is rich in folates and carotenoids (Thavarajah et al., 2017). It is a quick-cooking, rapidly expanding protein-rich crop with high iron and zinc but has low bioavailability due to the presence of phytate (Podder et al., 2020).

2. Deficiency of micronutrients in lentil

Iron, zinc and selenium deficiencies are major global health problems (Thavarajah et al., 2011). Lentil seeds are rich for iron (Aldemir et al., 2017). But iron deficiency symptoms may be observed on some genotypes of lentil grown in calcareous soils. Total 3512 accessions from 18 countries was screened for iron deficiency in a Calcic Rhodoxeralf soil in Syria in the 1979/80 season in ICARDA. 592 accessions (17% of total) showed chlorosis symptoms characteristic of iron deficiency at 105 days after sowing. Genotypes showing symptoms of iron deficiency were mostly from warm climated countries such as India (38% accessions showing Fe deficiency) and Ethiopia (30%). Populations from countries of lentil origin (Syria and Turkey) exhibited very low chlorosis frequencies. Iron deficiency chlorosis was positively correlated with cold susceptibility. Fe chlorosis was transient, the symptoms were largely disappeared at reproductive growth stage with soil temperature increases and favorable daylength conditions. In Indian germplasm, mild deficiency symptoms were not reduced seed yield, but there yield reductions were great in 47% of genotypes with severe symptoms. Straw yields was also reduced with the severity of symptoms (Erskine et al., 1993).

In severely deficit soils, lentil plants require micronutrients to increase yields. Therefore, micronutrient management is very important for lentil productivity which is mostly ignored (Hossain et al., 2020).

Globally, more than one billion people are experiencing Selenium deficiency due to low dietary content (Rahman et al., 2015). Selenium is essential for humans but not been considered for higher plants. Lentil is a selenium rich crop. Application of selenium fertilizer increased lentil grain yield compared to control in the study of Ekanayake et al., (2015). Applied selenate fertilizer increased seed selenium levels and antioxidant activity both. The biofortification of lentil showed its potential to provide adequate daily selenium to human diets (Thavarajah et al., 2017).

Saskatchewan is world's largest lentil producer and exporter. Maqsood et al., (2013), evaluated the response of three major lentil classes to three rates of Zinc fertilization on 10 different soils from Saskatchewan prairies. Zinc fertilizer application significantly influenced grain yield of lentil classes. This influence was soil dependent. A significant grain yield increase over control was observed by Zn application to Echo and Ardill soils. Whereas a significant grain yield decrease was observed in Melfort soil. Application of Zn fertilizer generally increased grain Zn concentrations. An increase 20% in Zn concentration over control was observed with 5 kg Zn /ha on Fox Valley soil.



Zinc plays a greater role during reproductive stage especially during fertilization (Pal et al., 2019) and critically required for pollen function and fertilisation in lentil. Increasing the Zinc supply from deficient to sufficient at the flower setting stage effects pollen and stigma morphology, pollen fertility and seed yield (Pandey et al., 2006).

Especially sulphur and moderately zinc are effective on powdery mildew (*Erysiphe trifolii*) on lentils (Chandra & Bharati, 2013). In a study of Singh et al., (2014), plots treated with 40 kg sulfur + 5 kg Zn were resulted with less powdery mildew disease. Significantly greater disease index (15.5%) was documented in the fields where non of these two nutrients applied.

To understand the effects of zinc, boron and molybdenum on lentil productivity, nodulation and nutrient uptake, Hossain et al., (2020) conducted trials on micronutrient deficit soils. The highest nutrient uptake, maximum nodulation and highest protein content (26.6%) in seeds were obtained from the treatment received all three micronutrients. Increased lentil yield were associated with increased nodulation and nutrient uptake by the plants under micronutrient enriched treatments. As a result, it is suggest that combination of Zn, B, and Mo may increase lentil yield in micronutrient deficit soils.

Pulses are generally considered more sensitive than cereals to abiotic stresses, including Boron toxicity (Hobson et al., 2004). Boron is an essential micronutrient for plants through participating key reactions such as reproduction, development and regeneration. Its both deficiency and excess negatively effects plant growth (Dilek Tepe & Aydemir, 2017). Pulses are also sensitive to deficiency of molybdenum in acid soils which causes poor growth of pulses (Mandai et al., 1998).

Fertilization of lentil is one of the most crucial management technique which affects growth and yield (Ali et al., 2017). In a study of Brennan & Bolland, (2003), application of fertilizer manganese doubled early shoot yields of lentil grown on alkaline soils. Two sources of manganese fertilizer was compared in two alkaline soils in Australia. Manganese sulfate (24.6% Mn) and manganese oxide (77.3% Mn) fertilizers were compared for yield and manganese content of dried lentil shoots harvested 45 days after sowing. Applications of manganese doubled shoot yields on both soils. For both soils, manganese sulfate fertilizer was two times as effective for producing dried shoots and about 40% more effective in increasing the manganese content of dried shoots. So manganese oxide was required to produce the same yield with manganese sulphate. The concentration of manganese in youngest mature shoots was associated with 90% of the maximum yield. The critical concentration of manganese was 18-21 mg/kg for youngest mature shoots.

Silicon was widely found beneficial for improving seed germination and alleviating drought stress in lentil crops by regulating osmolytes, hydrolytic enzymes and antioxidant defense system (Biju et al., 2017).

3. Toxicity of micronutrients in lentil

During their growth, plants are get subjected to various types of abiotic stresses including toxic metal ion concentrations which limit the growth and productivity of plants to various degrees (Kavousi & Barandeh, 2017). Heavy metal toxicity is a major environmental problem due to bioaccumulation in the food chain (Kavousi & Barandeh, 2017). As an example, Cadmium is easily absorbed by the root system in many plant species and due to its solubility in water and toxicity is considered as a major pollutant (Kavousi & Barandeh, 2016). Cadmium is highly toxic trace element sourcing from industrial processes and phosphate fertilizers. It can reach high levels in agricultural soil and is easily accumulated in plants. Plant roots translocate it to the above-ground vegetative parts. Higher concentrations damages root tips, reduces nutrient and water uptake, impairs photosynthesis and inhibits plants growth. Furthermore, induces



reactive oxygen species that affect the redox status of the cell and result with oxidative damage to proteins, lipids and other types of biomolecules. It also damages the root tip cells nucleoli, synthesis of RNA, ribonuclease activity and DNA repair mechanism (Kavousi & Barandeh, 2017).

Nickel is an essential micronutrient for plant growth but higher levels are highly toxic. The excess of nickel in the soil effect especially plant photosynthesis. Main photosynthetic pigment, Hill activity and activity of Rubisco gets effected. Number and size of stomata are also effected. In a sand culture experiment lentil plants were analyzed on the 30th day after sowing recieved different levels of Nickel (1mM, 4mM and 6mM). Nickel at all tested levels decreased the number and size of stomata in the leaves, chlorophyll a content, chlorophyll b content, total chlorophyll content, Hill activity and Rubisco activity compared to control plants (Beri & Sharma, 2016). Arsenic is a toxic metalloid. Its phytotoxicity is a result of accumulation in different tissues and following growth inhibition in plants (Alam et al., 2019). Arsenic contaminated irrigation waters are responsible for high levels of Arsenic in soils and crops globally (Ahmed et al., 2011). Lentil is increasingly exposed to high levels of Arsenic in soils (Talukdar, 2016). Growth of lentil gets impaired due to arsenic toxicity (Alam et al., 2019). It causes serious health problems in humans (Sah et al., 2013). Cardiovascular disease is a major cause of death worldwide and arsenic intake via drinking water is a well-known risk factor for cardiovascular diseases in between other health problems (Krohn et al., 2016).

Contamination of agricultural lands with copper due to the applied fungicides and pesticides and also discharge of industrial wastes to the environment results with a big threat for soils, crops and consequently foods (Hossain et al., 2020).

Boron toxicity is increasingly being recognized as a problem in arid areas of West Asia, where lentil is widely grown (Yau & Erskine, 2000). Another problem, aluminum stress effects lentil production under acidic soils (Singh et al., 2021).

Polyphenols in plants activate the defense mechanism against heavy metal stress (Timoracká et al., 2012). Also plant growth-promoting rhizobacterias support to decrease ionic toxicities. As an example, Highly phytotoxic effect of higher concentrations of Zinc ions in soils get reduced by plant growth promotion rhizobacterias (Wani et al., 2008). Arbuscular mycorrhizal fungi were showed to enhance zinc and nickel uptake from contaminated soil by lentil (Jamal et al., 2002). Copper-resistant bacteria reduces oxidative stress and uptake of copper in lentil plants. Islam et al., (2016) showed that seed inoculation with *P. vermicola* can be a tool to cope with copper pollution in crop plants. As a positive result of nutrition stress on lentils, it was observed that phenolic content and antioxidant potential of lentil sprouts may be enhanced by treatment of seedlings by abiotic stress applications without any negative influence on nutritional quality (Swieca, 2015).

4. CONCLUSIONS

Deficiency of Iron, Zinc, Selenium, Sulphur, Boron, Molybdenum; whereas toxicity of Cadmium, Nickel, Arsenic, Copper, Aluminum, Boron and Zinc studies were found in international academic articles in English. Lithium is a non-essential metal for life but it is becoming an environmental toxicity issue in plants due to batteries. High levels make it toxic for living organisms and results with detrimental effects. It looks like, is needed to make lithium studies with lentil. In severely deficit soils, lentil plants require micronutrients to increase yields. Therefore, micronutrient management is very important for lentil productivity which is mostly ignored. Selenium and manganese are two priority areas to be studied, probably in combination to each other, to improve yield and quality of lentil fastly especially in calcareous lands.



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SEBZE GEN KAYNAKLARININ TOPLANMASI

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ÖZET

Günümüz koşullarında hibrit ve GDO'lu ürünler yerel sebzelerin yerini almıştır. Yerel sebzelerin tamamıyla yok olmaması için gen kaynakların toplanıp morfolojik özelliklerin belirlenmesi gerekmektedir. Sadece bu yöntemlerle sınırlı kalmayıp toplanan bu genler ıslah çalışmalarına alınıp bunlardan yeni çeşitler oluşturulmalı ve muhafaza edilmelidir. Sonuç olarak; Ülkemizdeki ulusal tohum gen bankasındaki yerel genetik kaynaklarımızın Avrupa'daki gen bankalarına alınması için çalışmaların hızlı bir şekilde yürütülmesi gerekir. Gen kaynaklarımızla ilgili bilimsel araştırmalar yapıldığı halde araştırmalar sonucunda yerli ürünlerimiz eleniyor ya da tohumları yenilemede tekrara gidilmediği için tohumlar etkisini yitiriyor. Organik tarımda yerel sebzelerin yetiştirilebilirliğiyle ilgili çalışmalar yapılmalı. Birbirinden farklı özellikte olan yerli çeşitlerimizle ilgili coğrafi işaret tescil çalışmaları arttırılmalı ve tanınırlıklarının yaygınlaşması sağlanmalı. Ülkemizde yabancı sebze çeşitleri çoktur. Bunların bir kısmı toplanıp besin değerleri belirlenmiş olsa da bununla ilgili çalışmaların yoğunlaşması lazım. Avrupa'da süt ürününün dahi 250'den fazla coğrafi tescilinin olduğu gerçeği bize çok değerli yerel sebze gen kaynaklarımızın ne kadar önemsiz konumda olduğunu göstermektedir. Her türlü adaptasyon yeteneği ile donanmış ancak sadece birkaç agronomik özellikleri açısından detaylı araştırmalara ihtiyaç duyan ancak besin değeri yüksek, dedelerimizden kalan, bizim beslenmelerimizde başrolde olan, çocuklarımıza muhakkak tattırarak istediğimiz bu kadim genotiplerin yeni çeşit enflasyonu karşısında tamamen karışmadan eski genetik özelliklerini korumak ve handi kaplarını giderecek yeni gerek yetiştiricilik metotları gerekse yeni melezlemelerle üstün genotiplerin daha üstün çeşitlere dönüşümünü sağlamak aslında görevimizdir. Ülkemiz iklim çeşitliliği yönünden zengin olduğundan dolayı yerel sebze gen kaynakları da dolaylı olarak çok çeşitlilik arz etmektedir. Vejetasyon süresi çok kısa genotiplerin mevcudiyeti yanında uzun vejetasyon sürelerine sahip yerel sebze gen kaynakları da mevcuttur. Yüksek sıcaklıklara adaptasyon sağlamış yerel gen kaynakları ile daha düşük sıcaklıklarda ürün verebilen gen kaynaklarının oluşu başlı başına müthiş melezleme programının işaretleri arasındadır.

Anahtar Kelimeler: Sebze, gen kaynakları, yerel sebze genotipleri



COLLECTING VEGETABLE GENE RESEARCH

ABSTRACT

In today's conditions, hybrid and GMO products have replaced local vegetables. In order for the local vegetables not to be completely destroyed, it is necessary to collect the genetic resources and determine the morphological characteristics. These collected genes, which are not limited to these methods, should be included in breeding studies and new varieties should be created and preserved. As a result; Studies should be carried out quickly in order to take our local genetic resources from the national seed gene bank in our country to gene banks in Europe. Although scientific researches are carried out on our gene resources, our domestic products are eliminated as a result of the researches, or the seeds lose their effectiveness because the seeds are not repeated. Studies should be carried out on the cultivation of local vegetables in organic agriculture. Geographical indication registration studies related to our indigenous varieties with different characteristics should be increased and their recognition should be widespread. There are many varieties of wild vegetables in our country. Although some of them have been collected and their nutritional values determined, studies on this need to be intensified. The fact that even dairy products have more than 250 geographical registrations in Europe shows us how insignificant our local vegetable gene resources are. These ancient genotypes, which are equipped with all kinds of adaptation abilities but need detailed research in terms of only a few agronomic characteristics, but have high nutritional value, are inherited from our grandfathers, play a leading role in our diets, and which we definitely want to make our children taste, will preserve their old genetic characteristics and remove their handicap without being completely mixed in the face of new varieties inflation. In fact, it is our duty to transform superior genotypes into superior varieties with new breeding methods and new hybridizations. Since our country is rich in climate diversity, local vegetable gene resources also indirectly show a wide variety. Besides the availability of genotypes with very short vegetation periods, there are also local vegetable gene sources with long vegetation periods. The presence of local gene resources adapted to high temperatures and gene resources that can produce products at lower temperatures are among the signs of the great crossing program in themselves.

Keywords: Vegetable, gene resources, local vegetable genotypes



1. GİRİŞ

Gen merkezi bakımından belli bir öneme sahip olan Türkiye, dünyada genetik kaynak ve çeşitlilik bakımından oldukça önemli bir yere sahiptir (Kar ve ark., 2015). Doğu ve Akdeniz gen merkezlerinin kesişim noktası olan ülkemiz ayrıca Avrupa – Sibiryaya, Akdeniz ve İran – Turan fitocoğrafik bölgeleri de kapsar. Ülkemiz İpek Yolu'ndan kaynaklı Asya ve Avrupa kıtasında köprü görevi gördüğü için genetik kaynaklar açısından da oldukça zengindir. 1930'larda Dr. Miraç Gökgöl, Amerikalı Jack Harlan ve Rus Piotr Zhukovsky tarafından Türkiye'de bitki genetik kaynaklarının toplanıp değerlendirilmesine ilişkin ilk çalışmalar yapılmıştır. 2010'da Ankara'da kurulan Türkiye Tohum Gen Bankası'nın temel amacı, endemikler de dâhil olmak üzere bitki genetik kaynakları ile yabancı türlerin toplanıp korunması ve moleküler – morfolojik karakterizasyonunun yapılmasıdır. 1930 ve 1940'lı yıllarda Harlan, Westover ve Wellman adlı araştırmacılar ABD Tarım Bakanlığı Bitki Genetik Kaynakları Koruma Merkezi adına Türkiye'de ilk kez sebze genetik kaynaklarının toplanıp muhafazası ile ilgili çalışmalar yapıp ülkenin birçok yerinden yerel sebze tohumlarını toplayıp ABD'ye götürmüşlerdir.

Ülkemizde 1948 yılında Harlan tarafından toplanan havuç tohumları Ulusal Tohum Gen Bankası'nda bulunan en eski yerel sebze tohumudur. Bu konudaki asıl çalışmalarımız 1980'lerde başlamıştır. Gen kaynağı toplama çalışmalarında ülkede biber, kavun, karpuz, bakla ve domates en fazla toplanan sebze türleri olmuştur. Bunun dışında ise Vavilov (1940), bitki gen merkezlerini ikiye ayırmıştır. Bunlardan ilki birincil (primer) gen merkezi iken ikincisi ise ikincil (seconder) gen merkezidir. Birincil gen merkezi, yabancı türlerin ilk oluşum yerlerini ve kültüre alındığı alanları oluştururken ikincil gen merkezi ise birincil gen merkezlerinde kültüre alınıp farklılaşmaya başlayan türlerin en az varyasyonla ekolojik alanların uygun olduğu yerlere yayılmasını kapsar. Türkiye için birincil gen merkezi olarak soğan, bezelye ve bahçe pancarını örnek verirken ikincil gen merkezi için ise havucu örnek verebiliriz. Yerel sebze çeşitlerimizden 11 tanesi Türk Patent Enstitüsü coğrafi işaret tescili almıştır (Karaağaç ve Balkaya, 2017).



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2.1. SEBZE GEN KAYNAKLARININ TOPLANMASI İLE İLGİLİ ÇALIŞMALARDAN BAZILARI;

Göller Bölgesi'nde yapılan bir çalışmada toplanan 94 yerel kavun genotipi S3 kademesine kadar kendilendikten sonra modifiye edilmiş 47 IPGRI deskriptörleri üzerinden değerlendirmeleri yapılmıştır. Morfolojik ölçüm ve gözlemler yapıldıktan sonra yerel materyaller arasında çeşitliliğin olduğu görülmüştür. Bu materyaller aynı ilçelerden toplandığı halde oluşturulan kümeler üzerine büyük kısmının birbiriyle bağlantısının olmadığı gözlemlenmiştir. Yerel genotiplerin kalitatif özelliklerinden ilk çiçeklenme, dişi çiçekte erkencilik, dişi – erkek çiçek yoğunluğu ve çiçek yapısı sırasıyla orta, orta çiçeklenme,



çoğunlukla erkek çiçek ve andromonoik çiçek yapısına sahip olduğu tespit edilmiştir. Meyve şekillerinin çoğunlukla yuvarlak ve eliptik, meyve zemin rengi açık sarı, kabuk desenlerinin noktali, çiçek izi şekli düz ve yuvarlak, meyve ağırlığı ise orta – büyük, meyve etinin orta kalınlıkta, meyve et renginin soluk yeşil, meyve et yapısının yumuşak olduğu, tohum şeklinin eliptik ve 100 tohum ağırlığının da yüksek olduğu belirlenmiştir. Kantitatif karakterler yönünden % 73.16, kalitatif karakterler yönünden ise % 65.77 oranında varyasyon belirlenmiştir (Erdoğan, 2016).



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Yozgat'ın Aydıncık ilçesinde yetiştiriciliği yapılan Bağrıbüütün kavunu üzerine yapılan araştırmada amaç, SSR (Basit Dizi Tekrarları) moleküler markör sistemi ve DNA parmak izinin çıkarılıp coğrafi işaretlemeye katkı sağlamaktır. Yerel kavuna ait 4 adet genotipin 24 adet polimorfik SSR primeri ile genetik karakterizasyonu oluşturulmuştur. Polimorfik SSR primeri DNA parmak izi çıkarıldıktan sonra kullanılıp bunlardan CMSSR12254, CMSSR10506, CMSSR07989 ve CMSSR08902 primerleri daha yoğun bir şekilde polimorfizm göstermiştir. SSR primleri ile kavun genetik kaynaklarının genetik ilişkilerini belirlemişlerdir (Güney ve ark., 2020).

Emirzeoğlu ve Başak (2020)'ın araştırmaları ise Kırşehir'den toplanan yerel biberlerin morfolojik ve moleküler karakterizasyonunun belirlenmesi amacıyla yürütülmüştür. Çalışmada 30 adet ümitvar biber genotipleri kullanılmıştır. Biber genotiplerine 0, 50, 100, 150 mm NaCl gibi farklı tuz konsantrasyonları uygulandıktan sonra tolerans düzeyleri incelenmiştir. Biber genotiplerinin farklı tuz düzeylerine olan tepkileri açısından ayrı ayrı gözlenmiştir. 0 – 5 skalası kullanılarak genotiplerde tuz stresinden kaynaklı semptomatik zararlanmalar belirlenmiştir. Araştırmada % 50 çiçeklenme zamanı, bitki boyu, gövde çapı, yaprak sayısı, gövde ve kök yaş-kuru ağırlıkları, yaprak oransal su içeriği, nispi büyüme oranı, yaprak hücrelerinde membran zararlanması, klorofil ve karotenoid miktarı tespit edilmiştir. Deneme sonunda, genotipler arasında tuza toleranslılık açısından geniş bir varyasyonun olduğu ve tüm genotiplerde bitki gelişimine tuzun olumsuz etkisi saptanmıştır.

Karadeniz Bölgesi'nde Samsun dışında olmak üzere Amasya, Tokat, Kastamonu, Bartın, Bolu, Gümüşhane, Ordu ve Giresun'da da yerel sivri biber genotipleri toplanmış ve morfolojik özelliklerine bakılmıştır. Bitkisel ve meyve özellikleri belirlenen sivri biberlerin morfolojik açıdan tanımlanması yapıldıktan sonra toplanan bu materyaller Cluster (Küme) analizine tabi tutulup bunların benzerlikleri ve farklılıkları ortaya konmuştur. Cluster analizinin sonucunda 84 ve 99 ile 131 ve 172 numaralı genotiplerin benzerlik bakımından yakın olduğu görülürken 170 – 166 ve 170 –173 numaralı genotiplerin ise morfolojik özellikleri bakımından farklı olduğu görülmüştür (Kar ve ark., 2015).



Risalehaber.com

Haberdar.com

Kırşehir'in genelinde 2014 – 2015 yılında yerel sivri biberler toplanmıştır. 2014'te 240 ve 2015'te 313 biber genotipine ait 99 adet sivri biber hattının fide çıkışından vejetasyon süresinin bitimine kadar çeşitli özellikleri incelenmiştir. Materyallerde toplamda 48 agronomik ve morfolojik özellikleri incelenmiştir. Bunların max, min, ortalama değerleri ve frekans yüzdeleri belirlenmiştir. Küme ve temel bileşen analizi uygulanmıştır. Populasyonlar arasındaki ilişkinin belirlenmiştir. Analizler sonucunda 17 tane ana bileşen eksenini oluşturmuştur. Bu eksenler toplam varyansın % 75.82'sini tespit etmiştir. Genotiplerin dengrogramda 15 gruba ayrılması morfolojik ve agronomik özelliklere göre belirlenmiştir. Cluster analizi sonucunda; S1, S2, S62, S3, S9, S67 ve TR69737 kodlu genotiplerin yetiştiricilik ve morfolojik yakınlık derecesine bakıldığında birbirlerine çok uzak genotipler oldukları tespit edilmiştir (Başak, 2019).



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Ntv.com.tr

Bu çalışmada amaç ise yerel biber genotipleri üzerine fosfor kullanım etkinliğini tespit etmektir. Birbirinden farklı 8 yerli biberin genotipine sera koşullarında 5 farklı P tozu uygulanmıştır. Bunlar; 0, 25, 50, 100 ve 200 mg P kg⁻¹'dir. Deneme tesadüf parselleri deneme deseninde ve 3 tekerrürlü olarak dizayn edilmiştir. Denemede biber genotiplerinde fosfor dozları, bitki tarafından alınan toplam fosfor, kuru madde miktarları (gövdede) ve genotiplerin fosfor kullanım etkinlikleri saptanmıştır. Kuru madde miktarının fosfor dozlarındaki genotip ile genotip × fosfor dozu interaksyonunu dışındaki tüm incelenen özelliklerde doz, genotip ve genotip × doz interaksyonunun P<0.001 düzeyinde önem seviyesinde olduğu tespit edilmiştir. Fosfor uygulanmayan kontrol uygulamasında K – 7 genotipinde 2.07 g saksı-1 kuru madde üretimi gerçekleşmiştir. Bununla birlikte 200 mg P kg⁻¹ toprak uygulamasındaki kuru madde miktarı nispeten 2.1 kat artış gösterirken K – 3 genotipinde ise kontrole nazaran 3.4 kat artış kaydedilmiştir (Yıldırım, 2018).



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Ülkemiz biber yetiştiriciliğinde birçok yerli populasyon ve ticari çeşit kullanılmaktadır. Biber ıslahı açısından oldukça önemli bir yere sahibiz. Bunun sebebi ise genetik zenginliğimizden kaynaklanmakta genetik materyallerin özellikleri ve kombinasyonların istenilen özelliğe getirilmesine dayanmaktadır. İslah çalışmalarında ilk aşama, materyalin mevcut populasyon arasından seleksiyonuna ve çeşitli yönden karakterizasyonununun oluşmaktadır. 2004 ile 2007 yılları arasında gerçekleştirilen bir çalışmada, yerel biberler toplanıp bu genotiplerin morfolojik ve yetiştiricilik özellikleri açısından karakterizasyonu gerçekleştirilmiştir. Toplamda 94 yerli biber genotipinin genetik açıdan birbirlerine uzaklıkları SRAP markör sistemi kullanılarak belirlenmiştir. Belirlenen verilerde genotiplerin yüksek oranda varyabiliteye gösterdiği, kullanılan materyallerin çoğunluğunda genetik olarak uzak ilişkilerde buldukları ve oluşan dendogramda ayrı ayrı gruplarda görüldükleri tespit edilmiştir. 33 SRAP markör kombinasyonu kullanılmıştır. Bunun üzerine moleküler analizlerde varyasyonun % 85'i 9 faktör grubunda olurken genotiplerin genetik uzaklıkları ise % 62 ile % 94 arasında bir değişikliğe neden olmuştur (Bozokalfa ve ark., 2017).

Domates, dünyada Solanaceae familyasında yetiştiriciliği en fazla yapılan sebze türüdür. Domateste ıslah çalışmaları üzerine farklı gen kaynakları kullanılabilir. Çalışmada 61 genotip kullanılmıştır. Bunlardan 2'si ticariyken 59'u ise yerel çeşittir. Türkiye'nin farklı yörelerinde toplanan domatesler gen bankasında muhafaza edilmişlerdir. Bunların 2012'de Eskişehir ve Bilecik lokasyonlarında açık arazide yetiştiriciliği yapılmıştır. Bu çalışmaların varyasyonları morfolojik açıdan iki yerde de araştırılmıştır. Yerli genotiplerin içinde bulunan yer çeşitlerinden 107 (Mersin, TR 72511) ve 137 (Balıkesir, TR 62613)'nin; sırik çeşitlerinde ise 201 (Antalya, TR 69155), 226 (Kütahya, TR 64126) ve 249 (Yozgat, TR 71376) numaralı genotiplerin varyasyonu arttıran genotipler olduğu belirlenmiştir. Yerel domates çalışmalarında koyu kırmızı renkteki 213 (Adana, TR 72501), 116 (Muğla, TR 61675), 265 (Van, TR 40507) numaralı genotiplerin özellikleri açısından dikkat çekmeleri üzerine bu genotiplerin ıslah çalışmalarında önemli olduğu görülmüştür (Sönmez ve ark., 2014).



Gazetehudut.com

Haber48.com.tr

2003 – 2006 yıllarında Uludağ Üniversitesi'nde domates üzerine çalışmalar yapılmıştır. İki aşamada yapılan bu çalışmanın ilki Türkiye' de yetiştiriciliği yapılan 33 adet domates



genotipinden hangisinin tuza toleransının olduğu ve hangisinin hassas olduğu belirlenirken ikincisi ise tolerant ve intolerant genotipler resiprokal olarak melezlendikten sonra oluşan F1 döllerin tuz stresine olan toleransları ve sitoplazmaların tuz toleransı üzerine etkileri belirlenmiştir. 40 gün boyunca kontrol, 8 ve 12 d/Sm NaCl konsantrasyonları genotiplerden ve melezlerden oluşan fidelere uygulanmıştır. 33 adet genotipe tuz uygulandıktan sonra bitki boyu, yaprak sayısı, gövde – yaprak yaş ağırlığı, kök – gövde – yaprak kuru ağırlıkları ile K/Na – Ca/Na oranları 40395, 40443, 47839 gibi tuza tolerant gösteren ve 62573, 70452 gibi hassas genotipler gözlemlenmiştir. 40443 ve 62573, 47839 ve 62573, 62573 ve 40443 arasında melezlemeler yapılmıştır. Bunlardan F1 melezleri elde edildikten sonra tuz konsantrasyonunda daha iyi performans gösterdiği görülmüştür (Turhan, 2007).



Yerlitohum.com

Turkascihaberleri.com

Yerel genotipler gen havuzlarında muhafaza edilerek yerel genetik kaynakların korunması sağlanır. Bu çalışmada yerel domatesler farklı illerden toplanmış olup deneme materyalinde melezleme işlemleri yapılmıştır. Bazı bitkisel özellikler UPOV kriterleri göz önüne alınarak belirlenmiştir. Çalışmalardan sonra domates fidelerinin gövdelerinde antosiyanin 17 ebeveyn hattın 14'ünde tespit edilmiştir. Antosiyanin 136 melezden ise 128'inde belirlenmiştir. Ebeveyn hatların 15'inde bitki büyüme gücü 'orta', 2 ebeveyn hatta (% 11.76) 'çok' olarak gözlemlenmiştir. Ayrıca melezlerin 121'inde 'orta', 15 adedinde 'çok' olarak tespit edilmiştir. Gövde boğum arası kalınlıkları melezlerde ortalama 11.54 mm, ebeveynlerde ortalama 10.97 mm olarak belirlenmiştir. Gövde boğum arası uzunluğu melezlerde ortalama 6.35 cm olarak ölçülürken, ebeveynlerde ise ortalama 5.64 cm olarak ölçülmüştür. Yaprak uzunluğu; melezlerde ortalama 10.68 cm iken ebeveynlerde bu oran 10.52 cm olarak karşımıza çıkmaktadır. Çiçek salkım tipi; ebeveynlerin 11'i (% 64.71) basit ve 6 (% 35.29) karışık olduğu görülmüştür. Melezlerin 104 (% 76.74)'ü basit ve 32 (% 23.52)'si ise karışık salkımlı olarak saptanmıştır. Ortalama meyve ağırlığı melezlerde 147.8 g, ebeveynlerde ortalama 156.4 g olarak tartılmıştır. En fazla meyve ağırlığına sahip olan 5 × 15 melez olup ortalama 244 g meyve ağırlığındayken en az ise 24 g ile 7 numaralı ebeveyn olmuştur. Meyve yüksekliği ebeveynlerde ortalama 57.9 mm iken melezlerde bu oran 52.0 mm olarak saptanmıştır. Meyve genişliği ebeveynlerde ortalama 64.86 mm, melezlerde ise 58.7 mm olarak görülmüştür. Meyve kabuğu rengi ebeveynlerde 11 kırmızı, 5 açık kırmızı ve 1 pembe olarak kaydedilirken, melezlerde 93 kırmızı, 3 pembe ve 40 açık kırmızı olarak belirlenmiştir. Meyve suyundaki pH melezlerde ortalama 4.30 olarak belirlenmişken, ebeveynlerde 4.42 olarak tespit edilmiştir. Çalışmada bazı morfolojik özellikler belirlenmiştir. Bunlarda 17 ebeveyn ve 136 melez S1'dir (Keskin, 2014).



Yerlitohum.com

Beyazgazete.com

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Artvin ilinde gerçekleştirilen çalışmada, 74 köy seçilip 279 fasulye örneği toplanmıştır. Bunlar 2005 yılında tohum şekillerine ve renklerine göre ayrılıp 400 genotip oluşturulmuştur. Amaç; bitkisel özelliklerin belirlenmesidir. Bu yüzden Karadeniz Tarımsal Araştırma Enstitüsü' nün araştırma alanında yer ve sırik tipler 50 cm ve 70 cm sıra aralığında 5 m uzunluğunda olan sıralara 50 adet tohum gelecek şekilde ekilmiştir ve toplamda 68 gözlem yapılmıştır. 400 genotipin tanımlanması yapıldıktan sonra yapılan çalışmalarda 108 tane örneğin tohum vermediği görülmüştür. Diğer 292 genotipin tanımlama verilerinin yapılması üzerine 292 tane genotipten 88'i bodur, 29'u yarı bodur ve geriye kalan 175'i ise sırik formlu olarak belirlenmiştir. Yine tanımlama sonrasında 292 genotipin 145'inin beyaz, 147'sinin ise renkli tohuma ait olduğu gözlemlenmiştir. Bitki boyları 20 ile 310 cm, bakla sayısı 1 ile 163 adet, çiçek uzunluğu 4 ile 25 mm, çiçek sapı uzunluğu 2 ile 10 mm, bakla uzunluğu 4 ile 22 cm, baklada tane sayısı 1 ile 9 adet, baklada lokus sayısı 1 ile 9 adet, 100 tane ağırlığı 16.2 ile 80.6 g arasında değişiklik gösterdiği tespit edilmiştir. Bu genotiplerin morfolojik olarak varyabilitelerinin saptanmasında materyal beyaz ve renkli olarak 2 gruba ayrılmıştır. Beyaz tanelilerin 134 fasulye genotipine, renkli tanelilerin ise 145 fasulye genotipine Cluster analizi uygulanıp dendogramlar elde edilmiştir. Bu analizin ardından beyaz renklilerde 23 grup, renklilerde 26 grup olarak kümelendikleri belirlenmiştir. Bunun sonucunda varyasyonun görülmesi ve grupların oluşmasıyla genotiplerin kuru, taze ve iki amaç için de çeşit geliştirme ve ıslah çalışmalarında kullanılabilir kadar iyi olduğu tespit edilmiştir (Sözen, 2006).



Intfarming.com

Eskisehir.net

Batı Anadolu'daki 28 ilde yürütülen başka bir çalışmada, 45 adet yerel balkabağı toplanmıştır. Balkabağı genotipinin morfolojik karakterizasyonu ve saflaştırılması üzerine çalışma yapıldıktan sonra Konya'nın Altınekin ilçesinde her genotipin tohum ekimi yapılmıştır. 15 bitkinin morfolojik karakterizasyonu üzerine çalışmalar yapılmıştır. Meyve en ve boyu, meyve sapının çapı, meyve sapının uzunluğu, dilim sayısı, kabuk kalınlığı, meyve eti kalınlığı, SÇKM, çekirdek evi uzunluğu, lif oranı gibi genotiplerin belli özelliklerine bakılmıştır. Ölçüm sonuçları ise incelenen özelliklerin sırasına göre 25.74 cm, 29.38 cm, 16.71 mm, 64.21 mm, 9.38



adet/meyve, 3.07 mm, 36.17 mm, 6.6 briks, 147.46 mm ve % 3.74 olarak ölçülmüştür. Genotiplerin meyve boyun kısmında % 84.44 oranında eğrilik görülmeyip meyve şeklinin oval oluşu % 37.78, armudi % 33.33, golf sopası % 13.33, beyzi % 8.89 ve küre % 68.89 olarak tespit edilmiştir. Ayrıca dilimli % 93.33 (42 adet genotip) olurken, % 68.89' un meyve rengi turuncu ve % 31.11' in sarı olduğu belirlenmiştir. Ana renk dışında yeşil rengin % 24.44 oranında kabuk ikinci rengi olduğu belirlenmiştir. % 75.56'sında ise kabuk ikinci rengi saptanmamıştır. Meyve parlaklığı açısından % 31.11 orta, % 35.56 mat, % 33.33 parlak olarak saptanırken et rengi % 46.51 oranında kırmızı rengine benzer turuncu ve % 53.49 oranında ise turuncu olarak belirlenmiştir (Babaoğlu ve Türkmen, 2017).



Yerlitohum.com



Hurriyet.com.tr

Samsun ilinde yürütülen çalışma kestane kabağı üzerine yapılmıştır. Ümitvar yerli kestane kabağının 55ÇA15, 55ÇA06 VE 57Sİ21 çeşit adayları seleksiyon ıslahı üzerine yapılan araştırmada Samsun'un ekolojik koşullarında Bafra, Tekkeköy ve Salıpazarı gibi üç farklı lokasyonda bazı meyve kalite özelliklerine ve verim özelliklerine bakılmak istenmiştir. Kestane kabağı genotipleri ve lokasyonlar arasında önemli derecede farklılıkların bulunduğu, meyve boyutu ve meyve kabuk kalınlığına bakılarak belirlenmiştir. Meyve et rengi ve SÇKM'de önemli farklar bulunmamıştır. Kabak çeşit adayları verimlilik açısından sırasıyla 57Sİ21 (2.1 t da-1), 55ÇA15 (1.7 t da-1) ve 55BA03 (1.7 t da-1) olarak belirlenmiştir. Sonuç olarak 57Sİ21 genotipinin dekara verim sayısı ve meyve sayısı değerleri yüksekken meyve ağırlıkları ile meyve eti sertliğinin özelliklerinin ise değişmez olduğu görülmüştür. Böylece 57Sİ21 genotipin Samsun ilinin ekolojisine adaptasyon açısından en uyumlu genotip olduğu saptanmıştır (Aslan ve ark., 2019).



Sondakika7.com



Haberler.com

Konya ovasında dihaploid kestane kabağı çeşidi olan Arıcan – 97 ve Balkız çeşitleri üzerine çalışmalar yapılmıştır. Amaç, verim ve meyve özelliklerinin adaptasyon yeteneklerini belirleyip önemli farklılıklar elde etmek olmuştur. Arıcan – 97 en yüksek verime sahip (2350



kg/da) çeşit olup DH – 6 (2325 kg/da) da ikinci sıradaki verimi en yüksek olan çeşit adayı olmuştur. Aynı çeşitlerde bitki başına meyve sayısı en fazla 1.74 ve 1.50 adet olarak tespit edilmiştir. DH – 8 çeşit adayı en yüksek SÇKM ve pH' a sahip olurken tat testinde ise ticari çeşitlerin oranı daha yüksek olmuştur. Bunların sonucunda ise Arıcan – 97 ticari çeşit olarak önemli olsa da DH – 6 genotipinin meyve ve verim kalitesi bakımından son derece önemli olduğu görülmüştür (Seymen, 2020).

Su kabağı ile ilgili yapılan bu çalışmada TOGAV 3216, 1060650 ve 1110117 numaralı projelerin daha önce TÜBİTAK tarafından desteklenmesi üzerine ülkemizin çeşitli yörelerinde su kabağı genotipleri toplandıktan sonra karakterizasyonu üzerine araştırmalar yapılmıştır. Flow sitometri ploidi analizleri kolaylık, hızlı ve güvenilir olduğu için daha çok tercih edilen yöntemlerden biridir. Bu projede su kabağı genotiplerinin DNA içerikleri ve ploidi seviyelerine flow sitometri yöntemiyle bakılmıştır. Bu çalışma sonucunda genotipler arasında herhangi bir ploidi seviyesi açısından önemli bir fark bulunmadığı gibi genom içerikleri açısından ise farklılıkların meydana geldiği görülmüştür (Ersoy, 2016).



Tashkent.salexy.uz

Oreshka-pitomnik.ru

Kabakgiller üzerine yapılan başka bir çalışmada amaç, Türkiye'nin Doğu ve Batı Akdeniz Bölgesi'nde kabak, kavun, karpuz, salatalık çeşitleri toplandıktan sonra genetik olarak dirençli olup olmadıklarına bakılmıştır. Yabani ve ticari olarak toplanmış olan bu kabakgillerden PM organları duyarlı salatalık çeşidi olan Baccara' da tutulmuştur. Korunan PM patojeni *Podasphaera xanthii* olarak tanımlanması morfolojik, mikroskopik ve moleküler çalışmalarla belirlenmiştir. 34 yerel, yabani ve ticari kabakgil türü *P. xanthii* ile aşılanmıştır. Aşılanan bitkiler sonraki 3 gün boyunca tripan mavisi, diamino benzidin ve 3,3' – diheksiloksakarbosinin (DİOC6) boyama yöntemiyle incelenmiştir. Diğer 7., 14. ve 21. aşılama hastalık gelişmeleri hastalık ölçeğine göre puanlanıp duyarlı ve dirençli kabakgillerin genotipleri bulunmuştur. Dirençli kabakgil genotiplerinin VT18, Meltem F1, Poyraz F1 ile 348 ticari hıyar çeşitleri ve Adana kabak, Kalender hıyar 1 ve Kalender hıyar 2 patojen testi sonucu belirlenmiştir. Ayrıca bu testler, Kalende kavun 2'nin *P. xanthii*' ye karşı en duyarlı kara ırkı genotipi olduğu tespit edilmiştir (Yücesoy ve ark., 2020).

Aydın'ın Koçarlı ilçesine bağlı Çakmar, Güdüşlü, Çulhalar ve Mersinbeleni köylerinde yabani kuşkonmaz (*Asparagus acutifolius* L.) üzerine çalışmalar yapılmıştır. Yabani kuşkonmazın bazı bitkisel özellikleri, tüketilen sürgünlerin yapısı ve tohum özellikleri ile ilgili araştırmalar yapılmıştır. Ağustos ayının sonundan ekim ayına kadar çiçeklenme döneminin devam ettiği gözlemlenirken meyvelerin olgunlaşma zamanının ise ocak ayının sonuna kadar devam ettiği görülmüştür. Güdüşlü köyünde ilk olarak sürgünlerin çıktığı görülmüştür. Tartılı derecelendirme yöntemi ile veriler analiz edilirken analiz sonucuna göre Çakmar köyünde sürgün değerleri ve bitki özellikleri açısından en iyi genotip belirlenirken Çulhalar köyünde ise meyve ve tohum verileri açısından en iyi genotip olduğu gözlemlenmiştir (Akay, 2016).



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Sarımsağın (*Allium sativum* L.) 4 C gibi düşük sıcaklık ile 21 C oda sıcaklığı baz alınarak depolanması üzerine yapılan bu çalışmanın amacı tiamin biyosentezinde görev alan THIC geni üzerine gerçek zamanlı PCR (TR- PCR) analizleri saptanmaktadır. Geççi genotipe sahip olan Kastamonu sarımsağı ile erkenci genotipe sahip olan P1515971 sarımsak başları yaklaşık 12 haftalık bir sürede 4 C düşük sıcaklıkta ve 21 C oda sıcaklığında depolanmaya başlanmıştır. 4 hafta aralıklarla örneklemeler yapıp son aşama olarak ise toplam RNA izolasyonu ile cDNA sentezinin ardından THIC geninin ifade düzeyindeki değişimlere bakılıp aktin geni referans alındıktan sonra RT – PCR analizleri ile tespit edilmiştir. 4 C' de depolanan iki genotipin THIC geninde artış yaşanmıştır. P1515971 genotipine ait gen ifade düzeyi başlangıçta 1.60 olurken 12 haftalık depolamayla birlikte 4 C' de 40.58' e yükselmiştir. Kastamonu genotipinde ise bu durum başlangıçta 0.78 iken 12 hafta sonra ise 19.61' çıktığı görülmüştür. Sonuçta düşük sıcaklık dormansinin kırılmasında bıraktığı etki tiamin sentezinde de önemli bir etki bırakmıştır (Koçat, 2016).



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2. SONUÇ

Avrupa'da peynir gibi bir gıdada 254 adet coğrafi tescil olduğunu göz önüne alırsak ülkemizdeki yerel sebzeler yeterince değer elde etmemiştir. 19. yy. in ilk yıllarında doğal afetler, şehirleşme, endüstrileşme gibi nedenler bitkisel çeşitliliğin azalmasına sebebiyet verdiğinden bu tehlikeyi ortadan kaldırmak için çoğu ülke birleşip genetik kaynakları ve çeşitlilikleri tespit edip onları muhafaza etmeye çalışmışlardır. Yerel gen kaynakları üzerine yapılan ıslah çalışmalarında farklı ekolojik ortamlara adapte olmaları, hastalık - zararlılara dayanım göstermeleri ve kalite bakımından istenilen özellikte ürün elde etmelerinden dolayı yerel sebzeler hem genetik açıdan hem de ıslah çalışmalarından dolayı önemli bir yere sahiptir (Kar ve ark., 2015; Karaağaç ve Balkaya, 2017).



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İRAN BAHÇE SANATINDA AĞAÇLARIN VE BİTKİLERİN TÜRÜ VE KULLANIMI ÜZERİNE BİR DERLEME

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ÖZET

İnsanın doğaya olan ilgisi eski zamanlardan beri doğanın en önemli bileşeni olan ağaçlar ve bitkileri yaşam alanlarına taşımasında görünmektedir. Mimarlık alanında insanın doğaya vazgeçilmez bağı olan bitkilerin ve ağaçların kullanımının en güzel şekli bahçe tasarımlarında görünmektedir. Bahçe mimarisi, insanın uzun yıllardan beri doğa ile olan bağının bir ürünü olarak ortaya çıkarak tarihsel süreç içinde her dönemin, tarihi, coğrafya ve iklimsel şartları, sosyolojik, ekonomik, felsefi ve kültürel özellikleri ile ilişkin olarak değişerek gelişmiştir. Tarihi kaynaklara göre çok eski dönemlerden beri İran mimarisinde bahçe tasarımı önemli bir yere sahip olmuştur. Ağaçlar ve bitkiler bu bahçelerin su ögesinden sonra en önemli bileşenidir. Büyük bir alanı çöl bölgesinde yer alan İran'da çok sayıda bahçe örneği çölün zor iklimsel şartlarına rağmen çeşitli bitki türlerinin mükemmel bir mimari tasarımla bir araya geldiği bir mekan olarak uzun yıllardan beri yapılmıştır. Bitkilerin yaşamında ki en önemli ihtiyaç olan suyun kıymetli ve az olduğu çöl bölgesinde yaratıcı mühendislik yoluyla suyu verimli biçimde kullanılarak ve bahçe boyunca suyun dolaşımı sağlanarak bitkilerin ve ağaçların sulanmasının yanı sıra suyun hareketi ve sesinin dinlendirici özelliğini de ortaya konulmuştur. Bu bahçelerin tasarımlarının temel taşı sayılan bitkilerin türü ve bahçe tasarımında kullanımlarını incelemek bu çalışmanın ana amacıdır. Bu doğrultuda, ilk önce İran'ın bahçe kültürü ve mimarisi kısaca anlatıldıktan sonra bu mimari içerisinde bitkilerin rolü tartışılmaktadır. Çalışmanın bulguları zaman sürecinde unutulmaya yüz tutan ve İran'ın geleneksel mimarisinin en önemli parçası olan bahçelerin fark edilmesini sağlayarak, günümüz kentsel tasarım ve peyzaj mimari tasarımlarında uzun yıllardan beri kullanılmış olan bitkilere ve ağaçlara yer verilmesi konusunda çıktılar sunmaktadır. Bu bahçelerde yaygın olarak kullanılan ağaçlar ve bitkilerin kullanımı ve İran kültüründe ki yerini tanıtmak çağdaş bahçe modelleri tasarımı konusunda bu değerleri sürdürmek konusuna katkı sağlayabilir.

Anahtar kelimeler: İran bahçeleri, ağaçlar, bitkiler



A REVIEW ON THE TYPES AND USE OF TREES AND PLANTS IN IRANIAN GARDEN ART

ABSTRACT

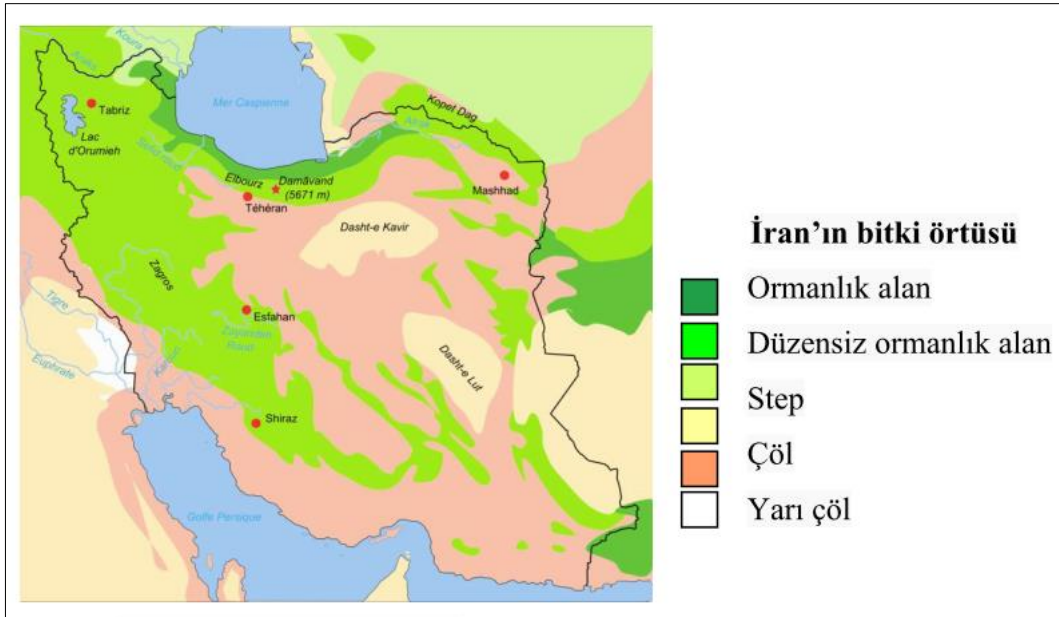
Human's interest in nature has been seen since ancient times that they have tried to integrate trees and plants as significant components of nature into their living spaces. In the field of architecture, the most beautiful form of such an integration of nature to human's living places appears in garden designs. Garden architecture has emerged as a product of man's bond with nature for many years. It has been developed in the historical process based on historical, geographical, climatic, sociological, economic, philosophical and cultural characteristics of each period. According to historical sources, garden design has had an important place in Iranian architecture since ancient times. After the water element, trees and plants are the most significant components of these gardens. In Iran, a large area of which is located in the desert region, many garden examples have been built for many years as a place where various plant species come together with an excellent architectural design despite the harsh climatic conditions of the desert. In the desert region water, which is the most important need in the life of plants, is precious and scarce. The relaxing feature of the movement and sound of water, as well as irrigation of plants and trees, has been designed by using water efficiently through creative engineering and by ensuring the circulation of water throughout the garden. The main purpose of this study is to examine the types of plants that are considered as the cornerstone of the Iranian garden design. For this purpose, firstly, the culture and architecture of Iranian garden is briefly explained. Then the role of plants in this architecture is discussed. The findings of the study draw attentions to the Iranian gardens, which have been forgotten in the course of time and are the most important part of Iran's traditional architecture. Furthermore, this study offers outputs about including plants and trees that have been used for many years in today's urban design and landscape architectural designs. Introducing the use of trees and plants commonly used in these gardens and their place in Iranian culture can contribute to maintaining these values in contemporary garden model design.

Keywords: Persian gardens, trees, plants



GİRİŞ

Bahçe mimarisi, insanın uzun yıllardan beri doğa ile olan bağının bir ürünü olarak ortaya çıkarak tarihsel süreç içinde her dönemin, tarihi, coğrafya ve iklimsel şartları, sosyolojik, ekonomik, felsefi ve kültürel özellikleri ile ilişkili olarak değişerek gelişmiştir. Göçebe hayattan yerleşik hayata geçiş sürecinin neticesinde, insanlar doğa ile olan ilişkilerini ve aynı zamanda tarımsal faaliyetlerini sürdürülebilmek amacıyla bahçeleri geliştirmeye başlamışlardır. Mezopotamya, Mısır, İran, eski Yunan ve Roma gibi önemli medeniyetlerde önemli bahçe örnekleri tarih kaynaklarında yer almıştır. İlerleyen dönemlerde ise farklı toplumların birbirinden etkilenmeleri ile bahçe kültürü ve tasarımı gelişimini sürdürmüştür. İran'da bahçe tasarımının tarihi milattan önce 6. Yüzyılda hüküm sürmüş olan ve tarihin en büyük imparatorluklarından biri olan hahameneşi döneminde krallar için yapılan bahçe örneklerine dayanmaktadır. Daha sonra Sasaniler döneminde bahçe inşaatı yaygınlaşarak devam etmiştir. İslam hükümeti altına girdikten sonra da bahçe tasarımı İslam dini inançlarından etkilenerek gelişmiştir ve yaygınlaşmıştır (Aşur & Yazıcı, 2018). İran bahçesini oluşturan temel bileşenler temelde su, bitkiler ve ağaçlar, köşk ve bahçeyi çevreleyen ve dış mekandan soyutlayan duvar oluşturmaktadır. Bu çalışmada bu bileşenlerden bitkiler ve ağaçlar konu olarak alınmaktadır. Şekil 1 İran'ın bitki örtüsü olarak farklı bölgelerini göstermektedir. İran'ın tüm iklimsel bölgelerinde çeşitli bahçe örnekleri bulunmaktadır. Ancak, çöl bölgesinde yer alan örnekler çölün zor iklimsel şartlarına rağmen çeşitli bitki türlerinin bir araya geldiği ve çölün ortasında cennet niteliğinde bir mekan yaratma nedeniyle daha çok ön plana çıkmıştır.



Şekil 1: İran'ın bitki örtüsü haritası (Aşur & Yazıcı, 2018)

Her bölgenin iklimsel ve coğrafya koşullarına uyumlu olan bitkiler ve ağaçlar daha yaygın olarak kullanılmıştır. Mevcut çalışma bölgeleri ayrı ayrı ele almadığından genel olarak İran bahçe örneklerinde daha yaygın olarak kullanılan ağaçlar ve bitkileri tartışmaktadır.

İRAN BAHÇELERİNDE AĞAÇLAR VE BİTKİLER

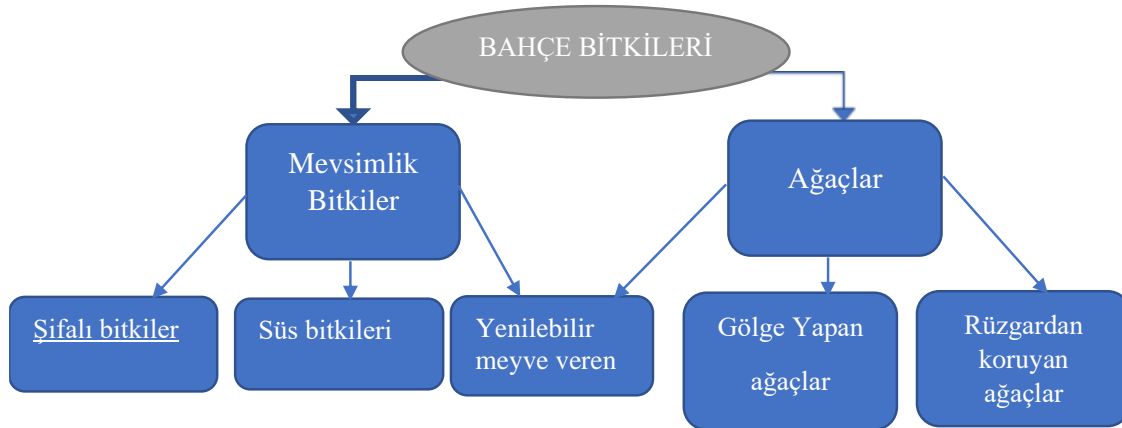
Bahçe Tasarımının en önemli bileşeni ağaçlar ve çeşitli bitkilerdir. Bitkiler ve ağaçların yetişebilmesinde de temel ihtiyaç sudur. İran bahçelerinin oluşumunda su kilit rol oynamıştır



ve İran'ın tarihi bahçelerinin çoğunun inşa edilme nedeni, bölgede doğal su kaynaklarının varlığıdır (Fekete & Haidari, 2015).

İran eski kavimlerden beri, ağaç, çiçek ve yeşilliklerin çevrelerinde ve yaşam alanlarında yer vermeleri doğaya olan ilgi ve saygınlıklarının da bir göstergesi olarak kültürlerinde yer almıştır. Örneğin yeni yılın başlangıcı baharın gelişi ve çiçek ve yeşilliğin açmasıyla nevruz bayramı ve töreni olarak çok eski yüzyıllardan beri kutlanması İranlıların doğaya ve bitkilere olan ilgisinin bir kanıtıdır. Ayrıca arkeolojik kazı alanlarından çıkmış olan nesnelere, ilk yerleşimlerde bile kil kapları üzerindeki çiçek, bitki ve su desenlerinin yer alması, yeşillığe verdikleri önemi gösterme açısından oldukça önemlidir (Aşur & Yazıcı, 2018).

İran bahçesindeki bitkiler, tür ve türlerin yanı sıra konum, dikim planı, güzellik ve kullanışlılık açısından oldukça önemlidir. İran bahçesindeki bitkiler, bahçeyi gölgelemek, üretmek ve süslemek gibi farklı amaçlar için kullanılır. Ağaçların ve bitkilerin süs ve estetik özelliğinin yanı sıra verimlilik ve kullanışlılığı açısından meyve ağaçları ve şifalı bitkilere ağırlık verilmiştir. Genellikle bahçenin ana ekseninin genişliği ve eksenin her iki yanındaki ağaç sıraları arasındaki mesafe nedeniyle, bu dikey yüzeyler kolayca görülebilir ve zamanla ağaçların büyümesi (ağaç türüne bağlı olarak) ağaçlarla kaplı bir koridor oluşturulmuştur. Ağaçların oluşturduğu bu koridor, bahçenin omurgasının ana eksenidir ve önemli işlevsel unsurların konumunu ve ana peyzajını şekillendirir (Tajaddini, 2008). Şekil 2 İran bahçesindeki bitkilerin gruplandırılmasını göstermektedir.



Şekil 2: İran bahçe örneklerinde bitkiler ve ağaçlar

İran bahçelerinde ağaç kullanımı ağaçların türüne bağlı olarak iki gruba ayrılır. Her daim yeşil olan ağaçlar (servi ve çam ağaçları) ve yaprak döken ağaçlar (meyve ağaçları örneği). Ağaçlar ve bitkiler gölge oluşturmak, yenilebilir ürün vermek ve estetik değerlerinin yanı sıra bazı ağaçların İranlıların eski inançları ve özellikle Zerdüşt dinine göre kutsal bir yere sahip olmaları da bahçede yaygın olarak kullanımını sağlamıştır. Örneğin, İran bahçelerinde servi önemli bir yere sahiptir. İslam öncesi İranlıların dini olan Zerdüşt dininde ve İran mitolojilerinde, servi ağacı her daim yeşil olma özelliğinden dolayı sonsuzluğu sembolize ederek kutsal bir değere sahiptir. Tarihi M.Ö. 6. yüzyılın sonlarına dayanan Taht-ı Cemşid'deki kabartma figürlerinde de servi ağacının bulunması bu inancın ve değerlerin bir kanıtıdır (Hekmati, 1987; Khosroujerdi ve Mahmudi, 2014)



Şekil 3: Taht-ı Cemşid'deki kabartma figürlerinde de servi ağacı

İran bahçelerinde yaygın olarak görünen ağaçlar ve o ağaçların bahçedeki kullanımı görseller ile birlikte tablo 1'de gösterilmektedir.

Tablo 1: İran bahçelerinde Yaygın Kullanılan Ağaç Türleri

İran bahçelerinde yaygın olan ağaç türleri	İlgili Ağacın Kullanımı	Ağacın Görseli
Salkım söğüt (Pouya ve Demirel, 2016)	Gölge oluşturmak	
Çınar (Pouya ve Demirel, 2016; Aşur ve Yazıcı, 2018)	Hava kirliliğini azaltma, bahçe de serin ve temiz hava sağlamak Yaygın ve geniş dallarıyla gölge oluşturmak	






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19-20 June, Izmir-TURKEY



<p>Sedir Aşur ve Yazıcı, 2018</p>	<p>Görsel estetik</p>	
<p>Çam (Pouya ve Demirel, 2016; Aşur ve Yazıcı, 2018)</p>	<p>Özellikle çöl bölgesi bahçe örneklerinde bahçenin dış duvarları sırasında dikilerek rüzgarlarının bahçenin içine nüfuz etmesini azaltır.</p>	
<p>Servi (Khosroujerdi ve Mahmudi, 2014)</p>	<p>-Sembolik ve kutsal yönü -Tüm mevsimlerde yeşil olarak estetik değerini her zaman korumak -Uzun ömürlü ve zor iklim şartlarına dayanıklı olma -Uzunluğu ve düzeniyle bahçenin iç bölmelerinde doğal bir bölücü unsur olarak kullanımı ve birçok bahçe örneğinde planın ana akslarını tanımlayan unsur</p>	
<p>Palmyeler ve Hurma ağaçları (Pouya ve Demirel, 2016; Aşur ve Yazıcı, 2018)</p>	<p>-Yörenin iklimine en uygun olan ağaç türlerinden -Mahsul vermek -Gölge yaratmak</p>	
<p>Karaağaç (Pouya ve Demirel, 2016; Aşur ve Yazıcı, 2018)</p>	<p>Gölge yapmak Yaprak döken bir ağaç olduğundan meyve ağaçlarıyla birlikte köşk çevresinde yer alan ağaçlardandır. Böylelikle yazın gölgesiyle binayı aşırı güneşten korur iken kışın yaprakları olmadığından güneşin yapıya girişini sağlar.</p>	










Kavak Ağaçları (Vibler , 1965)	-Gölge yapmak -Rüzgârın etkisini azaltmak	
<u>Simsir</u> (Vibler , 1965)	-Estetik katmak -Belirli aksları tanımlayarak bahçenin geometrik tasarımını desteklemek -Kısa olma nedeniyle manzarayı kapatmama özelliğinden dolayı köşk çevresinde daha fazla tercih edilmiştir.	
Meyve ağaçları olarak (Nar, İncir, Elma, Armut, Kiraz, Erik, Alıç, Badem, Ceviz, şeftali vb.)	-Yenilebilir -Verimlilik ve bereketi sembolü -Estetik değeri	

Ağaçların yanı sıra çiçekle ve çalılar da İran bahçesinin temel peyzaj bileşenlerini oluşturmaktadır. Düzenli ve dakik mühendislik ile tasarlanan sulama sistemi sayesinde ve doğru tasarım stratejileriyle çöl ikliminin zorluklarına meydan okuyarak birçok çiçek ve bitki türleri bu bahçelerde yetiştirilmektedir (Pouya & Demirel, 2016). Güller İran'ın çöl bölgesindeki en önemli ve yaygın çiçektir. Özellikle Şam gülü manevi olarak İran kültüründe değerlidir ve “hazreti Muhammet gülü” olarak da geçmektedir. Tablo 2’de İran bahçelerde en yaygın olan çiçekleri görselleriyle birlikte gösterilmektedir.



Tablo 2: İnan bahçelerinde Yaygın Kullanılan Çiçek Türleri ve görselleri

İnan bahçelerinde Yaygın Kullanılan Çiçek Türü	Çiçeğin Görseli
Şam Gülü (Aşur & Yazıcı, 2018)	
Leylak (Aşur & Yazıcı, 2018)	
Altınçanağı (Pourmand, 2011)	
Sarı nergis (Pouya & Demirel, 2016)	
Sardunya (Pourmand, 2011)	
<u>Yıldız çiçeği</u> (Pourmand, 2011)	
Nilüfer (Pouya ve Demirel, 2016; Aşur ve Yazıcı, 2018)	



Şebboy (Pouya & Demirel, 2016)		
Horozibiği (Vibler , 1965)		
Hatmi (Vibler , 1965)		

SONUÇ

Dünyanın farklı bölgelerinde bahçe sanatı ve yapısı, eskiden beri mimarlığın önemli yapıtları arasında yer almıştır. İtalya, Mısır, Japonya ve İran'da yer alan önemli bahçeler, insanoğlunun dünyanın her köşesinde, doğaya olan ilgisini kendi kültürel değerleriyle birleştirerek çeşitli yöntemlerle bahçelerinin tasarımında ortaya koydukları görünmektedir.

Bu çalışmada ele alınan İran bahçelerindeki temel bileşen olan bitkilerin gölgeleme, sınır, manzara oluşturma, erozyonu engelleme, rüzgar perdesi oluşturma vb. işlevsel kullanım amaçlarının yanısıra bazı ağaçlar ve bitkilerin inanç etkisiyle kullanımları İran bahçesinde önemli olduğu görülmektedir. Bu bağlamda, İran bahçesi bitkilerin kullanımı dışında bitkilerin kültürde anlamları ve değerlerini de göz önünde bulundurarak işlevsel mekan olmanın yanı sıra İran kültürünün ve inançlarının sembolik mekanları olduğu da düşünülmektedir. Böylelikle, bu değerli mimari eserleri tanımak ve tanıtmak özellikle kullanılan bitkileri hem botanik özellikler hemde anlamsal değerler olarak ele almak, İran bahçe modelinin oluşturulan çağdaş örneklerinin tasarımlarına da katkı sağlayabilir.



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**MONITORING TEMPORAL AND SPATIAL SCALE CHANGES IN SHORELINE
USING LANDSAT SATELLITE TIME SERIES (CASE STUDY: JASK PORT TO
CHABAHAR PORT)**

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ABSTRACT

Coastal systems are very dynamic and active, and their transformation occurs relatively quickly due to the collision of two dynamic land and sea environments. It is important to know the past, present and future of the coastline and how it changes, which causes problems for residents and coastal facilities. Remote sensing data and satellite images in different periods are considered as one of the most reliable and relatively accurate sources for studying and interpreting shoreline changes and quantitative measurements. In this study, we monitored changes in the shorelines using Landsat 5 satellite images for the years 2000, 2005, 2010, as well as Landsat 8 satellite images for 2015 and 2019 and using the randomized classification method of random forest in the Google Earth Engine platform environment. Monitoring shoreline variations from Jask port to Chabahar was investigated. First, the Normalized Difference Water Index was used to extract the water area from the land, and in the next step, the water and soil classes were classified using supervised random forest classification. Finally, variations happened during the period time were detected using post-classification method. The advantage of shoreline monitoring in the Google Earth Engine platform environment over other methods is time and cost savings, high speed calculations and automated capabilities that can be applied to other similar areas.

Keywords: Shoreline, landsat, classification, random forest



INTRODUCTION

Coastal zone is one of the most complex ecosystems that poses various number of non-living and living resources (Costanza et al. 1997). One of the main factors that contribute towards the shoreline changes is sea level rise phenomena. Many series of physical processes such as tidal flooding, sea level rise, land subsidence, erosion, and sedimentation, thus that area was categorized as a high impact of environment natural processes. Coastal monitoring is an essential feature for the sustainable management of naturally vulnerable areas.

Changes in shoreline is happened generally because of the decline of sediment supply to the coast and increased rates of erosion which is called recession. When depositing sediment occurs faster than erosional processes shoreline developed causing to accretion (Chu et al. 2009).

Today, application of satellite remote sensing data and Geographical Information System (GIS) are being used in extraction, analyzing, and mapping the shoreline changes. Application of GIS integrates the location of spatial information with its attribute information. GIS and remote sensing technologies are able to calculate the historical rate of changes. Aerial photographs, beach profiles, topographic and bathymetric surveys can be employed to evaluate the spatial and temporal changes in coastal areas qualitatively and quantitatively (Islam et al. 2014).

Google Earth Engine (GEE) provides users with the opportunity to conduct many advanced analysis, including spectral un-mixing, object-based methods, and linear modeling. Machine learning techniques for supervised and unsupervised classification are also available.

In this study we aim to carry out analysis of Landsat satellite imagery to investigate the shoreline changes at five time steps in south of Iran and along Oman Sea. Shoreline changes and variations are explained by erosion and accretion that occur. We also will highlight importance of shoreline monitoring and applications of GEE and satellite images in the analysis.

MATERIALS and METHODS

In the present study we monitored and interpreted changes to the shoreline over five dates 2000, 2005, 2010, 2015, and 2019. For this purpose, the images were analyzed by using GEE platform to highlight the variations. The database on GEE is geo-registered and corrected radiometric and atmospherically.

Study Area

Shorelines of Hormozgan and Sistan Baluchistan Provinces were investigated in this study. The area studied is a widespread region located in the geographical position between 57° 21' to 61° 21' east longitude. The shoreline is 1150 km long extended along the Oman Sea and includes coastlines of Chabahar, Konarak, and Jask cities. Multiple important ports and buildings are constructed in this region and many more are supposed to be built making study in the area of interest very crucial. (Figure 1).

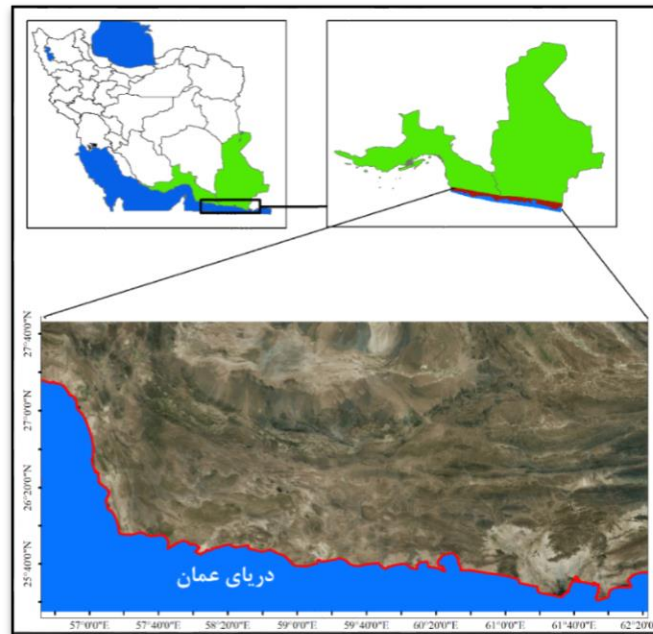


Figure 1. Geographical location of the study area.

Data Collection

For investigating the changes and variations happened over 20-year period in the study area, we employed Landsat satellite images taken over the study area in the years 2000, 2005, 2010, 2015, and 2019. For the years 2000, 2005, and 2010 Landsat 5 images and for the years 2015 and 2019 Landsat 8 data with less than five percent cloud cover were recruited. The spatial resolution of the images is 30 meters and proved to be suitable for detecting changes happening over the time on the land surface. (Table 1).

Table 1. Satellite images employed for classification

Year	Satellite	Spatial Resolution (m)
2000	Landsat 5	30
2005	Landsat 5	30
2010	Landsat 5	30
2015	Landsat 8	30
2019	Landsat 8	30

Images Classification

In this study images were classified into two classes including water and land surfaces and random forest method was employed for classification. Random forest as its name shows, consists of a large number of individual decision trees that operate as an ensemble. Each



individual tree in the random forest spits out a class prediction and the class with the most votes becomes our model's prediction (Breiman, 2001).

Classification Accuracy Assessment

In order to use the data more correctly and efficiently we need to realize how accurate the classified maps are (Plourde & Congalton, 2003). The most widely promoted classification accuracy is in the form of error matrix which can be used to derive a series of descriptive and analytical statistics (Congalton, 1991; Plourde & Congalton, 2003). The procedure is a very effective way to represent accuracy in that the accuracies of each category are plainly described along with both the errors of inclusion (commission errors) and errors of exclusion (omission errors) present in the classification. (Congalton, 1991). Overall accuracy, producer's accuracy, user's accuracy and Kappa statistics are generally reported, and these terms have been explained in detail in many studies (Congalton, 1991; Plourde & Congalton, 2003).

In this study, accuracy assessment was performed for the classified maps of all five time steps: 2000, 2005, 2010, 2015, and 2019. Random sampling method was employed for the accuracy assessment so that 600 samples were considered for accuracy assessment. 70 percent of the samples (420 samples) were considered as training and rest of the 30 percent (180 samples) were considered as test samples. Training samples and test samples were used for classification and accuracy assessment respectively. Interpretation was based on aerial photographs and field verification. In order to determine the reliability and accuracy of the classified images overall accuracy and the Kappa statistics were derived from the error matrices.

Change Detection

After classifying the images in order to magnify and detect the changes we used post-classification method. Post-classification methods detect land cover change by comparing independently produced classifications of images from different dates (Singh, 1989). Although the post-classification comparison method requires the classifications of images acquired from different times, it can not only locate the changes, but also provide "from-to" change information (Jensen, 2004)

RESULTS and DISCUSSION

Results of the accuracy assessment showed that classified images had satisfactory accuracy for interpretation which produce reliable maps. Kappa coefficient and overall accuracy are statistics representing correctly classified and misclassified pixels. It could be found from the table that random forest algorithm had acceptable performance in the present study. The overall accuracies of all five maps were above 91%, and Kappa statistics were above 0.91, indicating a strong agreement or accuracy between the classification map and the ground reference information.

Table 2. Summary of accuracy of the classified images.

The images	Kappa Coefficient	Overall accuracy
Landsat 5 (2000)	0.83	0.92
Landsat 5 (2005)	0.84	0.93
Landsat 5 (2010)	0.81	0.91
Landsat 8 (2015)	0.88	0.97
Landsat 8 (2019)	0.89	0.98



In order to classify the images more accurately we used Normalized Difference Water Index (NDWI). Thanks to this index we extracted the water from the area of interest. The final maps derived from images classification are shown in Figure 2. Classified images include water and land surfaces shown in blue and red respectively.

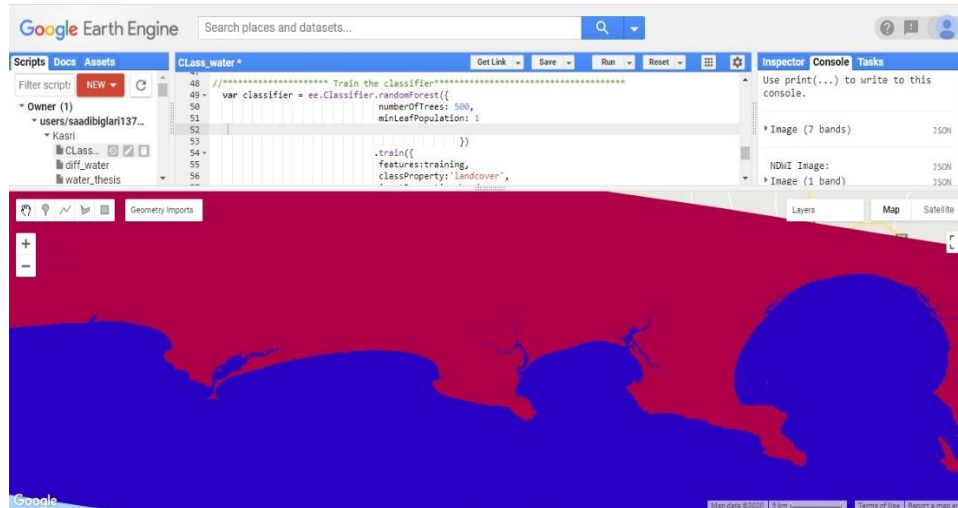


Figure 2. Classified image for the year 2000. Land and water surfaces are represented by red and blue respectively.

For detecting the changes, it is required to compare classified images in five time steps with each other. Post-classification is a change detection method in which the classified images are compared with each other and changes are highlighted. After performing multi-date post-classification, we detected changes and variations over the time period. In the figure 3 changes happened in the five time steps are shown. Most significant changes happened between the years 2010 and 2015. As it could be seen from the figure, highest recession has occurred in the year 2015. Changes from water to land surface and from land to water surface are represented in red and blue respectively. Water and land surfaces without change are indicated in green and yellow respectively.

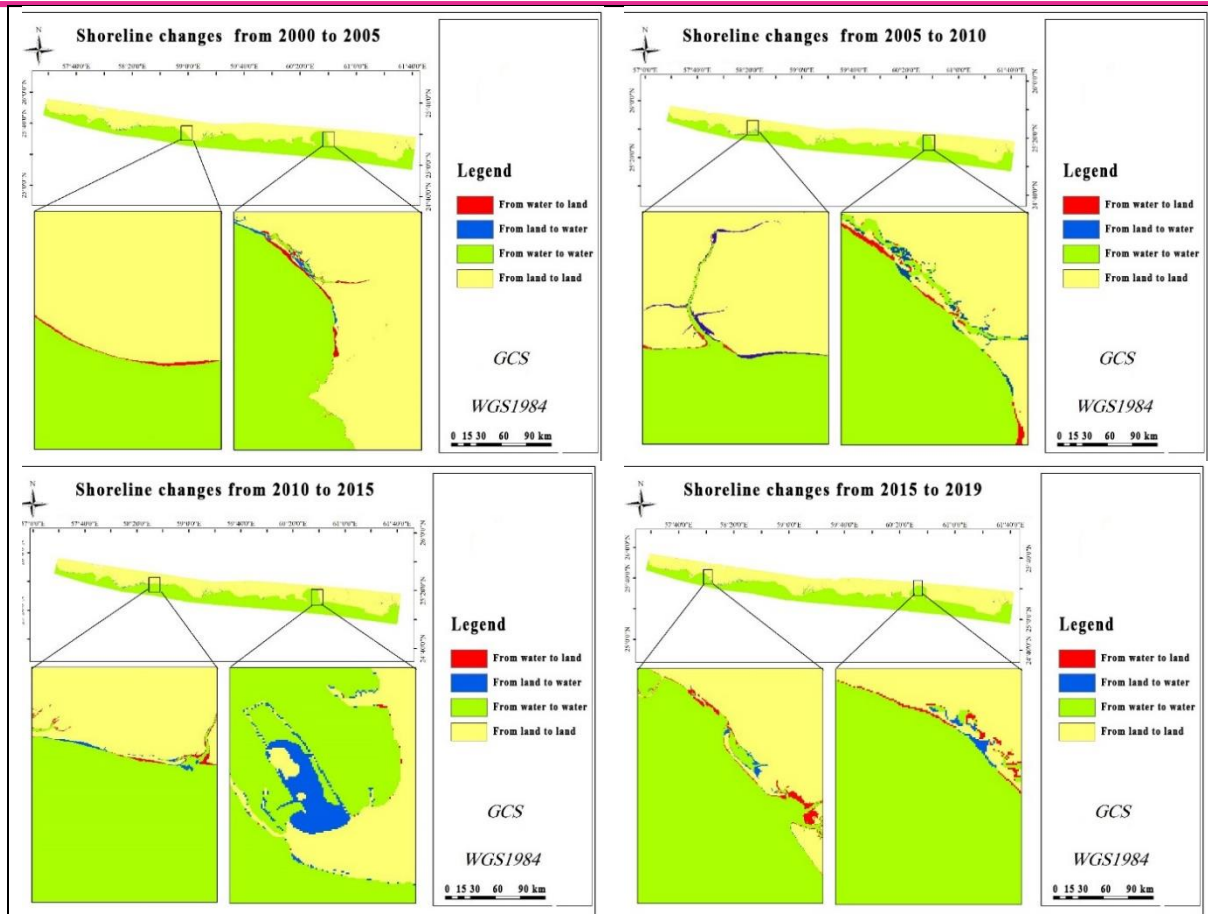


Figure 3. Change detected maps over the period time.

Change detection map analysis led us to map of accretion and recession happened in the shoreline. These variations are indicated in the figure 4 and accretion and recession are represented by red and blue respectively.

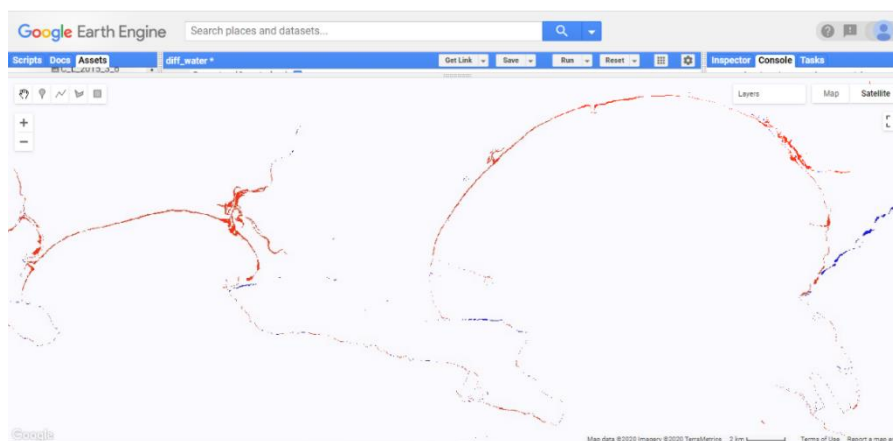


Figure 4. Accretion and recession map.

Parts of the shorelines with the highest level of variations are recognized as regions with high risk and unsuitable for construction and other activities. Annually changes in the five time steps are indicated in the Table 3. According to the table 3, figures 3 and 4, it could be understood



that in the years 2000, 2010, and 2015 the shoreline experienced recession in response to erosion and in the years 2005 and 2019 sedimentation and accretion has influence the shoreline.

Table 3. Annually changes in the shorelines from 2000 to 2019.

Time step	Change trend
2000	Recession
2005	Accretion
2010	Recession
2015	Recession
2019	Accretion

The sedimentation and erosion occurs in different parts of the shorelines and in different intensity level. So in this study we recognized high risk regions in the shorelines that should not be selected for construction activities and may be lost because of erosion. In the figure 5 parts of the unstable shoreline with highest variation is depicted in red.

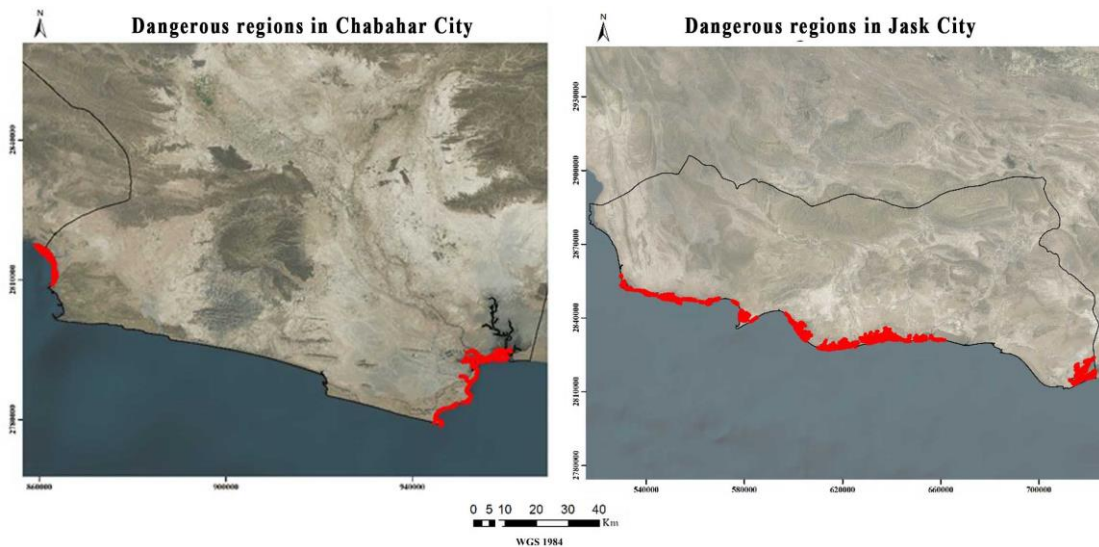


Figure 5. Regions with high risk in the study area

CONCLUSION

Shorelines are dynamic environments changing by water level fluctuation and disturbance in sediment balance. Shorelines are important in different aspects including determining marine territory, planning and construction in ports and harbors, landing the ships and evaluation of the possible threats. Different parts of the shorelines are influenced by environment differently so detecting susceptible and stable parts of the coastlines is vital for construction, fisheries, tourism, and even economic growth. In this matter satellite images can be very practical tool for monitoring the changes on the land. GEE provides us with possibility of analyzing large amount of data including the satellite imageries without downloading them. In this study, we investigated quantitative changes of shoreline in south of Iran over a 20-year period in response to erosion and sedimentation. Random forest algorithm showed an accurate performance in land cover classification. Classification and post-classification methods proved to be helpful in shoreline changes monitoring.



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THE EFFECTS OF ULTRASOUND APPLICATION AND ASCORBIC ACID ADDITION ON QUALITY PROPERTIES OF LOQUAT NECTAR

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ABSTRACT

Loquat fruit (*Eriobotrya japonica*) is a subtropical fruit that is usually consumed fresh, but also processed into products such as marmalade, jam and nectar. Ascorbic acid, a reducing agent that is widely found in nature and can be used for different purposes in the food industry, is very sensitive to heat treatment. Ultrasound, on the other hand, is a technology that can be applied as an alternative to heat treatment or in combination with different processes to extend the life of foods while maintaining quality. In this study, the effect of different ultrasound (US) applications (0, 15 and 30 min, 150 W, 25°C) and ascorbic acid (AA) additions (0, 2.5, 5 and 10 ppm) on important quality parameters such as pH, titration acidity, total soluble dry matter (%), ascorbic acid, total carotenoid content, total phenolic content, hydroxymethylfurfural content, antioxidant capacity and color values (L^* , a^* , b^*) were evaluated. pH value of loquat nectar (3.42-3.51) decreased with the addition of AA, while it increased with the increase of US application time. The total soluble dry matter value (11.60%-12.57%) increased significantly with both the US application time and the addition of AA. US application was not found to have a significant effect on the antioxidant activity (%), ascorbic acid amount, total phenolic substance content and color parameters of loquat nectar. It was determined that the L^* (25.5-37.9) and b^* (21.9-63.5) values increased with the increase in the amount of AA added to the nectars. Similarly, antioxidant activity (%), hydroxymethylfurfural (0.21-0.34 µg/100mL), ascorbic acid (0.18-1.79 mg/100mL), and total phenolic content (53.2-339.7 mg/L) also increased significantly with the increase of AA addition. The increase in antioxidant activity may be related to the increase in ascorbic acid, which is added to nectar and is known to be a strong reducing agent, and extractability of antioxidant compounds. When the results were evaluated in general, it was determined that ultrasound application had an improving effect on the quality of loquat nectar, especially in terms of the bioactive compound contents. This effect of ultrasound on loquat nectar can be explained by increasing the extractability of these substances. In addition, the positive effect of AA addition on the color and total phenolic content of loquat nectar may be related to its potential to inhibit browning reactions that occur as a result of enzymatic degradation of phenolic substances.

Keywords: Quality properties of loquat nectar, ultrasound, ascorbic acid addition, total carotenoid and phenolic content, color



1.INTRODUCTION

Loquat (*Eriobotrya japonica* Lindl.) is a subtropical evergreen fruit-tree and originated from south-eastern China, Japan, India and the Mediterranean countries (Zhang et al., 1990; Cuevas et al., 2003; Ferreres et al., 2009; Polat, 2007). China is the largest loquat producer country in the world followed by Spain, Pakistan and Turkey (Zheng et al., 2019; Caballero and Fernandez, 2003; TUIK, 2020). Because of the quality losses during transportation, loquat fruit are generally consumed in local markets. Loquat, a subtropical fruit, is also very sensitive to low temperatures (Zheng et al., 2000; Ding et al., 2002; Song et al, 2016). Therefore, the cold storage of loquat at low temperatures limits its postharvest quality and life (Cai et al., 2006; Xu et al., 2012). Producing nectar from loquat fruit can be a solution for consuming this fruit in a larger area for longer periods of the year.

In the fruit juice industry, juices are typically pasteurized by high temperature short time (HTST) pasteurization. Although this method is effective in inactivating microorganisms and enzymes, it can cause detrimental effects on the quality of the juice such as; causing color change, separation of particles, and a change in flavor or smell (Qin et al. 1995). Compared with thermal pasteurization, non-thermal processing technologies such as; high pressure processing, pulsed electric fields and ultrasound processing, offer the advantages of low process temperatures which results in a better retention of flavors and nutrients (Vega-Mercado et al. 1997). Ultrasound processing is a promising non-thermal processing technology and a potential alternative to traditional technologies (like thermal pasteurization) (Mason et al., 1996). Recent advances in ultrasound technology allowed for the use of this technology in the food industry. According to recent innovative studies reflected on the food science literature, it is emphasized that this technology will be used as processing assistive technologies in the near future (Dolatowski and Stasiak, 2012). The effects of ultrasound applications on the bioactive compounds of different fruit juices vary not only according to the ultrasound application conditions, but also according to the matrix characteristics of juice. For this reason, it was indicated that carrying out studies in the different juices in order to minimize the effect of ultrasound on quality properties to evaluate its applicability in the fruit juice industry is necessary (Dündar et al., 2020).

The rapid browning of loquats after crashing can be the main problem during juice processing. Ascorbic acid which is a reducing agent and decreases the pH of medium can be a solution in loquat juice production until the processing and inactivation the enzymes responsible from browning reactions. The main objectives of this study is to investigate the effect of ultrasound treatment and the addition of ascorbic acid for preventing the rapid color change until the treatment time on quality properties of loquat nectar.

2.MATERIAL and METHODS

2.1.Material

In this study, loquats were purchased from local market and stored at +4°C until further processing.

2.2.Method

For the production of loquat nectars, the processes shown in Figure 1 were applied to loquats, respectively. The loquats washed in order to remove unwanted elements such as dust, soil, pesticide residues and to reduce the microorganism load. Then, foreign elements such as leaves and stems and immature, green, yellow or crushed and rotten fruits are separated. After selection and sorting, stem separation was carried out in order to prevent the transfer of phenolic substances from the stem parts to the product and change in color. The fruits, whose seeds were



removed, were first homogenized with a blender (Waring, USA) for 20 s and then passed through a stainless steel sieve with 1 mm mesh diameter. For loquat nectar production, acid (100%), sugar and water were added so that the fruit ratio was 50%, the acidity was 0.60% and the total soluble solids value was 11° Brix. Then, 0, 2.5, 5 and 10 ppm ascorbic acid added to the nectars before ultrasounication treatments during 0, 15 and 30 min. Loquat nectars were bottled and stored at -65°C until quality analysis was performed.

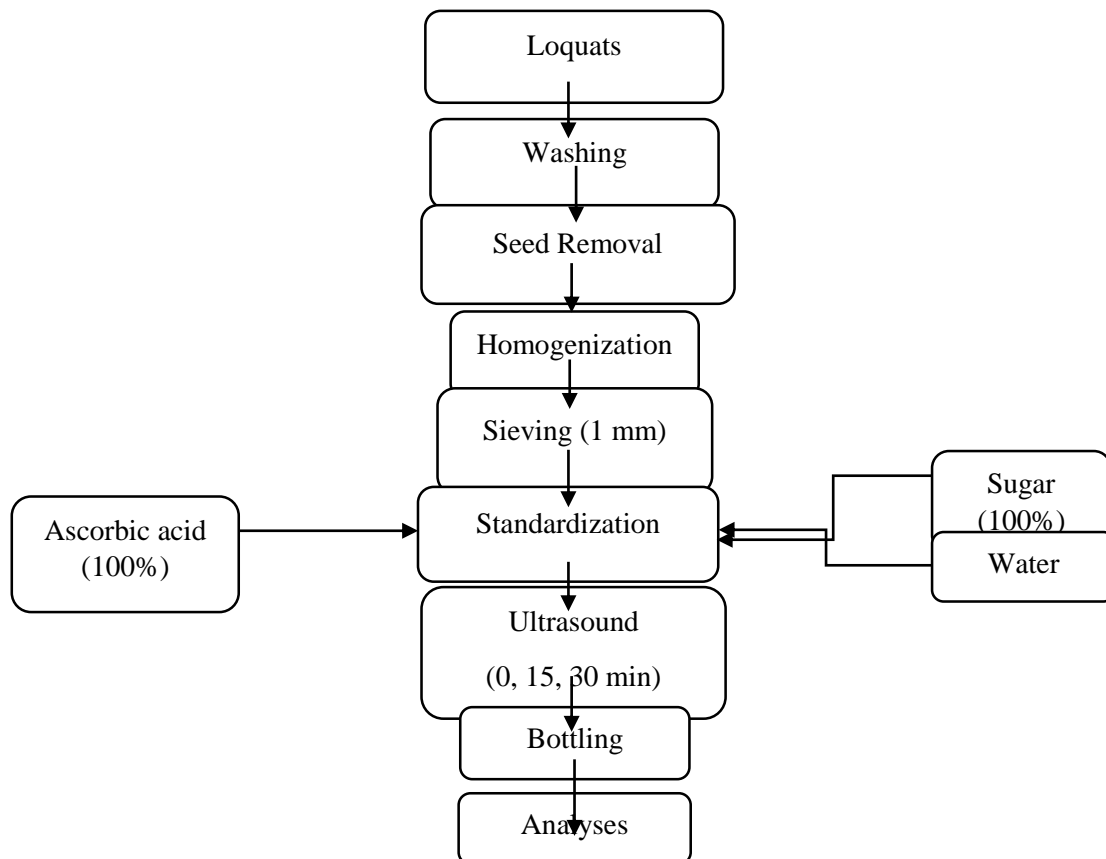


Figure 1. Loquat nectar production

2.2.1. Ultrasound Treatments

The ultrasound treatments were carried out in an ultrasonic device (UP200S, Hielscher, Germany) (average ultrasound power of 155 W and frequency of 24 kHz) equipped a digital power-meter and a temperature controller. The juice (for each run 300 g) was accurately weighed and placed in double-walled glass beaker with a cooling/heating system. The sonotrode was located 1 cm away from the bottom of the beaker during the experiment (Figure 2).

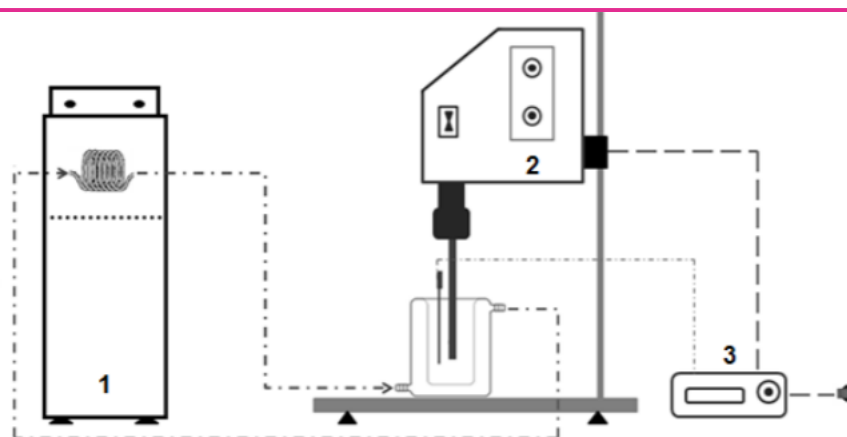


Figure 2. Ultrasound equipment (1: cold water circulator, 2: ultrasonic device, 3: power-meter) (Ağçam et al., 2017)

2.2.2. Analyses

pH determination of loquat nectar samples was made under room conditions using WTW brand pH meter with glass electrode (Cemeroğlu, 2007). The titration acidity of loquat nectars (10 mL) were determined by using pH meter and 0.1 N NaOH solution and the results were given in terms of % citric acid (Cemeroğlu, 2007). Also, soluble dry matter of nectar was measured with a portable refractometer (Refracto 30PX, Mettler Toledo) at 20°C.

For the determination of the color (30 mL) of nectar, ColorQuest XE Hunter Lab (Virginia, USA) with 20 mm glass optical cell light path was used. Lightness (L^*), redness (a^*) and yellowness (b^*) have been determined through the reflectance instruments (Lee ve ark., 2001). 20 µL of supernatant obtained by using the method of Gökmen and Acar (1996) were injected into a C18 ACE (4.6mm×250 mm) HPLC (Shimadzu, Japan) column at 30 °C for HMF analysis. Mobile phase was methanol/water/acetic acid (20/79/1, v/v/v) while the flow rate was 0.5 mL/min. Quantification and identification of HMF was carried out at 285 nm.

In a teflon centrifuge tubes containing 5 mL of 2.5% meta phosphoric acid (Merck, Germany), 5 mL of loquat nectar were added then centrifuged (4000 rpm-4°C-10 min) for determining ascorbic acid content. 0.5 mL of the supernatant was completed to 10 mL with 2.5 % meta-phosphoric acid. The tubes were vortexed at a high speed (Velp Scientifica, Italy), and the mixture was filtered using a 0.45 µm nylon filter (Millipore, Germany). The filtered supernatant (20 µL) was injected to the HPLC system (Shimadzu, Japan) including C18 column (Xterra, 5 µm, 4.6x250 mm, Waters) (Lee and Coates, 1999). For the quantification of AA, an external AA standard method ($R^2=0.998$), at 244 nm (Sigma-Aldrich, USA) was applied.

Total carotenoid determination was carried out according to the previously described method of Lee and Castle (2001) with some modifications. 5 mL of juice and 10 mL of a solution (hexane/methanol/acetone, 50/25/25, v/v with 0.1 % BHT) were mixed and then centrifuged (10 min-4000 rpm-4 °C). The supernatant phase was used for absorbance measuring (450 nm) by spectrophotometer (Perkin Elmer Lambda 25-UV/VIS, USA). Total carotenoids were calculated using the extinction coefficient of β -carotene ($E^{1/2} = 2505$).

Total phenolic contents were measured using the Folin-Ciocalteu method reported by Abdullakasm et al., (2007). For that, it has been mixed 5 mL of loquat nectar with 5 mL of 80% methanol (Merck, Germany). The tubes were centrifuged at 4000 rpm during 20 min at 4 °C (Heraeus Bofuge Primo R, Germany). After centrifugation, 100 µL of the sample and various concentrations of standard solution were mixed with 100 µL Folin-Ciocalteu reagent (Sigma-Aldrich, USA) and add into 3000 µL deionized water. After 10 min of incubation at room temperature, 100 µL of 20% Na₂CO₃ (Merck, Germany) solution have been added and



immediately mixed, then the tubes were put in the dark for 2 hours incubation at room temperature. Using a spectrophotometer (Perkin Elmer Lambda 25-UV/VIS, USA), the mixture absorbance was then measured at 765 nm and total phenolic content of the samples was expressed in milligrams of gallic acid per 100 mL (Sigma-Aldrich, USA) equivalents (mg GAE/100 mL).

The antioxidant activity of the loquat nectar was evaluated using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical-scavenging method. Measurements were carried out according to the procedure of Klimczak et al. (2007) with some modifications. 5 mL of sample was mixed with 5 mL of methanol solution (80 %), and then centrifuged (4000 rpm-10 min-at 4 °C). 0.1 mL of supernatant was added to 3 mL of DPPH solution (0.025 g/L in 80% methanol) and mixed by vortex. After incubating for 10 min in the dark, absorbance of the samples was measured at 515 nm using the spectrophotometer. Antioxidant activity was expressed as the percentage decline of the absorbance:

$$\text{Antioxidant activity (\%)} = \frac{A_{\text{control}} - A_{\text{sample}}}{A_{\text{control}}} \times 100$$

Where, A_{control} and A_{sample} were the absorbance of the control and sample, respectively.

All the mentioned analyses were repeated at least three times. In statistical evaluation, results were subjected to variance analysis using SPSS 20.0 packet program, and significant differences were determined according to Duncan's multiple comparison test ($p=0.05$). The effect of each independent variant (AA addition level and US treatment time) on quality properties was indicated with the letters right next to them.

3.RESULTS

3.1. pH, titration acidity and total soluble dry matter

The pH, titration acidity and total soluble dry matter values of nectars were given in Figure 3. The pH of loquat nectars was between the values of 3.42 and 3.51. pH value of nectar increased with US treatment time, while it was decreasing with AA addition level. The increasing effect of US on pH value of nectar can be related with the degradation of organic acids in the medium during ultrasonication.

Titration acidities of nectar (0.54% – 0.70%) increased with AA addition level, while it was decreasing with US treatment time. The reason of decrease in titrable acidity after US treatment also can be related with the degradation of organic acids with the effect of cavitations. The obtained pH and titrable acidity results supported each other.

The soluble dry matter values (0.54 – 0.70 g/mL) of loquat nectar increased with increasing US treatment time. This may be the result of evaporation during long treatment time (30 min). However, the effect of AA addition on soluble dry matter did not show a consistent change.

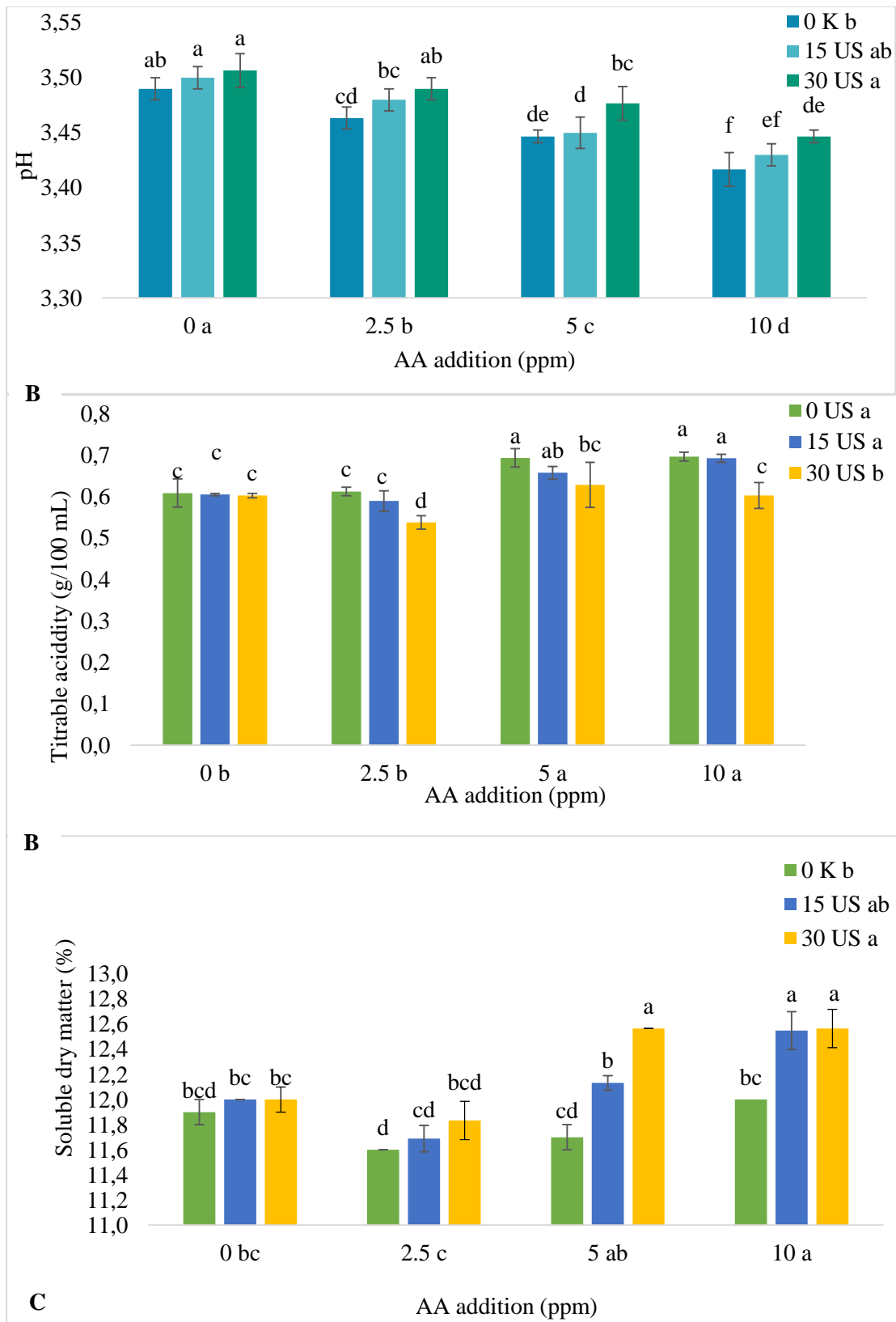


Figure 3. pH (A), titration acidity (B) and soluble dry matter (C) of ultrasonicated (US) and ascorbic acid (AA) added loquat nectars

The different letters are indicating that the mean values showed significant difference ($p < 0.05$).



It was showed that pH of kasturi lime juice showed non-significant changes after sonication treatments at 20°C, even after 60 min of treatment time . Sonication did not induce any significant changes in the titration acidity after 30 and 60 min ultrasonication (Bhat et al., 2011). The similar non-significant changes in the pH and titration acidity of sonicated orange and tomato juices was observed by some researchers (Adekunte et al. 2010; Tiwari et al., 2008). The reason of difference between the results of presented study and literature can be the different properties of juices.

3.2. Ascorbic acid content

The ascorbic acid content (0.18-1.79 mg/100 mL) of loquat nectars were given in Figure 4. US treatment had no significant effect on ascorbic acid content of nectars. On the other hand, when all the samples evaluated individually, the increasing effect of US were observed in the same level of AA addition groups.

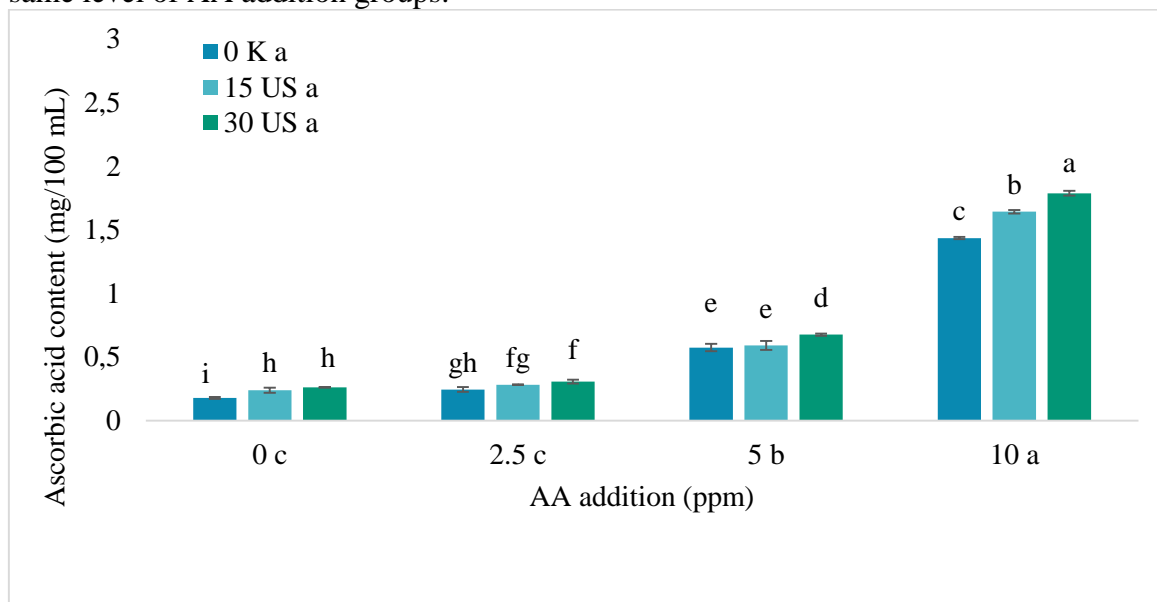


Figure 4. Ascorbic acid content of ultrasonicated (US) and ascorbic acid (AA) added loquat nectar. The different letters are indicating that the mean values showed significant difference ($p < 0.05$).

The change in AA content can be caused from this effect of US. It was reported that the ascorbic acid content of kasturi lime and guava juice was significantly increased after sonication treatments (Bhat et al., 2011; Cheng et al., 2007). In some cases, US can increase the extractability of bioactive compounds such as AA. The increase also can be attributed to elimination of dissolved oxygen which is essential for ascorbic acid degradation during cavitations (Chang et al., 2017).

3.3. Total Carotenoid Content

Total carotenoid content of loquat nectars was between the values of 17.47- 20.76 mg/100 mL (Figure 5). The enhancing effect of US treatments on total carotenoid content was determined. Both the US treatment time and AA addition level increased the total carotenoid content of nectars. The effect of AA, which is a reducing agent, on carotenoids may be related with the inhibition of oxidation reaction.

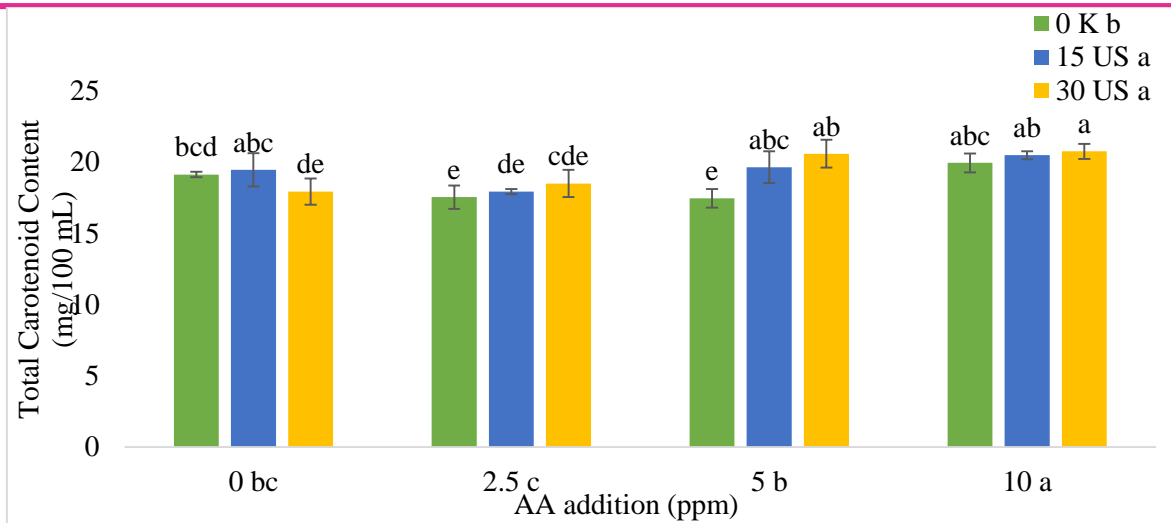


Figure 5. Total carotenoid content of ultrasonicated (US) and ascorbic acid (AA) added loquat nectars. The different letters are indicating that the mean values showed significant difference ($p < 0.05$).

Also, a significant increase after 1, 10, 20 and 30 min ultrasonication at 24 kHz frequency as compared to the control in orange juice were determined by Guerrouj et al., (2016). This increase in total carotenoids by sonication might be attributed to the mechanical disruption of cell walls, which might enhance the extractability of carotenoids in juice.

3.4. Total Phenolic Content

Total phenolic contents of loquat nectars were in a range of 53.2 mg/L - 339.7 mg/L (Figure 6). The phenolic content of loquat nectars was significantly affected from both US and AA addition. The addition of AA may have preserved the phenolic compounds against degradation by enzymes until the US treatment.

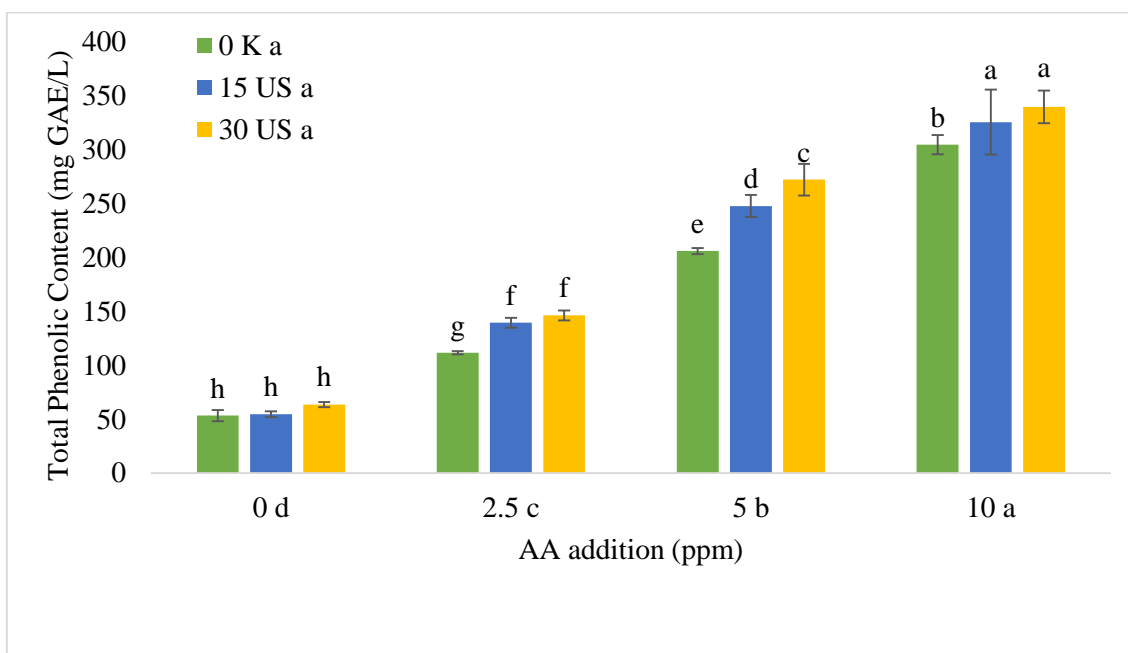


Figure 6. Total phenolic content of ultrasonicated (US) and ascorbic acid (AA) added loquat nectars. The different letters are indicating that the mean values showed significant difference ($p < 0.05$).



An increase in total phenolic content of orange juice from 42.74 up to 69.45 mg GAE/100 mL after ultrasonication treatments during 10, 20 and 30 min at 43.0 - 45.6°C were reported (Guerrouj et al., 2016). Increasing of total phenolic content in ultrasonicated apple juice at 60 °C was noticed by Abid et al. (2014). The effect of US treatment time on (increasing) phenolic content can be explained with the improvement in the releasing of bound phenolics and extractability after disruption of cell walls.

3.5. Hydroxymethylfurfural content

The HMF contents of ultrasonicated loquat nectars were given in Figure 7. The results showed that hydroxymethylfurfural content of nectar increased regardless of US time. The reason of this can be that AA addition levels were not high to contribute the HMF production. In a study about ultrasonication of strawberry nectar, the obtained results showed that high temperature, especially when combined with high level of ultrasound energy density, caused higher HMF content (Dündar et al., 2019). HMF is one of the main processing based products formed by AA and sugar degradation (Akyıldız et al., 2021). However, the HMF content was not affected by the AA addition level. The HMF formation can be related to the extreme temperature and pressure conditions occurring with cavitation during ultrasonication of nectar.

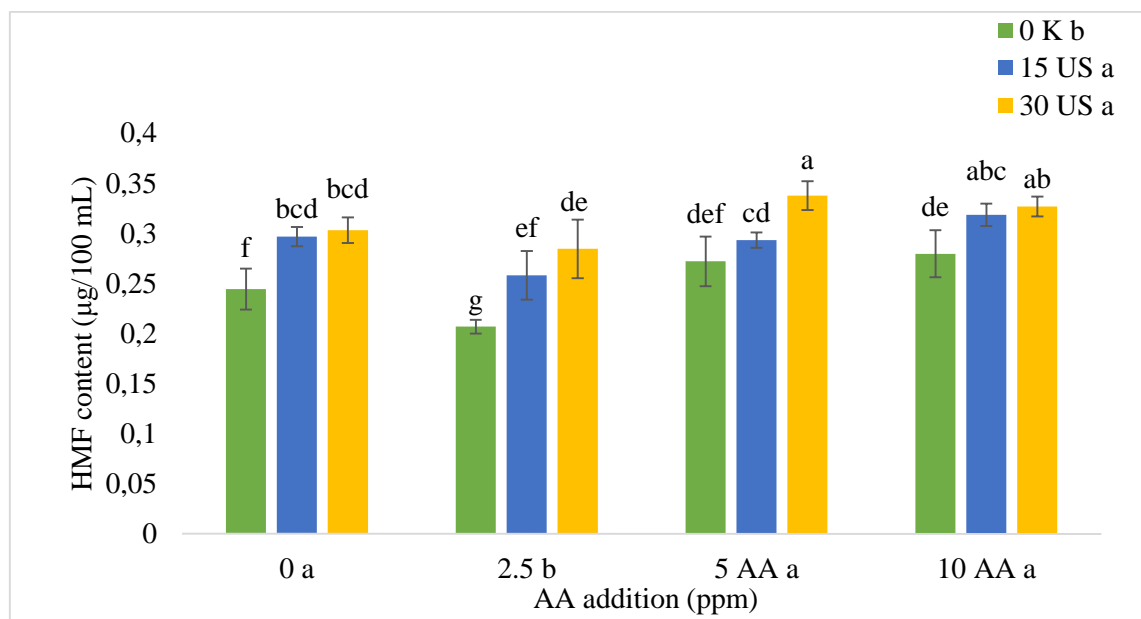
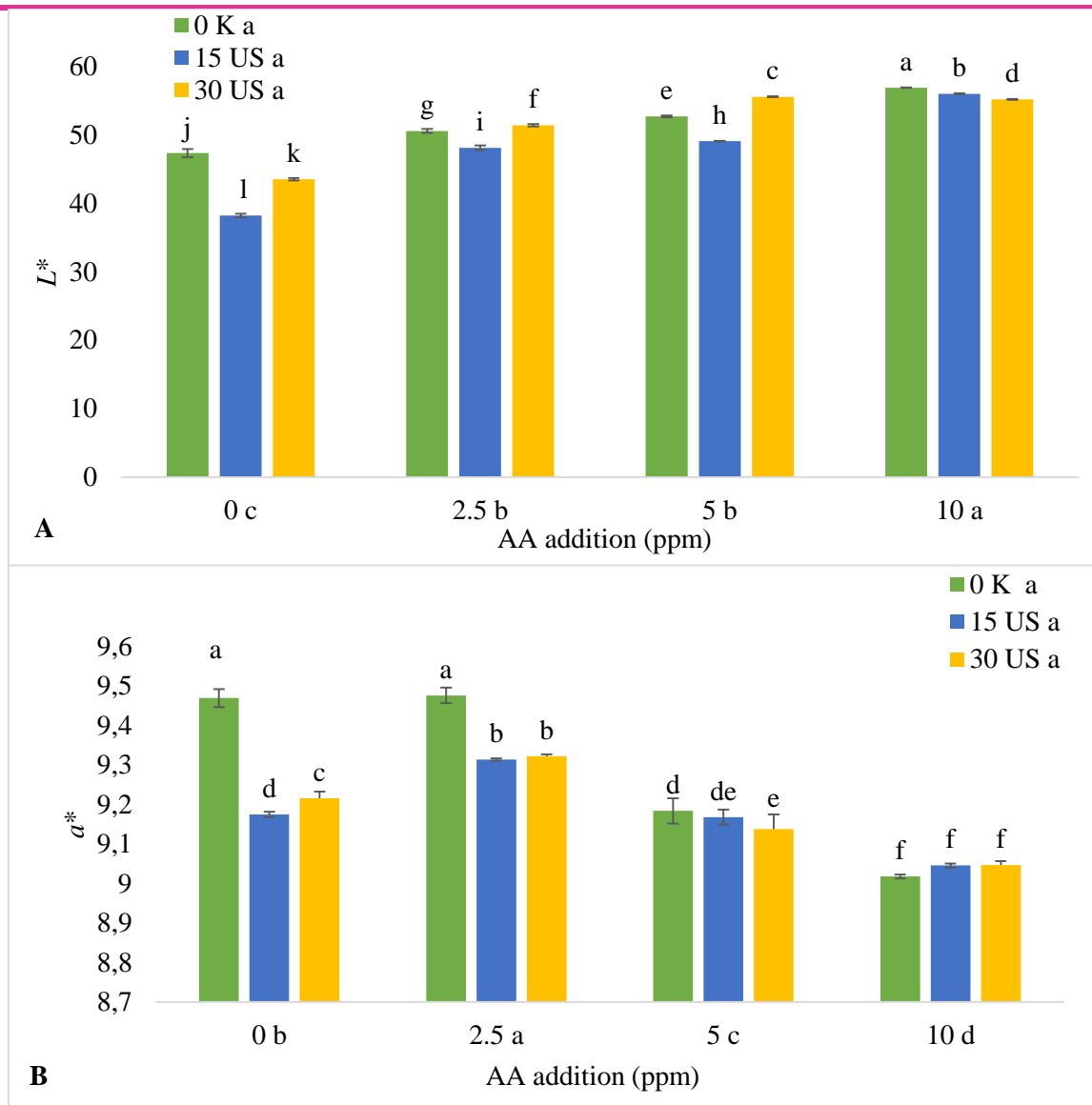


Figure 7. Hydroxymethylfurfural content of ultrasonicated (US) and ascorbic acid (AA) added loquat nectars. The different letters are indicating that the mean values showed significant difference ($p < 0.05$).

3.6. Color Parameters

The L^* (38.2 – 56.9), a^* (9.0 – 9.5) and b^* (21.9 – 63.5) were given in the Figure 8A, B and C, respectively. AA addition increased the L^* value of nectar, while US treatment did not affect significantly. L^* values showed that the addition of AA significantly increased lightness and prevented browning until the treatment as we aimed. Therefore, it can be said that the highest applied AA addition (10 ppm) was enough to prevent browning, while not contributing the HMF formation. AA addition had the highest increasing effect at lowest addition level on a^* value. The a^* values were not affected by the US treatment significantly.



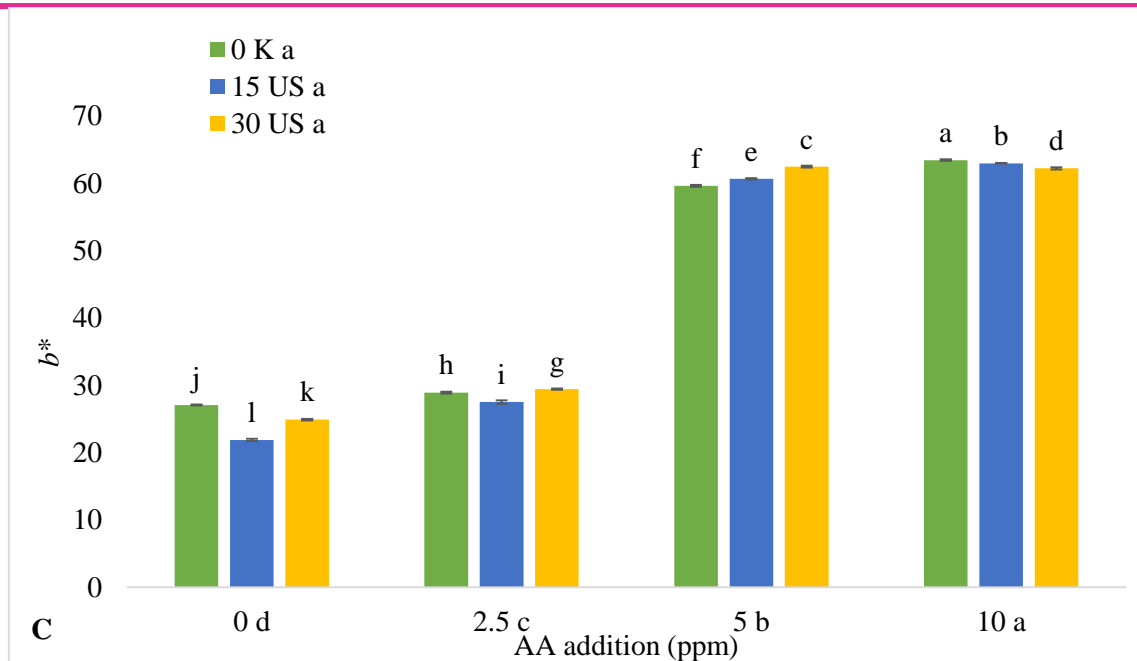


Figure 8. L^* (A), a^* (B) and b^* (C) values of ultrasonicated (US) and ascorbic acid (AA) added loquat nectars. The different letters are indicating that the mean values showed significant difference ($p < 0.05$).

Higher b^* values indicate the more yellow color in food. AA addition level significantly increased the b^* values. Similarly, decrease in a^* and increase in b^* value were observed in kasturi lime and orange juice after ultrasonication by Bhat et al. (2011) and Tiwari et al., (2008). The color of juices is mainly affected by the natural pigments in the fruit and some molecules responsible from browning. Change in color after ultrasonication in loquats can be attributed to the accelerated carotenoid isomerization during sonication treatments (Mason, 1991).

3.6. Antioxidant activity (%)

The results of antioxidant activity analyses were between 24.46% and 63.42%. As expected, the antioxidant activity of nectar increased with AA, an organic antioxidant matter, addition. The applied US treatments had no significant effect on the antioxidant activity of loquat nectar. In addition, antioxidant activity increased with US treatment in some samples like 10 ppm AA added nectars.

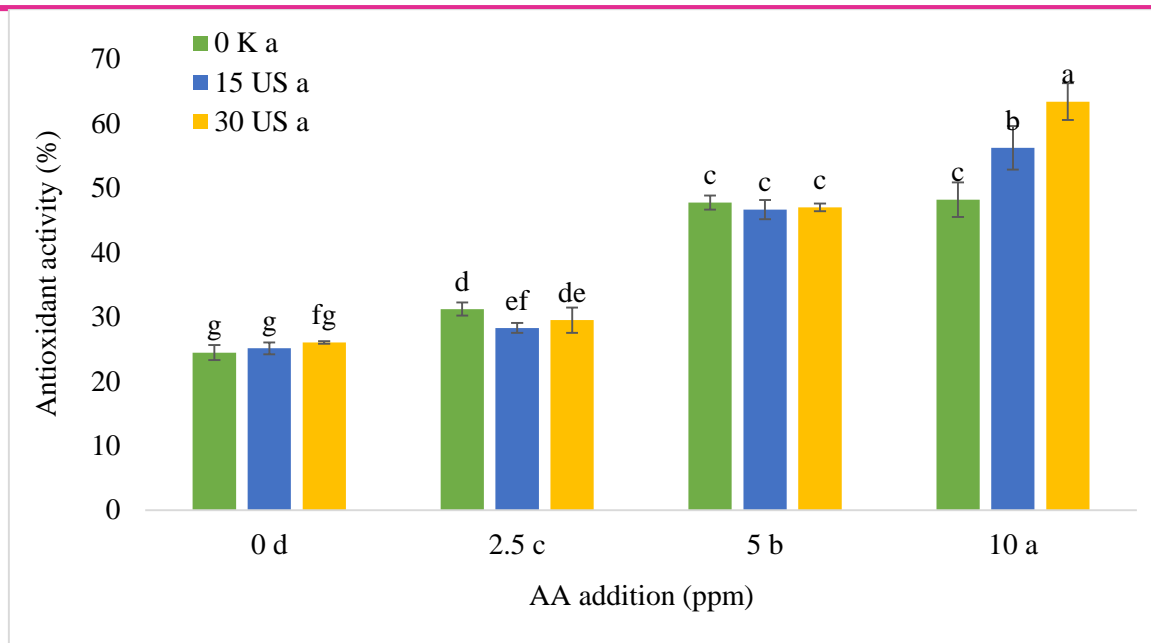


Figure 9. Antioxidant activity values of ultrasonicated (US) and ascorbic acid (AA) added loquat nectars. The different letters are indicating that the mean values showed significant difference ($p < 0.05$).

The ultrasonicated samples showed significant increase in the percent DPPH inhibition compared to control. Phenolic compounds are considered as important contributors of antioxidant activity in many fruit. As expected according to the obtained total phenolic content, which are increasing with ultrasound treatment, antioxidant activity was increased with ultrasonication. It was stated that ultrasonicated orange juice and kasturi lime juice also showed significant increase in the percent DPPH inhibition compared to control (Guerrouj et al., 2016 and Bhat et al., 2011).

4.CONCLUSION

The effects of ultrasound application (0, 15 and 30 min, 150 W, 25°C) and AA additions (0, 2.5, 5 and 10 ppm) on quality parameters such as pH, titration acidity, total soluble dry matter (%), ascorbic acid, total carotenoid content, total phenolic content, hydroxymethylfurfural content, antioxidant capacity and color values (L^* , a^* , b^*) were evaluated. pH value of loquat nectar (3.42-3.51) decreased with the addition of AA, while it increased with the increasing of US application time. The total soluble dry matter value (11.60%-12.57%) increased significantly with both the US application time and the addition of AA. US application was not found to have a significant effect on the antioxidant activity (%), ascorbic acid content, total phenolic content and color parameters of loquat nectar. It was determined that the L^* (25.5–37.9) and b^* (21.9–63.5) values increased with the increase in the amount of AA added to the nectars. Similarly, antioxidant activity (%), hydroxymethylfurfural (0.21–0.34 $\mu\text{g}/100\text{ mL}$), ascorbic acid (0.18–1.79 $\text{mg}/100\text{ mL}$), and total phenolic content (53.2–339.7 mg/L) also increased significantly with the increase of AA addition.

Ultrasound application had an improving effect on the quality of loquat nectar, especially in terms of the bioactive compound contents. This effect of ultrasound on loquat nectar can be explained by increasing the extractability of these substances. In addition, the positive effect of AA addition on the color and total phenolic content of loquat nectar may be related to its potential to inhibit browning reactions that occur as a result of enzymatic degradation of phenolic substances.



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Although US treatment increased the AA content in this study, prolonged processing at higher power levels may result with chemical decomposition of ascorbic acid, because of cavitation collapse at micro-scale (Tiwari et al., 2008). In addition, oxidation reactions, promoted by the interaction of free radicals formed during sonication and filled with water vapor and gases dissolved in the juice such as O₂ can end up with the ascorbic acid degradation (Korn et al., 2004; Rawson et al., 2011). Therefore, optimization of ultrasound treatment conditions according to quality properties of loquat juice with further studies will be useful. Moreover, the ascorbic acid addition above 10 ppm to loquat nectar and optimization this addition considering that high levels of ascorbic acid in the medium can cause browning reactions would be worthwhile.

With the use of loquats in the fruit juice industry, product diversity can be increased, while contributing to the country's economy, and ultrasound processing with low level of AA addition can be a suitable application to ensure higher quality in loquat nectar.



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KALİTE ÖZELLİKLERİ BAKIMINDAN EKMEKLİK BUĞDAY (*Triticum aestivum* L.) HATLARININ TESCİLLİ ÇEŞİTLER İLE KIYASLANMASI

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ÖZET

Buğdayın adaptasyon yeteneğinin yüksek olması, gerek ham gerekse işlenerek tüketilmesi nedeniyle önemi her geçen gün artmaktadır. Dünyada ve Türkiye’de buğday ekilişinin büyük bir bölümünü ekmeklik buğday (*Triticum aestivum* L.) oluşturmaktadır. Güneydoğu Anadolu Bölgesi Verimli Hilal Bölgesi içerisinde yer aldığından dolayı buğdayın önemli gen merkezlerinden biridir. Özellikle son on yılda küresel ısınma ve benzeri faktörler sebebiyle yağışların miktarında azalma ve üretim sezonu içerisindeki dağılımında düzensizlikler görülmektedir. Bu durum, kurak (arid) veya yarı kurak (semi arid) koşullarda verimini ve kalitesini koruyan genotipleri daha da önemli kılmıştır. Diyarbakır İlinde buğday üretim sezonu içerisinde 495 mm civarında yağış gerçekleşmektedir. Fakat, yağışın aylar bazında dağılımı düzensizdir. Tarım sistemi yönünden Diyarbakır İlinde daha çok kuru tarım sistemi uygulanmaktadır. Araştırma, 2012-2013 sezonu boyunca Diyarbakır İlinin yağışa dayalı koşullarında yürütülmüştür. Tesadüf Blokları Deneme Deseninde 3 tekerrürlü olarak kurulan denemede; 20 hat, 5 standart çeşit (Nurkent, Pehlivan, Cemre, Sagittario, Adana-99) ile kıyaslanmıştır. Denemede kullanılan hatların tamamı yazlık karakterli olup, incelenen tüm özelliklerde $p \leq 0.01$ seviyesinde genotiplerin benzer olmadığı belirlenmiştir. Tane verimi yönünden Cemre, Nurken ve G12 ön sırada yer almıştır. Yüksek tane verimi, ıslah programlarının ana hedeflerinden biridir. Fakat, buğdayda tane kalitesi buğdayın hangi ürüne işleneceğini belirlemede önemli bir rol oynamaktadır. İncelenen kalite özellikleri için G1, G2, G8, G19, G23, G24’ün yağışa dayalı koşullarda standart olarak yer alan tescilli çeşitlerden üstün olduğu görülmüştür. Kalite özellikleri yönüyle ümitvar olan hatların işaretlenerek genitör olarak gen havuzuna aktarılmasına karar verilmiştir. Ayrıca, denemenin farklı yıl ve lokasyonlarda tekrarlanmasının ıslah programı için isabetli karar olacağı sonucuna varılmıştır.

Anahtar Kelimeler: Ekmeklik buğday, kalite, genotip, ıslah programı



COMPARISON OF BREAD WHEAT (*Triticum aestivum* L.) LINES WITH REGISTERED VARIETIES IN TERMS OF QUALITY FEATURES

ABSTRACT

The importance of wheat is increasing day by day due to its high adaptation ability and its consumption both raw and processed. Bread wheat (*Triticum aestivum* L.) constitutes a large part of wheat cultivation in the world and Turkey. Since the Southeastern Anatolia Region is located in the Fertile Crescent Region, it is one of the important gene centers of wheat. Especially in the last decade, due to global warming and similar factors, a decrease in the amount of precipitation and irregularities in its distribution within the production season are observed. This situation made genotypes that preserve their yield and quality in arid or semi-arid conditions even more important. In the province of Diyarbakır, there is around 495 mm of precipitation during the wheat production season. However, the monthly distribution of precipitation is irregular. In terms of agriculture system, mostly dry farming system is applied in Diyarbakır Province. The research was carried out based on the rainfed conditions of Diyarbakır province during the 2012-2013 growing season. In the experiment conducted with 3 replications in the Randomized Blocks Experiment Designed; 20 lines were compared with 5 standard varieties (Nurkent, Pehlivan, Cemre, Sagittario, Adana-99). All of the lines used in the experiment are spring characters, and it was determined that the genotypes were not similar at the level of $p < 0.01$ in all the characteristics examined. Cemre, Nurken and G12 were in the forefront in terms of grain yield. High grain yield is one of the main targets of breeding programs. But, the grain quality of wheat plays an important role in determining which product the wheat will be processed into. G1, G2, G8, G19, G23, G24 were found to be superior to the registered varieties that took place as a standard under rainfall conditions for the quality characteristics examined. It was decided to mark the lines that are promising in terms of quality characteristics and transfer them to the gene pool as a genitor. In addition, it was concluded that repeating the trial in different years and locations would be the right decision for the breeding program.

Keywords: Bread wheat, Quality, Genotype, Breeding program



GİRİŞ

Tahıllar, insan beslenmesinde ana besin maddesi olmakla beraber endüstride ve besicilikte yoğun olarak kullanılmaktadır. Tahıllar içerisinde tarihi geçmişi bakımından ilk kültüre alınan buğday, dünya buğday ekilişi, üretimi, tüketimi ve aynı zamanda uyum yeteneği yüksek bir kültür bitkisidir. Buğdayın farklı çevre koşullarına uyum yeteneğinin yüksek olması tarımsal planlamalarda buğdaya özel bir konum sağlamıştır. Bu durum, her geçen gün artmaya devam eden gıda talebini tedarik etme bakımından tahılların ve özelden buğdayın önemini arttırmıştır (Doğan ve ark., 2014).

Ekmeklik buğdayda tane verimi ve kalitesinin seviyesi genotip ve ekolojik faktörlerin interaksyonuna bağlı olarak farklılık göstermektedir (Souza ve ark., 2004; Egesel ve ark., 2009). Ülkemiz, dünyada en fazla buğday tükemine sahip ülkelerden biri olmakla beraber buğday verilerine bakıldığı zaman 2018 yılı üretim sezonu verilerine göre 7.3 milyon hektar alanda ekiliş yapıldığı ve 20 milyon ton miktarında üretim gerçekleştirildiği bildirilmiştir (Anonim, 2019; Sönmez ve olgun, 2019).

Buğday türleri tüketim açısından değerlendirildiğinde dünyada tüketim amacıyla kullanılan buğdayın yaklaşık %95'inin ekmeklik buğday olduğu vurgulanırken geriye kalan kısmın durum ve spelta buğdayından oluştuğu bildirilmiştir. (Kılıç ve ark., 2014; Oral ve ark., 2018).

Yağışa dayalı koşullarda yapılan buğday yetiştiriciliğinde iklim faktörüne bağlı olarak bazı yıllarda yeterli seviyede yağış oluşmamaktadır. Bu durum, genotiplerin tane verimi ve kalite kapasitesini optimum düzeyde ortaya koyamaması ile sonuçlanmaktadır. Ayrıca, böylesi durumlarda su verme imkanı da yoksa tane kalitesi olumsuz etkilenmekte özellikle un randımanı üzerinde etkili olan kalite parametrelerinden bin tane ağırlığının değeri düşeceğinden dolayı birim tane miktarının un verimi düşmektedir (Aktaş, 2014; Karaman, 2019a).

Çalışmanın amacı, Diyarbakır İli koşullarına adaptasyonu iyi, tane verimi, kalitesi yüksek ve en az bir yönüyle tescilli kontrol çeşitlerinden farklı ve üstün ileri kademe hatları belirlemektir. Ayrıca, sonraki yıllarda bu ileri kademe hatları farklı lokasyonlarda da deneyerek çeşit adayları olabilecek yeni materyalleri belirlemektir.

MATERYAL ve YÖNTEM

Çalışma, 2012-2013 üretim sezonunda ve yağışa dayalı koşullarda Diyarbakır İli Merkez lokasyonunda yürütülmüştür. Tesadüf Blokları deneme deseninde 3 tekrarlamalı olarak yapılan çalışmada 20 ileri kademe hat, üretici koşullarında ekilen tescilli 5 kontrol (Nurkent, Pehlivan, Cemre, Sagittario ve Adana-99) çeşit ile karşılaştırılarak incelenen özellikler bakımından üstün olan hatlar belirlenmiştir (Tablo 1). Deneme ekimi 07 Ekim 2012 tarihinde, hasat işlemi ise 10 Haziran 2013 tarihinde gerçekleştirilmiştir. Besin elementi takviyesi olarak, saf madde üzerinden ekimle beraber 6 kg fosfor (P₂O₅) ve 6 kg azot (N) verilmiştir. Ayrıca, bitkilerin 3-4 kardeş olduğu dönemde üst gübre için 6 kg saf azot verilmiştir.

Çalışmanın yapıldığı sezonda uzun yıllar ortalamasının yaklaşık 185 mm üzerinde yağış gerçekleşmiştir (Şekil 1). Sıcaklık değerlerinin ise Nisan-Haziran arası dönem hariç genel olarak uzun yıllar ortalamasının üzerinde olduğu gözlemlenmiştir (Şekil 2). Yağışın uzun yıllar ortalamasına daha yüksek olması olumlu karşılanırken, sıcaklığın daha yüksek olması fenolojik dönemleri kısaltacağı ve bitkinin fizyolojik olumunu erken tamamlamasına yol açacağından dolayı olumsuz bir çevre faktörü olarak değerlendirilmiştir.



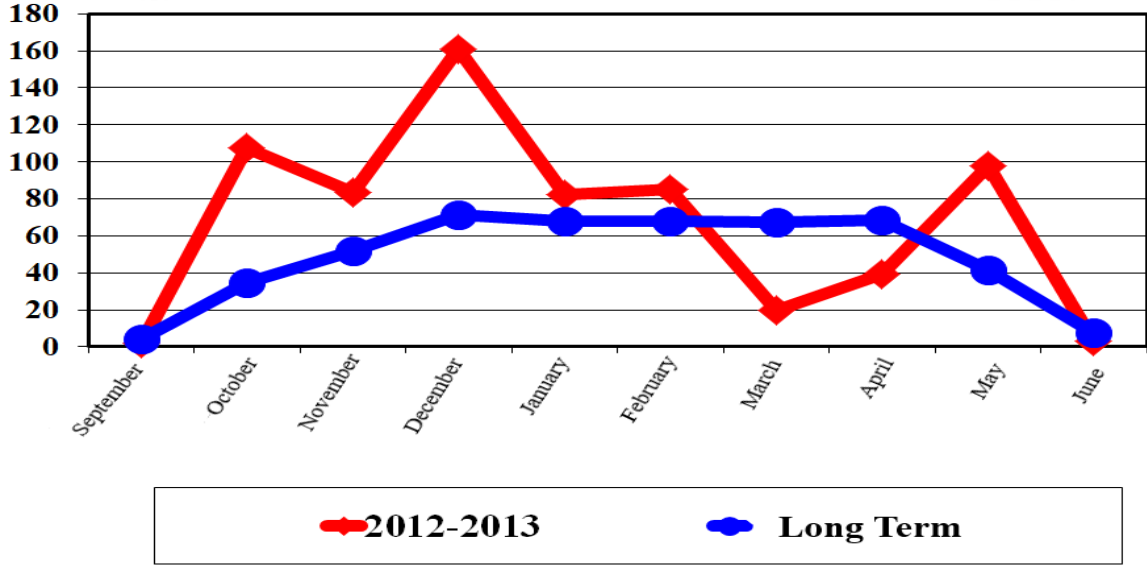
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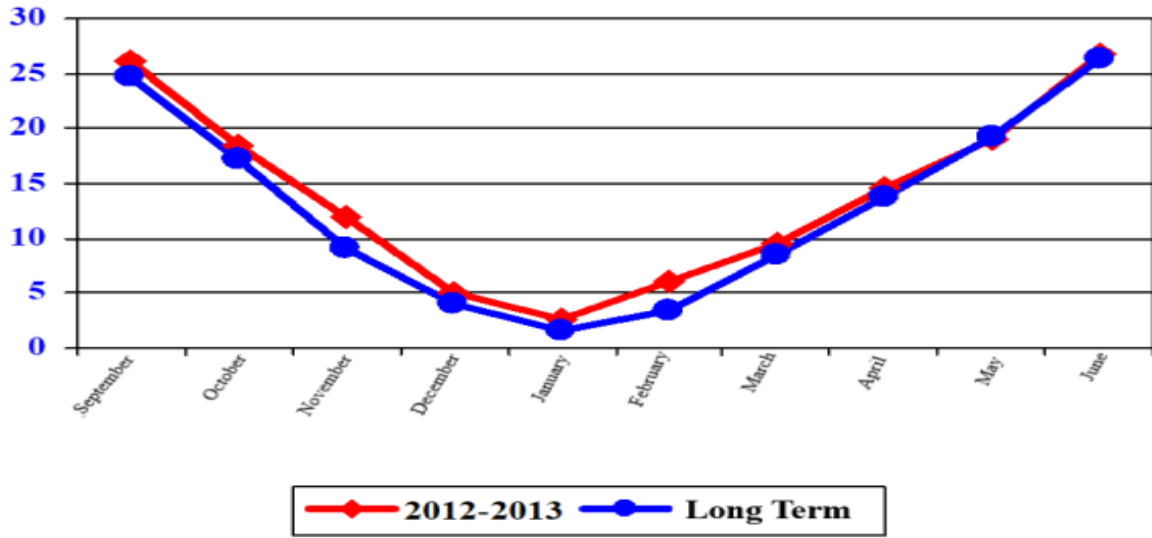
Tablo 1. Araştırmada kullanılan ekmeklik buğday materyaline ait bilgiler

Genotip	Pedigri	Orijin
G1	CAL/NH//H567.71/3/SERI4/CAL/NH//H567.71/5/2*KAUZ/6/PASTOR/7/KAUZ/PASTOR//PBW343	CIMMYT
G2	ATTILA/3*BCN//BAV92/3/TILHI/5/BAV92/3/PRL/SARA//TSI/VEE#5/4/CROC	CIMMYT
G3	FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/PARUS/6/FRET	CIMMYT
G4	FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/PARUS/6/FRET	CIMMYT
Nurkent	Kontrol	GAP UTAEM
G6	PBW343*2/KUKUNA//PARUS/3/PBW343*2/KUKUNA	CIMMYT
G7	PBW343*2/KUKUNA//SRTU/3/PBW343*2/KHVAKI	CIMMYT
G8	BAV92//IRENA/KAUZ/3/HUITES/4/DOLL	CIMMYT
G9	PBW343*2/KUKUNA//PARUS/3/PBW343*2/KUKUNA	CIMMYT
Pehlivan	Kontrol	TTAEM
G11	ACHTAR/4/MILAN/KAUZ//PRINIA/3/BAV92	CIMMYT
G12	GK ARON/AG SECO 7846//2180/4/2*MILAN/KAUZ//PRINIA/3/BAV92	CIMMYT
G13	SW89-5124*2/FASAN/3/ALTAR 84/AE.SQ//2*OPATA	CIMMYT
G14	ATTILA/BAV92//PASTOR/3/ATTILA*2/PBW65	CIMMYT
Cemre	Kontrol	GAP UTAEM
G16	CUNNINGHAM/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ	CIMMYT
G17	GOUBARA-1/2*SOKOLL	CIMMYT
G18	BOW/VEE/5/ND/VG9144//KAL/BB/3/YACO/4/CHIL/6/CASKOR/3/CROC	CIMMYT
G19	BOW/VEE/5/ND/VG9144//KAL/BB/3/YACO/4/CHIL/6/CASKOR	CIMMYT
Sagittario	Kontrol	TASACO
G21	PASTOR*2/BAV92/5/FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ	CIMMYT
G22	PBW343 CM85836-4Y-0M-0Y-8M-0Y-0IND	CIMMYT
G23	PRL/2*PASTOR CGSS97Y00034M-099TOPB-027Y-099M-099Y-099M-27Y-0B	CIMMYT
G24	WHEAR/KRONSTAD F2004 CGSS04Y00106S-099Y-099M-099Y-099M-13WGY-0B	CIMMYT
G25	Kontrol	DATAEM

CIMMYT: Uluslararası buğday ve mısır geliştirme merkezi, GAP UTAEM: GAP Uluslararası Tarımsal Araştırma ve Eğitim Merkezi Müdürlüğü, TTAEM: Trakya Tarımsal Araştırma Enstitüsü Müdürlüğü, DATAEM: Doğu Akdeniz Tarımsal Araştırma Enstitüsü Müdürlüğü, TASACO: Tasaco Tarım Sanayi ve Tic. A.Ş.



Şekil 1. Diyarbakır İlinin aylar bazında 2012-2013 sezonu ve uzun yıllar ortalama yağış grafiği



Şekil 2. Diyarbakır İlinin aylar bazında 2012-2013 sezonu ve uzun yıllar ortalama sıcaklık grafiği

Araştırmanın yapıldığı sezona ait deneme alanı toprak özellikleri incelendiğinde organik madde içeriği yönünden fakir olduğu belirlenmiştir (Tablo 2).



Tablo 2. 2012-2013 yılı deneme alanının toprak özellikleri

Bünye Sınıfı	Toplam Tuz (%)	PH (sç)	Kireç CaCO ₃ (%)	Fosfor P ₂ O ₅ (kg/da)	Organik Madde (%)	Su ile Doygunluk (%)
Killi	0.246	7.75	6.26	1.28	0.676	77

BULGULAR ve TARTIŞMA

Araştırmada incelenen tüm özellikler yönünden genotipler arasında $p \leq 0.01$ seviyesinde önemli farklılıklar olduğu görülmüştür. Ayrıca, incelenen özellikler bakımından genotipler arasındaki farklılıklar ve oluşan gruplar tablo halinde gösterilmiştir (Tablo 3).

Tablo 3. Çalışılan özelliklere ait veriler ve oluşan gruplar

Genotip	TV	HL	BTA	PR	ZS
G1	578.61 bcd	82.88 e-1	38.25 c-g	13.84 a	31.55 a
G2	640.00 a-d	84.27 ab	37.38 c-h	13.24 a-d	28.90 a-d
G3	608.33 a-d	82.38 f-1	39.75 b-f	12.36 f-1	22.30 hij
G4	634.00 a-d	81.98 ı	35.63 g-1	12.96 b-f	26.60 b-h
Nurkent	742.78 ab	82.60 e-1	38.50 c-g	12.41 f-1	24.15 e-j
G6	601.67 a-d	83.28 b-g	34.25 hı	13.46 ab	29.85 abc
G7	582.22 bcd	82.71 e-1	36.38 e-1	13.27 a-d	28.55 a-e
G8	659.72 a-d	84.23 abc	37.63 c-h	13.15 b-e	27.00 b-g
G9	520.39 d	82.89 e-1	33.25 ı	13.17 a-e	28.45 a-e
Pehlivan	683.33 a-d	83.00 d-1	42.38 ab	11.89 ı	19.70 j
G11	580.00 bcd	82.09 hı	36.25 e-1	12.98 b-f	28.10 a-f
G12	716.67 abc	82.82 e-1	37.75 c-h	13.01 b-f	25.55 c-1
G13	616.00 a-d	83.13 c-h	38.63 c-g	12.39 f-1	25.95 b-1
G14	681.94 a-d	84.02 a-d	37.63 c-h	12.49 e-1	25.10 d-1
Cemre	760.00 a	82.95 d-1	41.00 abc	13.50 ab	30.25 ab
G16	664.89 a-d	83.34 b-g	37.75 c-h	12.65 d-h	26.05 b-1
G17	633.89 a-d	83.44 a-f	40.13 bcd	13.40 abc	27.50 a-g
G18	608.17 a-d	83.65 a-e	36.13 f-1	12.87 b-g	24.90 d-1
G19	583.06 bcd	84.45 a	35.63 g-1	13.43 ab	28.55 a-e
Sagittario	651.94 a-d	82.71 e-1	39.88 b-e	13.27 a-d	29.15 a-d
G21	567.39 cd	82.79 e-1	37.25 d-h	12.18 hı	22.00 ij
G22	600.44 a-d	82.32 ghı	37.88 c-h	12.73 c-h	27.05 a-g
G23	649.50 a-d	82.96 d-1	44.50 a	11.87 ı	23.35 g-j
G24	651.44 a-d	83.14 c-h	42.88 ab	13.19 a-d	28.80 a-d
Adana-99	635.00 a-d	84.20 abc	37.38 c-h	12.25 ghı	23.85 f-j
Maksimum değer	760.00	84.45	44.50	13.84	31.55
Minimum Değer	520.390	81.980	33.250	11.870	19.700
Genel Ortalama	634.06	83.13	38.16	12.88	26.53
LSD (0.05)	172.78**	3.74**	1.11**	0.68**	4.52**
CV (%)	8.61	3.09	0.42	1.67	5.38



TANE VERİMİ, HEKTOLİTRE VE BİN TANE AĞIRLIĞI

Tüm tahıllarda olduğu gibi ekmeklik buğdayda da tane verimi birçok özelliğin etkisinde kalmaktadır. Genetik faktörler tane verimi üzerinde etkili olmakla beraber çevre faktörlerinin etkisi azımsanamaz. Farklı iklim koşullarında ve farklı araştırmacılar tarafından yapılan çalışmalarda tane veriminin çoklu gen kombinasyonlarının etkisi altında olan bir özellik olduğu vurgulanırken yıl, çevre, yağış miktarı gibi faktörlerin tane verimini belirlemede etkin rol aldığı bildirilmiştir (Mut ve ark., 2005; Kaydan ve Yağmur, 2008; Kılıç ve ark., 2018; Karaman, 2019b).

Araştırmada, tane verimi yönünden kontrol çeşitlerden üstün olan hat olmamakla beraber birçok hat en yüksek değere sahip kontrol çeşit ile aynı grupta yer almıştır (Tablo 3). Hektolitreye ağırlığı tanımlanırken birim hacimdeki buğday tanelerinin ağırlığı olarak ifade edilmektedir. Ayrıca, hektolitreye ağırlığı ile tane un verimi arasında önemli bir korelasyon olduğu ve bu durumdan dolayı hektolitreye özelliğinin ticari bir önem arz ettiği bildirilmiştir (Elgün ve ark., 2012; Sönmez ve olgun, 2019). Hektolitreye ağırlığında en yüksek değeri veren kontrol çeşitten (Adana-99; 84.20 kg hl⁻¹) daha üstün hatlar (G2; 84.27 ve G19; 84.45 kg hl⁻¹) olduğu belirlenmiştir (Tablo 3).

Tenolojik kalite parametrelerinden olan bin tane ağırlığı tane verimini etkileyen önemli özelliklerden biridir. Bin tane ağırlığının buğday tanesinin şekli (iriril, cılızlık, dolgunluk gibi) ile ilişkili olduğu vurgulanırken, bu özelliğin un randımanı konusunda da bilgi vermesi sebebiyle dikkate değer bir özellik olarak değerlendirilmiştir (Elgün ve ark., 2012; Sönmez ve olgun, 2019).

Bin tane ağırlığı yönünden 2 ileri kademe hattın (G23; 44.50 g ve G24; 42.88 g) en yüksek bin tane ağırlığını veren kontrol çeşit (Pehlivan; 42.38 g) ile aynı grupta yer aldığı belirlenmiştir (Tablo 3).

PROTEİN ORANI VE ZELENY SEDİMENTASYON MİKTARI

Ekmeklik buğdaydan elde edilen unun hangi ürüne işleneceğini belirlemede protein oranı dikkate alınmakta ve bu doğrultuda gıda sektöründe farklı ürünlerin elde edilmesi yoluna gidilmektedir. Bu nedenle, ekmeklik buğdayda protein oranı önemli kalite parametrelerinden biridir (Mut ve ark., 2007; Egesel ve ark., 2009). Araştırmada 10 ileri kademe hattın en yüksek protein değerine sahip kontrol çeşit (Cemre; %13.50) ile aynı grupta yer aldığı ve protein oranı bakımından ümitvar hatları temsil ettikleri belirlenmiştir. Özellikle G1(%13.84)'in protein oranı bakımından tüm genotipler içerisinde öne çıktığı görülmüştür (Tablo 3). Zeleny sedimentasyon miktarı protein kalitesini belirleyen bir özellik olduğundan dolayı ekmeklik buğdayda yüksek değerlerin elde edilmesi arzu edilen bir durumdur. Araştırmada, en iyi değeri veren Cemre (30.25 ml) kontrol çeşidi ile aynı grupta yer alan birçok hat görülmekle beraber özellikle G1'in tek başına 'a' grubunda yer alarak daha yüksek zeleny sedimentasyon değerini göstermiştir. Diyarbakır İlinin yağışa dayalı koşullarında yapılan ekmeklik buğday çalışmasında zeleny sedimentasyon miktarının 35.0-49.4 ml arasında değişim gösterdiği bildirilmiştir (Karaman, 2020). Bu çalışmada, 19.70-31.55 ml arasında değerler elde edilmiştir (Tablo 3). Çalışmamız bu yönüyle benzer değildir. Bu durumun ekolojik faktörler ve kullanılan materyalin genetiksel farklılığından kaynaklandığı düşünülmektedir.

SONUÇLAR VE ÖNERİLER

Diyarbakır İli koşullarında adaptasyonu yüksek, tane verimi ve kalitesi iyi olan ileri kademe hatları belirlemek üzere buğday ıslah programı kapsamında yapılan çalışma sonucunda; tane



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verimi yönünden Cemre, Nurken ve G12 ön sırada yer almıştır. Yüksek tane verimi, ıslah programlarının ana hedeflerinden biridir. Fakat, buğdayda tane kalitesi buğdayın hangi ürüne işleneceğini belirlemede önemli bir rol oynamaktadır. Bu kapsamda araştırılan kalite özellikleri için G1, G2, G8, G19, G23, G24'ün yağışa dayalı koşullarda standart olarak yer alan tescilli çeşitlerden üstün olduğu ve ümitvar hatları temsil ettikleri düşünülmektedir. Kalite özellikleri bakımından öne çıkan ileri kademe bu hatların işaretlenerek genitör olarak gen havuzuna aktarılmasına karar verilmiştir. Ayrıca, ıslah sürecinde bir yıllık sonuçlar üzerinden karar vermenin doğru olmayacağı ön görülerek denemenin farklı yıl ve lokasyonlarda tekrarlanmasının ıslah programında çeşit aday veya adaylarını belirlemek için isabetli karar olacağı sonucuna varılmıştır.



5. KAYNAKLAR

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**PATH AND CORRELATION ANALYSES BETWEEN PLANT NUTRIENT CONTENT AND
SOME MORPHOLOGICAL FEATURES OF HYACINTH (*HYACINTHUS ORIENTALIS* L.)
CULTIVARS**

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ABSTRACT

In this study, the effects of nutrient contents of four different varieties (Blue Jacket, Carnegie, Jan Boss, City of Haarlem) of hyacinths (*Hyacinthus orientalis* L.), which is a bulbous-tuberous ornamental plant grown in the field conditions, on the morphological features were investigated. The nutrition content are nitrogen, phosphorus, potassium, calcium, magnesium, iron, manganese, copper and zinc. The morphological features are the first flowering time and the full flowering time. Investigation was performed by means of correlation and path analysis. As a result of the study, it was found that some nutrients accelerate flowering, while others do not.

Keywords: First flowering time, *Hyacinthus orientalis* L., macro-micro elements, multivariate analysis



INTRODUCTION

Geophytes, which are considered as ornamental plants, are used in landscaping, balconies, indoor and outdoor plants and cut flowers. Hyacinth is also one of the bulbous plants and is a geophyte belonging to the Liliaceae family. Nutrition is very important in plants. Plant nutrients can act by interacting with each other as well as acting on the growth and development of the plant alone. Nutritional elements are an important factor in ornamental plants as well as in other plants. Lack or excess is a factor in development as well as flower yield and quality. It is obvious that in the case of bulbous tuberous ornamental plants, bulbs do not need much fertilization, but it is obvious that a reasonable amount of feeding also increases flower quality and yield. It is necessary to know the nutrient content in the plant in order to create a plant nutrition program. Path analysis was invented by Sewall Wright over 50 years ago. Path analysis is one of the multivariate statistical methods and is an extension of the regression model. In this method, not only the direct effect of independent variables on the dependent variable, but also the indirect effects of all independent variables on the dependent variable can be analyzed. The purpose of path analysis is to estimate the amount and importance of relationships between variables. The total effect is the sum of the direct and indirect effects (Everitt and Dunn, 1991). The method of path coefficients has long been a simple, highly productive method for analysis of genetic and environmental variables in formally closed breeding-population systems (Li, 1975). In this study, micro and macro nutrient elements as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn) were used to calculate direct and indirect effects to the first and full flowering time.

MATERIAL and METHODS

Material

The hyacinth bulbs (*H. orientalis* “Jan Bos”, “Blue Jacket”, “Carnegie”, “City of Haarlem”) used in this study were planted in November, morphological observations were made during the vegetation period (Çiğ, 2005), and then the nutrient element (N, P, K, Ca, Mg, Mn, Cu, Zn and Fe) contents were determined. The plant analyses were done according to Kacar and Inal (2008).

Method

In the path analysis, indirect effect of independent variables plays an important role on the dependent variable (Ulukan et al., 2003). Indirect effect of X_i (IE_{YX_i}) on Y can be calculated by the following equation:

$$IE_{YX_i} = r_{X_i X_k} P_{YX_k}$$

where $r_{X_i X_k}$ is correlation coefficient between X and X_i variables, P_{YX_k} is path coefficient of X_i variable (Keskin et al., 2005). R statistical package was used for analysis (R Core team, 2020).

RESULTS and DISCUSSION

Descriptive statistics concerning all parameters were given in Table 1.



Table 1. Descriptive Statistics of All Nutrient Elements and First and Full Flowering Time

Parameter	N	Mean	Std. Deviation	Minimum	Maximum
Full Flowering Time (day) (FullFT)	48	159.670	4.57	153	169
First Flowering Time (day) (FFT)	48	157.770	4.63	149	168
N (%)	48	3.927	0.436	3.000	4.790
P (mg kg ⁻¹)	48	0.415	0.099	0.270	0.680
K (mg kg ⁻¹)	48	3.771	0.269	3.290	4.320
Fe (mg kg ⁻¹)	48	534.9	112.4	378.7	936.6
Mg (mg kg ⁻¹)	48	1.664	0.216	1.030	2.440
Cu (mg kg ⁻¹)	48	12.545	2.906	6.120	21.650
Zn (mg kg ⁻¹)	48	35.036	6.366	17.870	49.330
Mn (mg kg ⁻¹)	48	31.559	6.321	20.310	49.110
Ca (mg kg ⁻¹)	48	5.407	1.160	3.000	9.070

Correlation coefficients between all parameters were given in Table 2.

Table 2. Correlation Matrix Between Parameters

Parameters	N	P	K	Fe	Mg	Cu	Zn	Mn	Ca	FFT
P	0.378**									
K	0.233	-0.202								
Fe	-0.159	0.292*	-0.367*							
Mg	0.174	-0.011	0.069	0.078						
Cu	-0.024	0.021	-0.169	-0.025	-0.044					
Zn	-0.139	0.391**	-0.137	0.152	-0.031	0.173				
Mn	0.131	0.114	0.027	0.332*	0.094	0.097	-0.034			
Ca	0.109	-0.237	-0.361*	-0.351*	0.417**	-0.246	-0.415**	0.004		
FFT	-0.410**	-0.633**	0.074	-0.005	0.001	-0.101	-0.010	-0.117	-0.018	
FullFT	-0.399**	-0.608**	0.077	-0.031	-0.034	-0.045	0.002	-0.119	-0.047	0.985**

*:p<0.05; **:p<0.01(FFT-First Flowering Time, FullFT-Full Flowering Time)

Results of the path analysis for the factors affecting FFT were illustrated in Table 3.

Table 3. Direct and Indirect Effects of Investigated Traits to The First Flowering Time (FFT)

Parameters	N	P	K	Fe	Mg	Cu	Zn	Mn	Ca
N	-0.067	-0.284	0.010	-0.026	0.006	0.003	-0.033	-0.008	-0.010
P	-0.025	-0.753**	-0.008	0.048	-0.000	-0.003	0.093	-0.007	0.022
K	-0.016	0.152	0.041	-0.060	0.002	0.022	-0.033	-0.002	-0.034
Fe	0.0105	-0.220	-0.015	0.165	0.003	0.003	0.036	-0.020	0.033
Mg	-0.012	0.008	0.003	0.013	0.035	0.006	-0.007	-0.006	-0.039
Cu	0.002	-0.016	-0.007	-0.004	-0.002	-0.133	0.041	-0.006	0.023
Zn	0.009	-0.294	-0.006	0.025	-0.001	-0.023	0.238	0.002	0.039
Mn	-0.009	-0.086	0.001	0.055	0.003	-0.013	-0.008	-0.061	-0.000
Ca	-0.007	0.178	0.015	-0.058	0.015	0.033	-0.099	-0.000	-0.095



**: $p < 0.01$; $R^2 = 0.526$

According to the regression analysis results the prediction model can be written as follows:
 $FFT = 168 - 0.71N - 35.1P + 0.71K + 0.00678Fe + 0.75Mg - 0.213Cu + 0.173Zn - 0.0444Mn - 0.379Ca$
 Results of the path analysis for the factors affecting FullFT were illustrated in Table 4.

Table 4. Direct and Indirect Effects of Investigated Traits to The Full Flowering Time (FullFT)

Parameters	N	P	K	Fe	Mg	Cu	Zn	Mn	Ca
N	-0.077	-0.269	0.013	-0.020	0.003	0.002	-0.031	-0.008	-0.013
P	-0.029	-0.711**	-0.012	0.037	-0.000	-0.002	0.087	-0.007	0.027
K	-0.018	0.144	0.057	-0.047	0.001	0.013	-0.030	-0.002	-0.042
Fe	0.012	-0.208	-0.021	0.127	0.001	0.002	0.034	-0.019	0.041
Mg	-0.013	0.008	0.004	0.010	0.014	0.004	-0.007	-0.005	-0.048
Cu	0.002	-0.015	-0.010	-0.003	-0.001	-0.079	0.038	-0.006	0.029
Zn	0.011	-0.278	-0.008	0.019	-0.000	-0.014	0.222	0.002	0.048
Mn	-0.010	-0.081	0.002	0.042	0.001	-0.008	-0.007	-0.058	-0.000
Ca	-0.008	0.168	0.021	-0.045	0.006	0.020	-0.092	-0.000	-0.116

**: $p < 0.01$; $R^2 = 0.48$

According to the regression analysis results the prediction model can be written as follows:
 $FullFT = 169 - 0.80N - 32.6P + 0.97K + 0.00517Fe + 0.30Mg - 0.125Cu + 0.159Zn - 0.0416Mn - 0.457Ca$
 Direct effects of N, K, Fe, Mg, Cu, Zn, Mn and Ca were found non-significant. The correlation coefficients between N, P and FFT, FullFT were negative and significant ($p < 0.01$). This means that as the amount of nitrogen and phosphorus in the plant nutrient content increases, the first and full flowering period is shortened. However, the correlation coefficient of N with FFT and FullFT was found negative and statistically significant ($p < 0.01$), the direct effect of N on the FFT and FullFT was found negative and non-significant. Despite the small correlation coefficients between Fe and Zn and FFT, FullFT, the direct effects of Fe and Zn on first and full flowering time were higher and negative than other nutrient contents. There are not many articles investigating the effects of plant nutrient content on the first flowering or full flowering times (Cho et al., 2017). Rossiter, in his 1978 study, reported that flowering in *Trifolium subterraneum* was delayed due to phosphorus deficiency. Another study performed in Alpine *Gnaphalium supinum* shown that phosphorus has a positive effect on flowering, while the amount of nitrogen does not affect it at all (Petraglia et al., 2014). Kant et al., 2011, reported that low phosphorus dose delayed flowering in *Arabidopsis*, but high doses did not affect it either.

CONCLUSIONS

As a result, we can say that the first flowering date and the full flowering date of hyacinths are strongly affected by the phosphorus content of the plant. Increasing the phosphorus content of the plant accelerates flowering. Although there is a correlation between nitrogen and flowering date, it does not directly affect the first and full flowering date. No statistically significant results were found between the other nutrient content and the first and full flowering dates.



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**RESPONSIBILITIES OF WATER MANAGEMENT IN HOTEL INDUSTRIES WITH
REFERENCE TO KERALA, INDIA.**

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ABSTRACT

“Water, water everywhere but not a drop to drink.....indeed”, water is a prime natural resource and a basic element for sustaining life on the earth. According to United Nations World Water Development Report (UNWWDR), Water, a shared responsibility, currently 1.1 million people lack access to safe drinking water and 2.6 million are deprived of basic sanitation. Clear water has almost become a scarce commodity and the most precious natural resource. It is a universal asset. Water management in India is a great challenge to maintain the gap between demand and supply and this paper is focused to the needs and significance of water resource management in the hotel industries. In recent years there has been increasing realization of the importance of water in the continuing well- being and development of mankind. More and more planners and decision- makers have started to realize the critical importance of efficient water resources management for the sustainable development. To achieve sustainability in future, it is necessary to manage water resources efficiently by the hotel industries or tourism sector. This research paper also provides findings and suggestions taken for the better utilization of water resources in this sector through the strategies like reducing, recycling, and reusing.

Keywords: Water Management, sustainability, hotel industry, water conservation, rain water harvesting



INTRODUCTION

Water resources are sources of water that are potentially useful. Uses of water include agricultural, industrial, household, recreational and environmental activities. All living things require water to grow and reproduce. 97% of the water on the Earth is salt water and only three percent is fresh water; slightly over two thirds of this is frozen in glaciers and polar ice caps. The remaining unfrozen fresh water is found mainly as groundwater, with only a small fraction present above ground or in the air.

Water management is the management of water resources under set policies and regulations. Once water is an abundant natural resource, is becoming a more valuable commodity due to droughts and overuse. All human management of water has some effect upon its quantity or quality or both, and the record of the decade maybe assessed in terms of those changes and how people sought to turn them to human benefit or to minimize the harm they might do to the environment.

Hotel companies have both a strong commercial moral imperative for addressing water use. Most of the hotels pay for the water resource consumption is twice –first by purchasing fresh water and then by disposing of it as waste water. Hotels and resorts can innovate and enhance their water management efficiency under 4Rs; Reducing, Reusing, Reaching and Recycling. Water management efficiency in hotels and resorts can be achieved through adopting water saving measures in different aspects of operation, including general operation, maintenance, and hospitality service, kitchen operation, dining area operation, swimming pool, water features and landscape management. Water conservation plan on efficient management of rainwater and its shortage, allocation and transfer of stored water for use, measures to keep water clean and free from pollution, distribution and consumption with minimum losses and efficient use through adoption of water saving technologies in domestic, agricultural and industrial use. Most of the initiatives like watershed management, rain water and ground water harvesting, judicious use of water in households, agriculture and industries and appropriate recycling techniques due to one or the other reasons did not provide much relief to water crisis. The water use efficiency needs to be stepped up. ‘Give and take’ is the general rule of life. The same rule applies to water.

Integrated Water Resources Management

The term ‘Integrated Water Resources Development and Management’ as, ‘A process which promotes the coordinated development and the management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems’. It is a holistic approach that seeks to integrate the management of the physical environment within that of the broader socioeconomic and political framework. The river basin approach seeks to focus on implementing IWRM principles on the basis of better coordination amongst operating and water management entities within a river basin, with a focus on allocating and delivering reliable water-dependent services in an equitable manner.

Integrated water resources management (IWRM) has been defined by the Global Water Partnership (GWP) as ‘a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems’. The development of IWRM was particularly recommended in the final statement of the ministers at the International Conference on Water and the Environment in 1992 (so called the Dublin principles). This concept aims to promote changes in practices which are considered fundamental to improved water resource



management. IWRM practices depend on context; at the operational level, the challenge is to translate the agreed principles into concrete action. Operationally, IWRM approaches involve applying knowledge from various disciplines as well as the insights from diverse stakeholders to devise and implement efficient, equitable and sustainable solutions to water and development problems. As such, IWRM is a comprehensive, participatory planning and implementation tool for managing and developing water resources in a way that balances social and economic needs, and that ensures the protection of ecosystems for future generations. Water's many different uses, for agriculture, for healthy ecosystems, for people and livelihoods- demands coordinated action. An IWRM approach is consequently cross-sect-oral, aiming to be an open, flexible process, and bringing all stakeholders to the table to set policy and make sound, balanced decisions in response to specific water challenges faced.

The concept of Integrated Water Resources Management (IWRM) emerged around the 1980s in response to increasing pressures on water resources from competition amongst various users for a limited resource, the recognition of ecosystem requirements, pollution and the risk of declining water availability due to climate change. IWRM addresses the "three E's": Economic efficiency, Environmental sustainability and social Equity, including poverty reduction. The three basic "pillars" of IWRM are the enabling environment of appropriate policies and laws, the institutional roles and framework, and the management instruments for these institutions to apply on a daily basis. IWRM addresses both the management of water as a resource, and the framework for provision of water services to all categories of users, and it addresses both water quantity and quality. The basin/sub basin must be recognized as the basic unit for planning and management, and a firm societal commitment and proper public participation must be pursued. India has not yet reached the level of Water Resources Development as has already been achieved by many developed countries; therefore, there is a need for India to undertake developmental measures along with management measures.

A central goal of IWRM at the river basin level is to achieve water security for all purposes, as well as manage risks while responding to, and mitigating disasters. The path towards water security requires trade-offs to maintain a proper balance between meeting various sectors' needs, and establishing adaptable governance mechanisms to cope with evolving environmental, economical and social circumstances. Well-developed, well- tested, scientifically robust, socially acceptable and economically viable approaches to implement IWRM at the river basin level are still not widely available. IWRM strives for effective and reliable delivery of water services by coordinating and balancing the various water-using sectors – this is an important part of sustainable water management.

Water Conservation

Water conservation includes all the policies, strategies and activities made to sustainably manage the natural resource of fresh water, to protect the hydrosphere, and to meet the current and future human demand. Population, household size, and growth and affluence all affect how much water is used. Factors such as climate change have increased pressures on natural water resources especially in manufacturing and agricultural irrigation. Many US cities have already implemented policies aimed at water conservation, with much success.

The goals of water conservation efforts include:

- Ensuring availability of water for future generations where the withdrawal of freshwater from an ecosystem does not exceed its natural replacement rate.
- Energy conservation as water pumping, delivery and wastewater treatment facilities consume a significant amount of energy. In some regions of the world over 15% of total electricity consumption is devoted to water management.



- Habitat conservation where minimizing human water use helps to preserve freshwater habitats for local wildlife and migrating waterfowl, but also water quality.

The key activities that benefit water conservation (save water) are as follows:

1. Any beneficial reduction in water loss, use and waste of resources.
2. Avoiding any damage to water quality.
3. Improving water management practices that reduce the use or enhance the beneficial use of water.

One strategy in water conservation is rain water harvesting. Digging ponds, lakes, canals, expanding the water reservoir, and installing rain water catching ducts and filtration systems on homes are different methods of harvesting rain water. Harvested and filtered rain water could be used for toilets, home gardening, lawn irrigation, and small scale agriculture. Another strategy in water conservation is protecting groundwater resources. When precipitation occurs, some infiltrates the soil and goes underground. Water in this saturation zone is called groundwater. Contamination of groundwater causes the groundwater water supply to not be able to be used as resource of fresh drinking water and the natural regeneration of contaminated groundwater can takes years to replenish. Some examples of potential sources of groundwater contamination include storage tanks, septic systems, uncontrolled hazardous waste, landfills, atmospheric contaminants, chemicals, and road salts. Contamination of groundwater decreases the replenishment of available freshwater so taking preventative measures by protecting groundwater resources form contamination is an important aspect of water conservation.

Rainwater harvesting

Rainwater harvesting is the accumulation and deposition of rainwater for reuse on-site, rather than allowing it to run off. Rainwater can be collected from rivers or roofs, and in many places, the water collected is redirected to a deep pit (well, shaft, or borehole), a reservoir with percolation, or collected from dew or fog with nets or other tools. Its uses include water for gardens, livestock, irrigation, domestic use with proper treatment, indoor heating for houses, etc. The harvested water can also be used as drinking water, longer-term storage, and for other purposes such as groundwater recharge. Rainwater harvesting is one of the simplest and oldest methods of self-supply of water for households usually financed by the user.

Rainwater harvesting provides an independent water supply during regional water restrictions, and in developed countries, is often used to supplement the main supply. It provides water when a drought occurs, can help mitigate flooding of low-lying areas, and reduces demand on wells which may enable groundwater levels to be sustained. It also helps in the availability of potable water, as rainwater is substantially free of salinity and other salts. Application of rainwater harvesting in urban water system provides a substantial benefit for both water supply and wastewater subsystems by reducing the need for clean water in water distribution system, less generated storm water in sewer system, and a reduction in storm water runoff polluting freshwater bodies.

A large body of work has focused on the development of life cycle assessment and life cycle costing methodologies to assess the level of environmental impacts and money that can be saved by implementing rainwater harvesting systems.

Waste Water Treatment

Wastewater is any water that has been used and is no longer pure. It includes:

1. Grey water – water that has been used in cooking, bathing, laundry
2. Sewage from toilets - containing human waste
3. Irrigation water - containing fertilizers and pesticides



4. Water from swimming pools and hot tubs - often containing harsh chemicals like chlorine and bromine
5. Industrial water from factories, businesses, etc.
6. Water from the environment - surface water, storm water, and groundwater.

Basic Wastewater Treatment:

- Preliminary treatment removes trash and coarse sand and grit. This is commonly accomplished with bar screens and grit chambers. Grease traps are also part of re-treatment. Kitchen outflow pipes, for example, must have grease traps.
- Primary treatment removes most of the settleable solids, and floating material, including much of the oil and grease. This results in a “sludge” that must be disposed of periodically. Typically, primary treatment removes 50% of the suspended solids and about 30% of the biodegradable components.
- Secondary treatment removes most of the remaining solids and further breaks down the biodegradable components. Primary and secondary treatments are often combined in a single septic tank with two chambers. Within a septic tank, grease floats to the top, solids settle to the bottom, and anaerobic bacteria slowly process the biodegradable components. Water from the first tank flows to the second tank for further processes.

Outflow from the second tank is finally sent out of the septic tank to a leaching field (also called drain field or seepage field), where it is further filtered naturally and taken up by plants. If the system is working well, this outflow should be quite clean, and can be captured and re-used for irrigation – though the water should be tested to be sure it is indeed clean enough for this purpose.

Key Considerations for Wastewater Treatment:

- Most coastal hotels will need to install their own septic systems. Once installed, septic systems should not be forgotten or assumed to run trouble-free. They need regular inspection and maintenance to work properly. Otherwise, treated water emerging from the septic system can become progressively more contaminated as the system becomes clogged with grease and sludge and its cleaning efficiency declines. Septic tanks must be cleaned of sludge periodically (leaving 10% of the sludge to re-populate the bacterial population), and the preliminary treatment components, particularly grease traps, must also be cleaned.
- Grease traps must be cleaned once per week, particularly in kitchens. Otherwise, the grease will ultimately clog the pipes of the septic system. The common practice of dissolving grease with sulfuric acid is not recommended. The grease merely re-hardens downstream (often in the outflow pipe to the leaching field), and the acid kills helpful bacteria. Instead, manually scoop out small grease traps, hire professionals to clean large grease traps, and use bio augmentation – additional of helpful bacteria that can break down grease.
- Sludge from the septic system or treatment plant must be disposed of carefully; it can be environmentally hazardous. In some cases, properly treated sludge can be used on the grounds as fertilizer.
- Properly treated wastewater can then be re-used for irrigation, but it must be monitored to be sure it truly is clean and will not spread disease.
- Laundry grey water should not be sent through the wastewater treatment process. Hot laundry water restricts growth of helpful bacteria, the surges of large volume can overload the system, and grey water does not require full treatment in any case (since it usually contains only soap and dirt). Laundry water is best sent to a laundry water re-use system, or can be sent to a soakage pit.
- Harsh chemicals like bleaches and chemical



cleaners can make wastewater unsuitable for any environmental use. The best course of action is to limit the use of these chemicals in the first place. In most cases, other cleaners can be used.

- Proper training is critical for employees who perform system maintenance (e.g., grease trap cleaning) or treatment plant operation. Wastewater treatment should not be viewed as a menial or unimportant job; it is a complex process with great importance for the environment and the community.

OBJECTIVES

- To study the present water resource management efficiency among the selected hotels.
- To study the existing water conservation mechanisms adopted by the hotels.

SIGNIFICANCE OF STUDY

India has abundant water resources, but the water problem is very serious issue in many states. In the year 2016, water problem/ scarcity was noticed in about 10 states in India. About 32 cores of the population do not have access to drinking water. Water problem in India is a man made problem and not the fault of nature. Why because, India gets an annual rainfall of 1150 mm as compared to the world average of 840 mm. Hotels and resorts were one of the major sectors which highly in need of water. So their small mismanagement in water may create a great impact in our water resources. Hence, this study is mainly focus on the efficiency in water management and the role of Government to ensure that our water resources are legitimately used or not in the hotel industries.

On a long- term basis, the quantity of water that is available to a country is limited. Also, nearly all the economically exploitable sources of water have now already been developed, or are in the process of development. This means it would be increasingly difficult to find new sources of water which could be developed economically and in an environmentally- safe manner in the future. Water management will be an increasingly complex task and sensitive political issue in the twenty- first century.

STATEMENT OF THE PROBLEM

Water management is an emerging environmental problem in the World. Wasting water or inefficiently using water is one of the fastest growing water waste flows worldwide. Water is an essential element to the hotel industry. Today mostly in hotels and resorts water is using in large amount – for food preparation, cleaning and hygiene. The management of water is not merely a technical issue; it requires a mix of measures including changes in policies, prices and other incentives, as well as infrastructure and physical installations. Integrated Water Resources Management (IWRM) focuses on the necessary integration of water management across sectors, policies and institutions. Long term measures are required for the development of water assets. Hence for the conservation of water, efficient water management in hotel industry is very important. So the area of study is focusing on the water management efficiency in hotels and resorts.

HYPOTHESIS

- ❖ There is no significant relationship among the opinion on water conservation method rain water harvesting practices by five and four star hotels.
- ❖ There is no significant relationship among the opinion on water conservation method sewage water treatment practices by five and four star hotels.



RESEARCH METHODOLOGY

Research is a continuous and dynamic process. It is the systematic collection, analysis and interpretation of data to answer a certain questions or to solve a problem. A carefully designed questionnaire is used to collect information from the chosen respondents. The questions are included to know about the respondent's opinion about the present water management efficiency in the hotels and to know what are the measures adopted by the hotels for conserving water resources. Research design is descriptive in nature as it involves studying the water management efficiency among the hotels in Thiruvananthapuram.

Sampling Techniques

The research was carried out in the Thiruvananthapuram. The respondents were the top, middle and junior level management. Total 100 respondents are selected for collecting data from ten hotels. The present study adopts case study method. Thus the appropriate sampling technique chosen for the study is quota sampling. The sampling units are hotels belonging to two categories- five star hotels and four star hotels. Since the sampling technique is quota sampling, the researcher did turn the whole sampling units into two quotas corresponding to the two types of hotels under consideration. Considering the total number of five star hotels and four star hotels within Trivandrum district, it was decided by the researcher that the study can be carried out effectively if the both the quotas filled with five units each. Thus the ten units of hotels were selected for the case study.

Statistical Tools Used for Analysis: The collected data were classified and further analysis was done with the help of statistical tools like tables, pie charts, bar charts, percentage analysis, cross tabulation, chi square, correlation, SPSS etc.

INFERENCE ANALYSIS

The purpose of research is the discovery of general principles based upon the observed relationship between variables (Best & Kahn, 2009). To achieve this purpose, statistical analysis is done.

Hypotheses Test 1

In tune with the objectives, the study proposed to test the following hypotheses.

- ❖ **There is no significant relationship among the opinion on water conservation method rain water harvesting practices by five and four star hotels.**

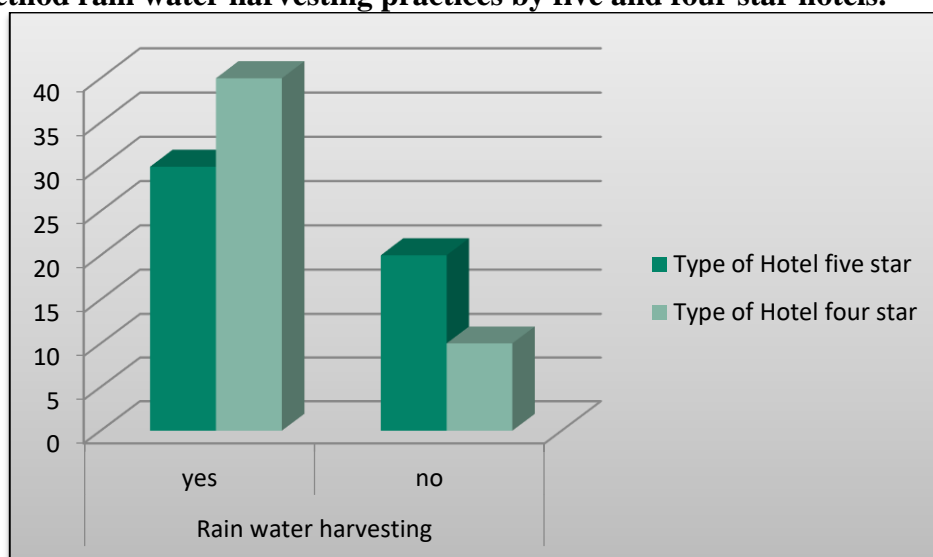


Figure:1 Primary Source



Inference: Figure present the water conservation method, rain water harvesting adopted in the hotels or not. From the 100 respondents, 70% opinion is YES and remaining 30% is NO.

Hypotheses Test 2

- ❖ **There is no significant relationship among the opinion on water conservation method sewage water treatment practices by five and four star hotels.**

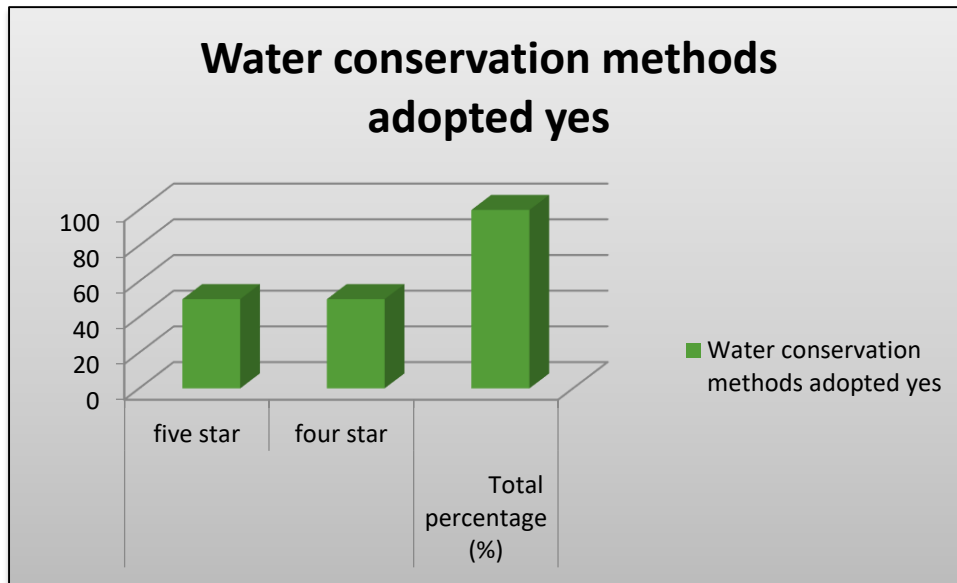


Figure:2 Primary Source.

Inference: In the figure it present, all the selected hotels for the study using any water conservation methods or not. 100% of respondents are u comes under the opinion YES. Water consumption of hotel industry is too high, so adopting water conservation methods is very signifying one. Some of the water conservation methods used by the hotels are rain water harvesting, tanks for water saving, sewage water treatment, filtering, recycling, etc. Here all the ten hotels using water conservation mechanisms.

FINDINGS

- Municipal water is their major source of water supply and majority of them are using this water for drinking after filtration.
- Star hotels need above 15000 liter water for daily consumption. Their monthly expenditure is come between 50, 000 and 1, 50, 000 rupees.
- Per day hotels need 0 to 5000 liter of water for drinking purposes.
- All hotels have water conservation methods. 70% of the hotels adopted rain water harvesting, tanks, sewage water treatment etc.
- Every star hotel has minimum two swimming pools. Majority of the pools quantity of water filling is above 50000 liter of water.
- 60% of hotels changing the water in the swimming pools on monthly basis and 90% of them were reused.
- All hotels use native plants which is suited with our climate. The main purpose of the native plants is reducing the quantity of water for irrigation.



- From 0 to 5 times every hotel watered their gardens. That means, minimum one time every hotels watered their landscape.
- In hotel industry more water is consumed in the toilets. So every hotels use different types of mechanisms for reducing the water consumption in the toilets.
- All hotels promote the reuse of towels and bed linen.
- 80% of respondents' opinion is they were using techniques for controlling water flow in the kitchen.
- All the five and four star hotels giving training to the staffs in the kitchen to control water consumption.

SUGGESTIONS

- Increase awareness among the staffs and guests, about the importance of local fresh water resources and provide opportunities to use water wisely.
- Provide staff training, it is very necessary for conserving water. Every departmental staffs should need training for controlling the water consumption. Train staff so they understand how to make effective use of water.
- Promote guests to reuse their towels and linens; it will help to reduce the daily loads of laundry.
- Suggest guests to check their taps before retraining the bathrooms.
- Conduct regular inspections of taps, showers, toilet mechanisms, kitchens, over flow from tanks and other water storages.
- Create a separate department for water management in the hotels and establish realistic goals for each department.
- Install sub- meters in each guest bathrooms, so it will helps to measure specific users of water.
- At early morning and late night check the water meters, for avoiding leakages.
- All the hotels should measure consumption of water on a monthly basis.
- Reduce the width and depth of the swimming pools; it will help to reduce the quantity of water filling in the pools.
- Cover the swimming pools to avoid water evaporation, when it is not in use.
- Water in the swimming pools should be use for irrigation purposes. Because all the star hotels have large area for gardening and minimum three times a day they watered the gardens.
- For efficient water management in the hotels, install or adopt most modern technologies and fittings. That is, aerators, dual- flush, water-saving shower heads, push button taps, filtration techniques, recycling, sewage water treatment, etc.

CONCLUSION

Hotel industry is one of the fastest growing sectors of the economy of our time. Environmental management practices in hotels are usually geared towards energy conservation, water conservation, reduction of waste and establishing good relations with local communities. Environment management has become a critical issue to the hotel industry in recent times. The study on water management efficiency among hotels highlighted the importance of water management practices in hotel industries in the current scenario.

Hotel industry can minimize their impact on local water sources like municipal water by adopting effective rain water harvesting and recycling of sea water. Most of the hotels are situating near sea or lakes. Therefore, it is easy to adopt recycling technologies for the daily uses of water. Depending on the atmospheric quality of the location, rainwater is relatively clean and chemical free. This rain water can be collected and stored for dry seasons.



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ORGANOMİNERAL VE İNORGANİK GÜBRE UYGULAMALARININ MISIR BİTKİSİNDE VERİM VE MİNERAL MADDE ALIMINA ETKİSİ

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ÖZET

Bu çalışmada, farklı dozlarda organomineral ve inorganik gübre uygulamalarının sera koşullarında mısır bitkisinin verimi, bazı bitki parameteleri ile mineral madde alımı üzerine etkileri araştırılmıştır. Çalışma, saksı denemesi olarak tesadüf blokları deneme desenine 4 tekrarlamalı olarak yürütülmüştür. Sera koşullarında yürütülen çalışmada 5 kg'lık 32 plastik saksı kullanılmıştır. Her saksıda önce 4 adet mısır tohumu yetiştirilmiş daha sonra seyreltilerek 2 bitki bırakılmıştır. Araştırmada kontrol uygulaması hariç tüm saksılara 20 kg.da⁻¹ N ve 8 kg.da⁻¹ P₂O₅ uygulanmıştır. Mısır tohumları ekilmeden önce kontrol uygulaması hariç saksılara 8 kg P₂O₅ olacak şekilde organomineral ve inorganik gübreler ile taban gübrelemesi yapılmıştır. Araştırmada dekara toplam 20 kg N uygulanması planlandığından, taban gübre ile uygulanan azotun eksik kalan miktarı ekimden 4 hafta sonra üre (% 46 N) formunda üst gübreleme olarak uygulanmıştır. Çalışmada 8 farklı uygulama konusu; 1) Kontrol 0 kg.da⁻¹ gübresiz, 2) 72 kg.da⁻¹ 11-11-11-11 SO₃+18 OM +ME organomineral gübre, 3) 66 kg.da⁻¹ 12-12-12+20 SO₃+12 OM organomineral gübre, 4) 66 kg.da⁻¹ 12-12-12+12 SO₃+15 OM organomineral gübre, 5) 61 kg.da⁻¹ 13-13-13+13 SO₃+ 15 OM+ ME organomineral gübre, 6) 55 kg.da⁻¹ 15-15-15+ Zn inorganik kompoze gübre (çiftçi uygulaması) 7) 35 kg.da⁻¹ 13-24-12 14 SO₃+Fe+ Zn inorganik kompoze gübre (çiftçi uygulaması) 8) 20 kg.da⁻¹ DAP (18-46-0) inorganik kompoze (çiftçi uygulaması) şeklinde planlanmıştır. Çalışmada uygulamaların mısır taze ağırlığı yanı sıra bitki boyu, gövde çapı, kuru madde miktarı ve bazı mineral madde (N, P, K, Ca ve Mg) içerikleri üzerine etkisi belirlenmiştir. Tüm uygulamalar, mısır taze ağırlığı, bitki boyu, gövde çapı, kuru madde miktarı ve % N, P, K, Ca, Mg içeriklerini kontrole göre önemli derecede artırmıştır. En yüksek değerler dekara 66 kg organomineral gübre uygulamaları olan 3 nolu (12-12-12+20 SO₃+12 OM) ve 4 nolu (12-12-12+12 SO₃+15 OM) uygulama konularından elde edilmiştir.

Anahtar Kelimeler: Mısır, organomineral gübre, inorganik gübre, verim, mineral madde



THE EFFECT OF ORGANOMINERAL AND INORGANIC FERTILIZER APPLICATIONS ON YIELD AND MINERAL ELEMENT UPTAKE OF CORN PLANT

ABSTRACT

In this study, the effects of different doses of organomineral and inorganic fertilizer applications on the yield, some plant parameters and mineral element uptake of maize plant were investigated under greenhouse conditions. The research was carried out according to the random block design with four replications as a pot experiment. In the study carried out under greenhouse conditions, total of 32 plastic pots with 5 kg of air-dried soil were used and maize was grown. First, four maize seeds were grown in each pot, and then plants were diluted to 2. 20 kg.da⁻¹ N and 8 kg.da⁻¹ P₂O₅ were applied to all pots except for the control. Before planting maize seeds, base fertilization was made with organomineral and inorganic fertilizers as 8 kg.da⁻¹ P₂O₅, except for the control. Since it was planned to apply 20 kg.da⁻¹ N in the research, the missing amount of nitrogen was applied as top fertilization in the form of urea (46% N) 4 weeks after planting. In the experiment; 8 different treatments were applied; 1) Control 0 kg.da⁻¹ no fertilizer, 2) 72 kg.da⁻¹ 11-11-11-11 SO₃+18 OM +ME organomineral fertilizer, 3) 66 kg.da⁻¹ 12-12-12+20 SO₃+12 OM organomineral fertilizer , 4) 66 kg.da⁻¹ 12-12-12 + 12 SO₃ + 15 OM organomineral fertilizer, 5) 61 kg.da⁻¹ 13-13-13 + 13 SO₃ + 15 OM + ME organomineral fertilizer, 6) 55 kg.da⁻¹ 15-15 -15+ Zn inorganic compound fertilizer (farmer application) 7) 35 kg.da⁻¹ 13-24-12 14 SO₃ + Fe + Zn inorganic compound fertilizer (farmer application) 8) 20 kg.da⁻¹ DAP (18-46-0) inorganic compound (farmer application). The effects of the applications on the plant height, stem diameter, dry matter amount and some mineral elements (% N, P, K, Ca and Mg) contents as well as maize fresh weight were determined. All applications significantly increased maize fresh weight, plant height, stem diameter, dry matter content and the contents of N, P, K, Ca and Mg compared to the control. The highest values were obtained in the treatments numbered 3 (12-12-12+20 SO₃+12 OM) and numbered 4 (12-12-12+12 SO₃+15 OM) in which 66 kg of organomineral fertilizer was applied per decare.

Keywords: Mazie, organomineral fertilizer, inorganic fertilizer, yield, mineral elements



1. GİRİŞ

Dünya nüfusunun hızla artması gıda ve tarım ürünlerine olan ihtiyacı artırmıştır. Artan ihtiyacın karşılanabilmesi için tarımsal üretimin artırılması çabası içine girilmiştir. Bu nüfusun ihtiyacını karşılamakta temel üretim ortamı olarak kullandığımız tarım toprakları, amacı dışında kullanımlara açılmaları nedeniyle giderek daralmış, mevcut alanlar ise bilinçsizce yapılan tarımsal uygulamalar nedeniyle giderek verimsizleşmiştir. Tarımsal üretimde verimliliği artırmanın en hızlı ve etkili yolu kimyasal gübre uygulamaları olmuş ve bu uygulamalardan oldukça başarılı sonuçlar da alınmıştır. Fakat uzun süreli ve aşırı kimyasal gübre uygulamaları toprakların çeşitli özelliklerine olumsuz etki yapması, yer altı sularını kirletmesi vb. nedenlerle çeşitli sorunları da beraberinde getirmiştir (Liu ve ark., 2010; Shan ve ark., 2015).

Türkiye’de tarımsal üretimi kısıtlayan en önemli toprak faktörleri yüksek pH, kireç ve düşük organik madde içeriğidir. Bitki besleme ve toprak verimliliği açısından ideal toprak pH’sı 6.0-7.5 arasında, kireç içeriği %5’in altında, organik madde içeriği ise %3’ün üzerinde olmalıdır. Toprakların pH ve kireç içeriğinin yüksek, organik madde içeriğinin düşük olması topraklarda fosforun ve mikro besin elementlerinin (demir, çinko, bor vb) bitkiler tarafından alınamaz forma dönüşmesine, azotun ise gaz formuna dönüşerek uçmasına neden olmaktadır. Türkiye topraklarının %81’nin pH değeri 7.0’den fazla (Usta, 1995), Türkiye topraklarının %58.6’nın kireç içeriği %5’ten yüksektir (Eyüpoğlu, 1999), Türkiye topraklarının %65’nin organik madde içeriği %2’nin altında, %88’nin organik madde içeriği ise %3’ün altında olduğu rapor edilmiştir (Eyüpoğlu, 1999). Yine 2011-2014 yılları arasında 10 bin adet toprakta yapılan analizlerde topraklarımızın %99’nun organik madde içeriğinin %3’ten daha az olduğu bildirilmiştir (Güçdemir, 2006). İyi nitelikteki bir toprağın asgari %5 oranında organik madde içermesi gerektiği dikkate alındığında, ülke topraklarımızın organik maddece fakir olduğu açıkça görülmektedir.

Toprakların organik madde içeriğini artırabilmek için anız artıklarının toprağa karıştırılması, çeşitli organik materyallerin (leonardit, hayvan gübresi, kompost vb.) uygulanması, yeşil gübrelemenin yapılması ve organomineral gübre kullanımının yaygınlaştırılması gereklidir.

Topraktaki bitki besin maddesi miktarını artırmak, bitkilerin büyümesine ve yüksek verime ulaşmasına yardımcı olmak amacıyla yapılan tarımsal gübreleme işleminde genellikle bünyelerinde Azot (N), fosfor (P) ve potasyum (K) gibi besin elementleri barındıran organik ya da kimyasal gübre çeşitlerinden yararlanılmaktadır.

Tarımın vazgeçilmez unsurlarından olan gübreleme işlemi, çoğunlukla kimyasal gübreler kullanılarak yapılmaktadır. Kimyasal gübrelerin canlılara ve doğaya verdiği zarar göz önüne alındığında, geleneksel gübreleme alışkanlıklarının alternatif çözümlerle değiştirilmesi gerekliliği ortaya çıkmaktadır. Bu alternatiflerden biri olan organomineral gübre, organik materyal ve bitki besin elementlerinin karmasıdır.

Organomineral gübreler (OMG); kimyasal gübreler ile organik materyallerin (kompost veya leonardit) belli oranlarda tekniğine uygun olarak karışımı ile elde edilmektedir. Organomineral gübre üretiminde geniş bir yelpazeye yayılan farklı organik materyallerden (biokatılar, kanalizasyon atıkları, bitkisel atıklar, hayvan gübresi v.b) yararlanma olanaklarının da araştırıldığı gözlenmektedir. Organomineral gübreler, kimyasal gübrelerde bulunan bitki besin elementlerini ve organik maddeyi yapılarında beraberce bulundurmaktadır. Organomineral gübrelerde azot (N), fosfor (P), potasyum (K), kükürt (S), çinko (Zn) bitki besin elementleri ile humik-fülvik ve kompost kaynaklı organik madde bir arada bulunur ve taban gübresi olarak kullanılmaktadır. Organomineral gübrelerin içindeki organik maddeler ve onu oluşturan humik maddelerden humik ve fulvik asitlerin, toprak verimliliğinin sürdürülebilirliği üzerinde fiziksel, kimyasal ve biyolojik bakımdan çok önemli faydaları bulunmaktadır.



Organik materyallerin toprak verimliliği üzerine olan olumlu etkilerinden yararlanılarak “organik madde+mineral gübre” şeklinde üretilen organomineral gübreler, bir yandan yıkanma ile besin elementlerinin kaybını azaltırken diğer yandan toprağın verimlilik öğelerini düzelterek kullanılan minerallerin etkinliğini artırmaktadır.

Organomineral gübre uygulamalarının toprakların fiziksel, kimyasal ve mikrobiyolojik özelliklerine etkilerinin olumlu olduğu, organomineral gübrelerin toprak organik maddesi ve toprağın biyolojik dinamizmine önemli katkı sağladığı rapor edilmektedir. Dolayısıyla organik madde toprakların mineral tutma kapasitesini (katyon değişimini), su ve hava tutmasını, iz element seviyelerini artırır, pH seviyesini dengeler ve mikro-organizma dengesini düzenler. Organomineral gübrelerin içerdiği organik maddenin toprak bünyesini iyileştirici olumlu bu özellikleri dolayısıyla bitki yetiştiriciliğinde birim alandan alınan verimi de olumlu yönde etkilemektedir (Kacar ve Katkat 1999; Makinde ve ark., 2011; Olaniyi ve ark., 2010; Süzer ve Çulhacı, 2016)

Organik gübreler besin maddesi içeriği az olmasına rağmen toprağa organik madde kazandırmaları ve toprağın fiziksel özelliklerini iyileştirmeleri açısından önem taşırlar. Toprakta mikrobiyolojik faaliyeti hızlandırarak strüktür, havalanma ve su tutma kapasitesini yükseltir, makroelement takviyesi yapar ve toprak fosforunun yarayışlılığını artırır (Güneş ve ark., 2002). Kimyasal gübrelerle yapılacak gübrelemenin etkinlik derecesi, diğer faktörlerin yanında toprağın organik madde kapsamına bağlı bulunmaktadır. Bitkisel üretimde tam başarının sağlanabilmesi için belirli esaslara dayanılmak şartı ile organik ve inorganik gübrelemenin kombine edilmesi gerekmektedir (Özbek 1981).

Dünyanın farklı ülkelerinde (İngiltere, Almanya, Nijerya, Türkiye, İspanya, Brezilya, Polonya, İtalya vb.), farklı organomineral gübreler kullanılarak (farklı kompozisyon ve form), farklı konularda çok sayıda çalışma yürütüldüğü görülmüştür. Araştırmalarda geniş bir bitki deseni (silajlık mısır, buğday, kanola, çeltik ,marul, lahana, karpuz, kavun vb.) materyal olarak kullanılmıştır. Konu ile ilgili çalışmalarda yaygın görüş olarak, bitki besin elementi sağlama potansiyeli ve toprak özelliklerinin iyileştirilmesindeki etkisinden dolayı, kimyasal gübrelere en iyi alternatifin organomineral gübreler olduğu savunulmaktadır (Kominko ve ark., 2016). Aynı zamanda, ülkemizde organomineral gübrelerin etkinliği ve topraklardaki reaksiyonları konusunda detaylı çalışmalara ihtiyaç olduğunu vurgulamıştır (Erdal, 2018).

Gübre değeri veya toprak özelliklerini iyileştirici özellikleri bulunan organik atıklara mineral ilavesi ile oluşturulan organomineral gübreler, temel özellikleri açısından organik ve mineral gübrelerden farklı bir gübre sınıfı olarak kabul edilmektedir. Organomineral gübreler, bir ya da birden çok organik gübrenin bir veya birden fazla tekli, kompoze, ikincil veya mikro bitki besin maddeli kimyasal gübreler ile tepkimesi veya karışımı sonucu elde edilen katı ve sıvı ürünler olarak tanımlanmaktadır (Kacar 2010).

Organomineral gübre kullanılarak yapılan çalışmalarda araştırmacıların genelinde organomineral gübre kaynağı olarak ticari materyalleri kullandığı görülürken, bir kısmının organik gübreyle kombine mineral gübre uygulamaları yaptığı, bir kısmının ise kendisinin formüle ettiği organomineral gübreleri kullandığı gözlenmiştir.

Yapılan çalışmaların genelinde organomineral gübre uygulamalarının gerek toprak özellikleri, gerekse bitki gelişimi ve verimi ile mineral beslenmesine olumlu katkı yaptığı görülmüştür. Erdal (2018), organomineral gübrelerde bitki besin maddelerinin bir kısmının organik maddeye bağlanması nedeniyle besin maddesi kayıplarının ve topraklar tarafından alınmaz konuma dönüşme oranının azaldığını, böylece organik gübrelerin verim ve kaliteyi artırdığını rapor etmiştir. Aynı zamanda, ülkemizde organomineral gübrelerin etkinliği ve topraklardaki reaksiyonları konusunda detaylı çalışmalara ihtiyaç olduğunu vurgulamıştır.



Organomineral gübre kullanımı ülkemizde devlet desteğiyle yaygınlaştırmaya çalışılmaktadır (Tablo 1). Destekleme uygulamalarıyla organik gübre tüketimi 2019'da 220 bin ton iken; 2020 yılında yüzde 70 artışla 375 bin tona çıkmıştır. Türkiye'de şu an 300-350 bin ton organomineral gübre üretildiği tahmin edilmektedir.

Tablo 1. Organomineral gübre ve diğer gübre çeşitlerinin tüketim değerleri (ton)* (Tunç, 2017)

Yıllar	Organomineral Gübre	Özel Gübre	Toprak Düzenleyici	Diğer	Toplam
2006	953,59	1.964,13	7.114,82	0,61	10.032,54
2007	1.169,27	5.746,12	6.704,11	0,19	13.619,50
2008	433,31	5.636,62	7.352,22	0,68	13.422,15
2009	262,98	7.825,46	4.085,74	0,53	12.174,18
2010	249,97	6.843,68	4.570,99	0,54	11.664,64
2011	738,49	10.152,80	6.210,99	0,71	17.102,28
2012	1.436,75	13.659,32	7.071,87	0,89	22.167,94
2013	2.066,64	13.700,42	14.116,55	3,75	29.883,61
2014	126.741,08	48.485,35	63.006,57	6,47	208.233,00

Bu çalışmada, organomineral ve inorganik gübre uygulamalarının sera koşullarında mısır bitkisinin verimi (taze ağırlık), bazı bitki parameteleri (bitki boyu, gövde çapı, kuru madde miktarı) ile mineral madde (N, P, K, Ca ve Mg) alımı üzerine etkileri araştırılmıştır.

MATERYAL ve YÖNTEM

2.1 Materyal

2.1.1. Toprak

Araştırmada kullanılan toprak materyalini Ege Üniversitesi Ziraat Fakültesi Menemen Araştırma ve Uygulama Çiftliğinden usulüne uygun olarak alınan yüzey toprak örneği oluşturmaktadır (Jackson, 1962). Toprak örneği E.Ü. Ziraat Fakültesi Toprak Bölümü serasında hava kurusu hale gelinceye kadar kurutulmuş, 4 mm'lik elekten elenmiştir. İyice karıştırılan toprak örneğinden laboratuvar analizleri için 5 kg kadar ayrılmış, arta kalan toprak serada saksı denemesinde kullanılmıştır. Araştırma materyali toprak örneğinin fiziksel ve kimyasal analiz sonuçları Tablo 2'de verilmiştir. Tablo 2 incelendiğinde, araştırma materyali toprak örneğinin kumlu tın bünyeli ve hafif alkalin reaksiyona sahip olduğu, tuzluluk probleminin olmadığı belirlenmiştir. Kireçli ve organik maddece fakir olan toprakta, toplam azot (N), alınabilir fosfor (P) ve potasyum (K) orta, alınabilir kalsiyum (Ca), magnezyum (Mg), bakır (Cu) ve mangan (Mn) yeterli, alınabilir demir (Fe) ve çinko (Zn) içeriğinin ise yetersiz düzeyde olduğu saptanmıştır (Yağmur, 1997).



Tablo2. Denemelerinin yürütüldüğü saksılarda kullanılan toprak örneğinin fiziksel ve kimyasal özellikleri

Fiziksel ve Kimyasal Özellikler	Birim	Sonuç	Yorum	
pH		7.52	Hafif Alkalin	
Toplam Tuz	%	0.036	Tuzluluk Yönünden Sorun Yok	
Kireç (CaCO ₃)	%	8.02	Kireçli	
Kum	%	68.20		
Mil	%	15.40		
Kil	%	16.40		
Bünye		Kumlu Tın		
Organik Madde	%	1.72	Fakir	
Toplam-N	%	0.071	Orta	
Alınabilir	P	mg/kg	8.35	Orta
	K	mg/kg	178	Orta
	Ca	mg/kg	3480	Yeterli
	Mg	mg/kg	172	Yeterli
	Na	mg/kg	40	Sorunsuz
	Fe	mg/kg	3.60	Yetersiz
	Cu	mg/kg	1.12	Yeterli
	Zn	mg/kg	0,75	Yetersiz
Mn	mg/kg	16.52	Yeterli	

2.1.2. ORGANOMİNERAL VE MİNERAL GÜBRELER

Araştırmada dört farklı gübre üretici firma tarafından ticari olarak üretilen ve satılan organomineral ve mineral gübreler kullanılmıştır (Tablo 3). Bu çalışmada kullanılan organomineral gübreler 24.03.2014 tarihli Resmi Gazete’de “Tarımda Kullanılan Organik, Organomineral Gübreler ve Toprak Düzenleyiciler ile Mikrobiyal, Enzim İçerikli ve Organik Kaynaklı Diğer Ürünlerin Üretimi, İthalatı, İhracatı ve Piyasaya Arzına Dair Yönetmelik” kapsamında üretilmiştir (Resmi Gazete, 2014). Tarımda Kullanılan Organik, Mineral ve Mikrobiyal Kaynaklı Gübrelere Dair Yönetmelikte (Resmi Gazete, Tarih; 23.02.2018, Sayı; 30341) organomineral gübrelere geniş şekilde yer verilmiş olup, yönetmeliğin amacının; “toprakların fiziksel, kimyasal ve biyolojik yapısının iyileştirilmesi, bitkisel üretimde verimliliğin artırılması, insan sağlığının korunması ve çevre kirliliğinin önlenmesi amacıyla, organik, mineral ve mikrobiyal kaynaklı gübrelerin kullanımını yaygınlaştırmak, tanımlamak, bunlara ait analiz metotlarını belirlemek ve bu ürünlerin ithali, ihracı, üretimi, piyasaya arzı ile kayıt altına alınmasına ilişkin usul ve esasları belirlemek” olduğu vurgulanmıştır. Aynı yönetmelikte organomineral gübre; “organik muhtevanın ve/veya organik gübre(ler)nin bir veya birden fazla birincil, ikincil veya mikro bitki besin maddeleri ile karışımı veya reaksiyonu ile elde edilmiş ürünler” olarak tanımlanmıştır. İlgili yönetmeliği ekler kısmında N, NP, NK, NKP ve mikro elementli katı ve sıvı gübrelere bahsedilmektedir. Organomineral gübrelere organik madde içeriği tekli besin elementli (makro besin elementi) gübrelere en az % 20, birden fazla besin maddesi (makro besin elementi) içeren gübrelere en az %15 olması zorunludur (T.C. Resmi Gazete, 2018).

Tablo 3. Araştırmada kullanılan organomineral ve mineral (inorganik gübreler)

Organomineral Gübreler	Mineral(İnorganik) Gübreler
11-11-11+11 SO ₃ +18 OM +ME+10*	13-24-12+14 SO ₃ +Fe+ Zn
12-12-12+20 SO ₃ +12 OM+8*	15-15-15+ Zn
12-12-12+12 SO ₃ +15 OM	DAP (18-46-0)
13-13-13+13 SO ₃ + 15 OM+ ME+5*	--

*:Toplam Humik ve Fulvik Asit



2.1.3. BİTKİ

Bitki Materyali Araştırmanın bitki materyalini serada saksı denemesi şeklinde yürütülen mısır bitkisi oluşturmaktadır. Araştırmada kullanılan mısır bitkisi (*Zea mays* L.) KWS Kayras hibrit mısır çeşididir. Bu çeşit Menemen ovasında en fazla kullanılan, yüksek verim potansiyeline sahip, yatmaya karşı dayanıklı, adaptasyon yeteneği yüksek, kısa süreli stres şartlarına toleranslı ve görülen sap hastalıklarına karşı dayanıklı bir çeşittir.

2.2. MATERYAL

2.2.1. SERA DENEMESİ

Deneme 5 kg toprak alan plastik saksılarda tesadüf blokları deneme desenine 4 tekrarlamalı 8 uygulama olarak toplam 32 adet saksıda yürütülmüştür (Tablo 4). Her saksıya önce 4 adet mısır tohumu ekilmiş, daha sonra seyreltme yapılarak her saksıda 2 bitki bırakılmıştır. Araştırmada kontrol uygulaması hariç tüm saksılara 20 kg.da⁻¹ N ve 8 kg.da⁻¹ P₂O₅ olacak şekilde N ve P uygulanmıştır. Bu amaçla mısır tohumları ekilmeden önce kontrol uygulaması hariç saksılara 8 kg P₂O₅ olacak şekilde organomineral ve inorganik gübreler ile taban gübrelemesi yapılmıştır. Araştırmada dekara toplam 20 kg N uygulanması planlandığından, taban gübre ile uygulanan azotun eksik kalan miktarı ekimden 4 hafta sonra üre (% 46 N) formunda üst gübreleme olarak uygulanmıştır. Saksılara başlangıçta su tutma kapasitesinin % 60'ı olarak her gün tartılmak suretiyle sulama yapılmış, vejetasyon aşamasında bu miktar su tutma kapasitesinin %80'ine ulaşmıştır. Araştırma sonucunda organomineral ve inorganik gübre uygulamalarının yapıldığı deneme konularında yetiştirilen mısır bitkisinin verimi belirlenmiş (taze ağırlık), bazı bitki parameteleri ölçümleri (bitki boyu, gövde çapı, kuru madde miktarı) ile mineral madde (N, P, K, Ca ve Mg) analizleri yapılmıştır.

Tablo 4. Araştırmanın yürütüldüğü uygulama konuları

Gübre	Uygulama No	Doz (kg.da ⁻¹)	Uygulama
Gübresiz	1	0	Kontrol 0 kg/da gübresiz
Organomineral	2	72	11-11-11-11 SO ₃ +18 OM +ME
	3	66	12-12-12+20 SO ₃ +12 OM
	4	66	12-12-12+12 SO ₃ +15
	5	61	13-13-13+13 SO ₃ + 15 OM+ ME
İnorganik	6	55	15-15-15+ Zn (çiftçi uygulaması)
	7	35	13-24-12 14 SO ₃ +Fe+ Zn (çiftçi uygulaması)
	8	20	DAP (18-46-0) (çiftçi uygulaması)

2.2.2. BİTKİ VERİMLİLİK PARAMETRELERİ

Saksı denemelerinde yetiştirilen mısır bitkisinde hasat sırasında ve sonrasında taze ağırlık (saksı verimi), kuru madde, bitki boyu ve gövde çapı analiz ve ölçümleri yapılmıştır. Hasat sırasında hasat edilen bitkilerin yaş ağırlığı tartılarak taze ağırlık (g), bitki boyu metre ile gövde çapı ise kumpasla ölçülerek bulunmuştur. Hasat sırasında taze ağırlık ölçümleri yapılan bitkiler 105°C sabit ağırlığa ulaşmaya kadar kurutma dolabında kurutulmuş daha sonra tartımları yapılarak uygulamalara ait bitki kuru madde miktarları belirlenmiştir (Anonim, 2018).

2.2.3. BİTKİ ÖRNEKLERİNİN KİMYASAL ANALİZ YÖNTEMLERİ

Sera denemesinde her bir saksıdan alınan bitki yaprak örnekleri önce çeşme suyu ve saf su ile yıkanmış, kurutma kâğıdı ile kurutulduktan sonra kese kağıtlarına konularak 65-70°C sabit ağırlığa ulaşmaya kadar 48 saat kurutulmuştur. Daha sonra kuru ağırlıkları belirlenen yaprak



örnekleri mikro değirmende öğütülerek analize hazır hale getirilmiştir. Kurutulup öğütülerek analize hazırlanan biber yaprak örneklerinde toplam azot makro Kjeldahl yöntemiyle; toplam P, K, Ca, Mg analizleri için yaş yakma (4 kısım HNO_3 + 1 kısım HClO_4) yöntemi uygulanarak elde edilen ekstraktlarda; toplam P vanadomolibdo fosforik sarı renk yöntemi ile kolorimetrik olarak; toplam K, Ca alev fotometresi ile toplam Mg ise atomik absorpsiyon spektrofotometrede okunarak belirlendi (Kacar, 1972; Kacar, ve İnal 2008).

2.3. İSTATİKSEL ANALİZ YÖNTEMİ

Araştırmada elde edilen verilerin istatistiksel olarak değerlendirilmesi JUMP istatistik paket programı yardımıyla tesadüf blokları deneme desenine göre varyans analizi yapılmış, varyans analiz sonuçlarına göre ortalamalar arasındaki farklılıklar LSD testi uygulanarak gruplandırılmıştır (Kalaycı, 2005).









3.BULGULAR ve TARTIŞMA

3.1. ORGANOMİNERAL VE İNORGANİK GÜBRE UYGULAMALARININ MISIR BİTKİSİNİN VERİM PARAMERELERİ ÜZERİNE ETKİSİ

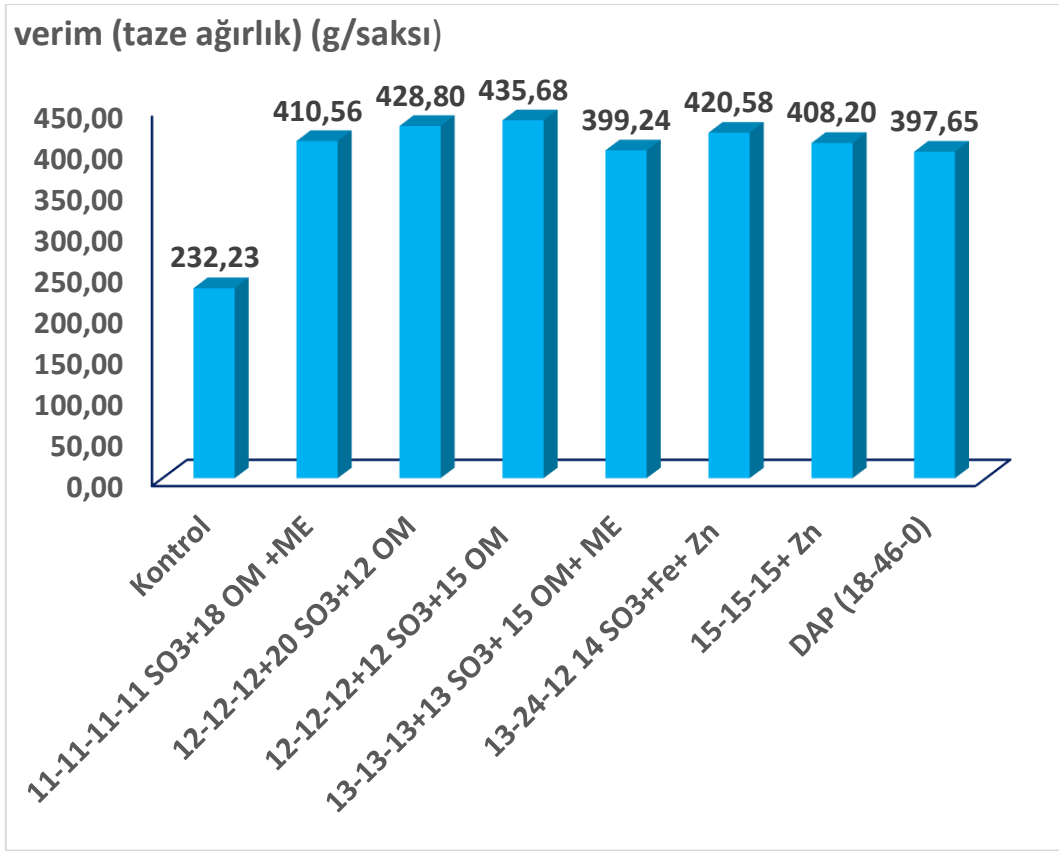
Serada saksı denemesi şeklinde yürütülen, organomineral ve mineral gübre uygulamalarının mısır bitkisi verim parametrelerine (saksı verimi (taze ağırlık), bitki boyu, kuru madde ve gövde çapı) ait sonuçlar ve istatistiki değerlendirmesi Tablo 5'de verilmiştir.

Tablo 5. Organomineral ve mineral gübre uygulamalarının mısır bitkisi saksı verimi (taze ağırlık) bitki boyu kuru madde ve gövde çapı üzerine etkisi

Uygulamalar	Taze ağırlık (g.saksı ⁻¹)	Bitki Boyu (cm)	Kuru Madde (%)	Gövde Çapı (cm)
Kontrol	232,23 d	104 c	18,94 d	2,47 d
11-11-11-11 SO ₃ +18 OM +ME	410,56 b	116 b	30,16 c	3,02 bc
12-12-12+20 SO ₃ +12 OM	428,80 a	121 a	33,08 a	3,22 a
12-12-12+12 SO ₃ +15 OM	435,68 a	123 a	32,47 b	3,22 a
13-13-13+13 SO ₃ + 15 OM+ ME	399,24 c	115 b	30,50 c	3,15 b
13-24-12 14 SO ₃ +Fe+ Zn	420,58 ab	117 b	32,36 b	3,15 b
15-15-15+ Zn	408,20 b	116 b	30,16 c	2,90 c
DAP (18-46-0)	397,65 c	115 b	31,14 bc	2,94 c
Maksimum	435,68	123,00	33,08	3,22
Minimum	232,23	104,00	18,94	2,47
Ortalama	391,62	115,88	29,85	3,01
Önem düzeyi	**	*	**	*

SAKSI VERİMİ (TAZE AĞIRLIK)

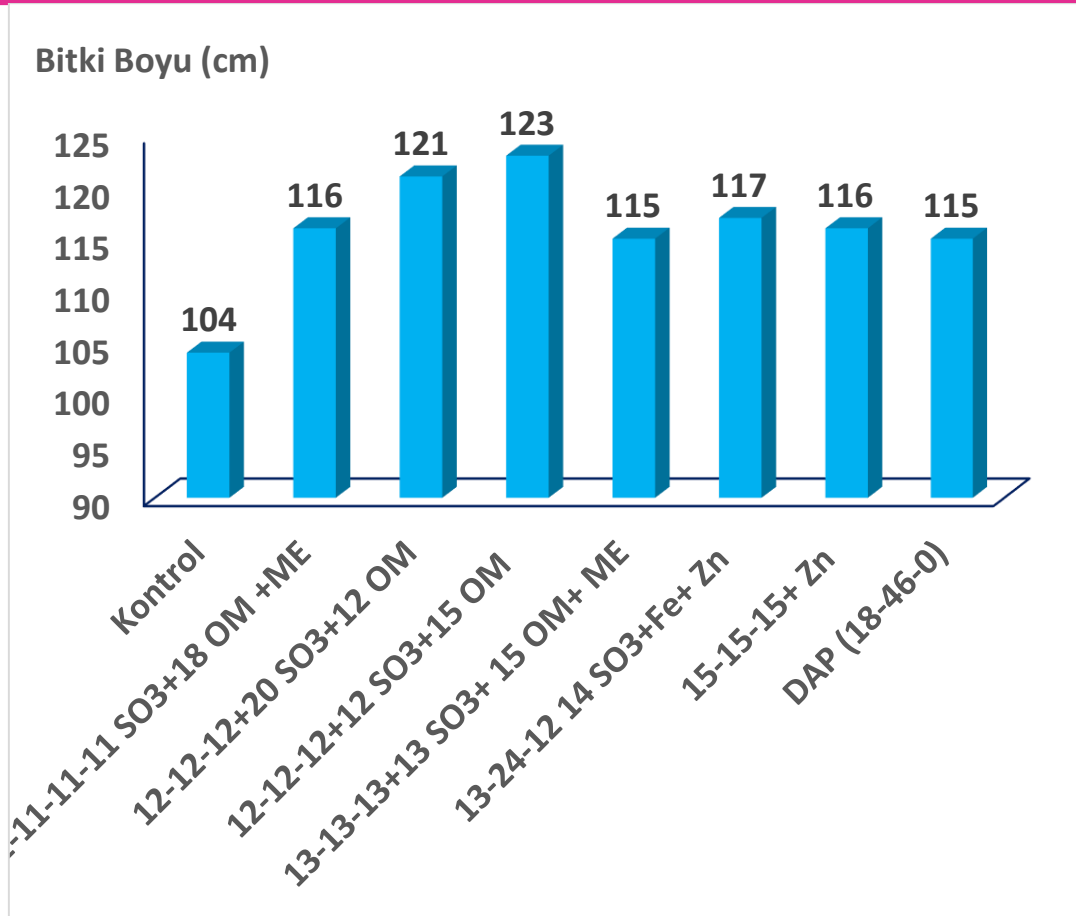
Tablo 5 incelendiğinde organomineral ve mineral gübre uygulamalarının mısır bitkisi saksı verimi üzerine istatistiksel olarak önemli ($p<0.1$) etkili olduğu bulunmuş, yapılan istatistiki değerlendirmede 12-12-12+12 SO₃+15 OM ve 12-12-12+20 SO₃+12 OM organomineral gübre uygulamaları aynı grupta yer almıştır (Tablo 5). Tüm uygulamalarda saksı verimi (taze ağırlık) değerleri kontrole göre artış göstermiş, en yüksek saksı verimi (taze ağırlık) 12-12-12+12 SO₃+15 OM organomineral uygulamasında (435.68 g.saksı⁻¹), en düşük saksı verimi (taze ağırlık) kontrol (232.23 g.saksı⁻¹) uygulamasında elde edilmiş, ortalama saksı verimi (taze ağırlık) 361.92 g.saksı⁻¹ olarak bulunmuştur. En yüksek saksı veriminin elde edildiği 12-12-12+12 SO₃+15 OM organomineral gübre uygulamasını, 12-12-12+20 SO₃+12 OM (428.80 g.saksı⁻¹) organomineral gübre uygulaması ve 13-24-12 14 SO₃+Fe+ Zn mineral gübre uygulaması (420.58 g.saksı⁻¹) izlemiştir; 11-11-11-11 SO₃+18 OM +ME; 15-15-15+ Zn; 13-13-13+13 SO₃+ 15 OM+ ME; DAP (18-46-0) uygulamaları mısır bitkisi saksı verimi (taze ağırlık) açısından bu uygulamaları takip eden uygulamalar olarak belirlenmiş (Şekil 1), tüm uygulamalar kontrole göre verim artışı sağlamıştır (Tablo 5).



Şekil 1. Organomineral ve mineral (inorganik) gübre uygulamalarının mısır bitkisi saksı verimi (taze ağırlık) üzerine etkisi

BİTKİ BOYU

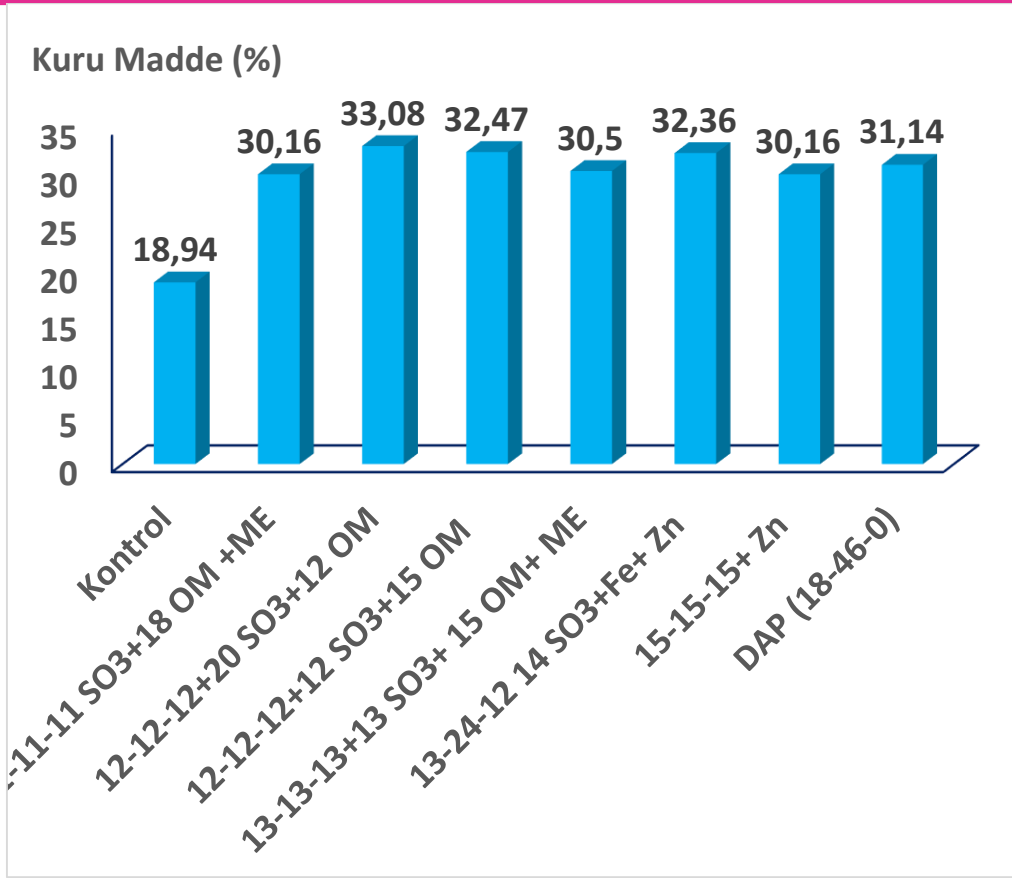
Organomineral ve mineral gübre uygulamalarının mısır bitkisi bitki boyu üzerine istatistiksel olarak önemli ($p < 0.05$) etkili olduğu bulunmuştur (Tablo 5). Hem organomineral hemde mineral gübre uygulamalarında ölçülen bitki boyu değerleri kontrole uygulamasındaki bitki boyundan daha uzun ölçülmüştür. En uzun bitki boyu 12-12-12+12 SO₃+15 OM organomineral uygulamasında (123 cm), en düşük bitki uzunluğu kontrol (104cm) uygulamasında elde edilmiş, ortalama bitki boyu 118.88 cm olarak belirlenmiştir. En büyük bitki boyunun elde edildiği 12-12-12+12 SO₃+15 OM organomineral gübre uygulamasını, 12-12-12+20 SO₃+12 OM (121 cm) organomineral gübre uygulaması ve 13-24-12 14 SO₃+Fe+ Zn mineral gübre uygulaması (117 cm) izlemiştir; 11-11-11-11 SO₃+18 OM +ME ve 15-15-15+ Zn (116 cm); ile 13-13-13+13 SO₃+ 15 OM+ ME ve DAP (18-46-0) (115 cm) uygulamaları bitki boyu açısından bu uygulamaları takip eden uygulamalar olarak belirlenmiştir (Şekil 2). Yapılan istatistiksel değerlendirmede 12-12-12+12 SO₃+15 OM ve 12-12-12+20 SO₃+12 OM organomineral gübre uygulamaları aynı grupta yer almıştır.



Şekil 2. Organomineral ve mineral (inorganik) gübre uygulamalarının mısır bitkisi bitki boyu üzerine etkisi

KURU MADDE

Serada saksı denemesi şeklinde yürütülen araştırmada uygulama konularından elde edilen mısır bitkisi kuru madde değerleri ve yapılan istatistiksel değerlendirme sonuçları Tablo 5’de verilmiştir. Tablo 5 incelendiğinde organomineral ve mineral gübre uygulamalarının mısır bitkisi kuru madde miktarı üzerine istatistiksel olarak önemli ($p < 0.1$) etkili olduğu bulunmuştur. Tüm uygulamalardan elde edilen kuru madde değerleri kontrole göre yüksek bulunmuş, en yüksek kuru madde içeriği 12-12-12+20 SO₃+12 OM organomineral uygulamasında (%33.08), en düşük kuru madde içeriği kontrol (%18.94) uygulamasında elde edilmiş, ortalama kuruma madde miktarı ise %29.85 olarak bulunmuştur. En yüksek kuru madde miktarının elde edildiği 12-12-12+20 SO₃+12 OM organomineral gübre uygulamasını, 12-12-12+12 SO₃+15OM (%32.47) organomineral gübre uygulaması ve 13-24-12 14 SO₃+Fe+ Zn mineral gübre uygulaması (%32.36) izlemiştir; DAP (18-46-0) (%31.14); 13-13-13+13 SO₃+ 15 OM+ ME (%30.50) ve 11-11-11-11 SO₃+18 OM +ME ile 15-15-15+ Zn (%30.16) uygulamaları takip eden uygulamalar olarak belirlenmiştir (Şekil 3).



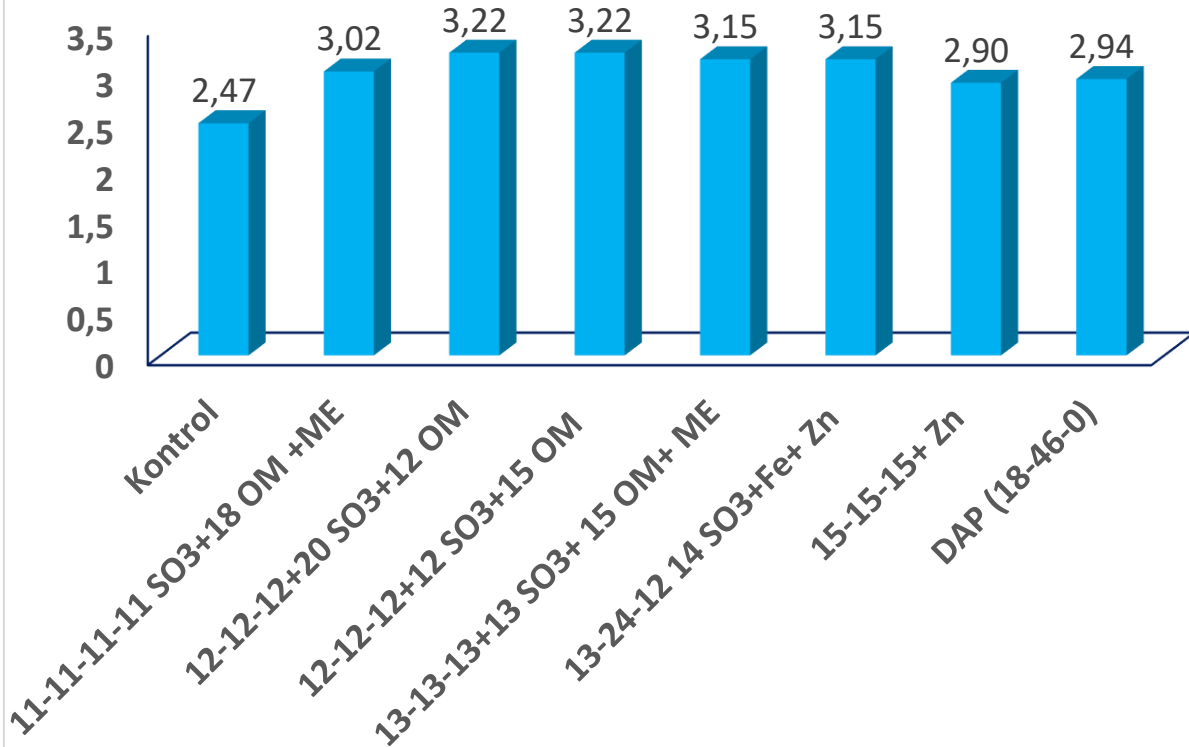
Şekil 3. Organomineral ve mineral (inorganik) gübre uygulamalarının mısır bitkisi kuru madde içeriği üzerine etkisi

GÖVDE ÇAPI

Gübre uygulamalarının (organomineral ve mineral) mısır bitkisi gövde çapı üzerine istatistiksel olarak önemli ($p < 0.05$) etkili olduğu bulunmuştur (Tablo 5). Organomineral ve mineral gübre uygulanan araştırma konularında ölçülen bitki gövde çapı değerleri kontrol uygulamasından daha kalın bulunmuştur. En geniş gövde çapı değeri 12-12-12+12 SO₃+15 OM ve 12-12-12+20 SO₃+12 OM (3.22 cm) organomineral gübre uygulamasında, en dar gövde çapı ise kontrol (2.47cm) uygulamasında elde edilmiş, ortalama bitki gövde çapı 3.01 cm olarak belirlenmiştir. En büyük gövde çapının elde edildiği 12-12-12+12 SO₃+15 OM ve 12-12-12+20 SO₃+12 OM (3.22 cm) organomineral gübre uygulamasını, 13-13-13+13 SO₃+ 15 OM+ ME; 13-24-12 14 SO₃+Fe+ Zn (3.15 cm); 11-11-11-11 SO₃+18 OM +ME (3.02 cm); DAP (18-46-0) (2.94 cm) ve 15-15-15+ Zn (2.90 cm) uygulamaları izlemiştir (Şekil 4). Yapılan istatistiki değerlendirmede en geniş gövde çapının ölçüldüğü 12-12-12+12 SO₃+15 OM ve 12-12-12+20 SO₃+12 OM organomineral gübre uygulamaları aynı grupta yer almıştır.



Gövde Çapı (cm)



Şekil 4. Organomineral ve mineral (inorganik) gübre uygulamalarının mısır bitkisi gövde çapı üzerine etkisi

Erdal (2018), organomineral gübrelerde bitki besin maddelerinin bir kısmının organik maddeye bağlandığını, topraklara uygulanması nedeniyle besin maddesi kayıplarının azaldığını böylece organik gübrelerin verim ve kaliteyi artırdığını rapor etmiştir.

Silva ve ark., (2020), Brezilya’da yaptıkları mısırdaki organomineral gübre uygulama çalışmalarının da organo mineral gübrelerin mineral fosfatlı gübrelerden daha etkili olduğunu saptamışlardır. Araştırmacılar ayrıca gövde çapı üzerine kil bünyeli topraklarda organomineral gübrelemenin pek etkili olmadığını rapor etmişlerdir.

Kışlık ekmeçlik buğday yetiştiriciliğinde Hexaferm® organomineral gübreleriyle yapılan denemeden elde edilen 7 farklı gübre uygulama konusuna bağlı olarak bir dekaradan alınan ortalama tane verimleri 251 kg/da ile 631.1 kg/da, ortalama bitki boyu 60 cm ile 95 cm, 1 m²'de fertil başak sayısı 341 adet ile 503 adet, bir başakta tane sayısı 22 adet ile 38 adet, bintane ağırlığı 46-49 g ve hektolitreye ağırlığı 83 kg/hl ile 84 hg/hl olarak ölçülmüştür. Verim unsurları bakımından dekar başına ortalama 636.1 kg/da ile en yüksek verimi veren 5. nolu konu, buğday ekim öncesi toprak altına tabana “Hexaferm® 12.12.0.12S”den 25 kg/da + üste kardeşlenmede “ÜRE” den 15 kg/da + bitkiler kaleme kalkma devresinde “Amonyum Nitrat %33 N” den 15 kg/da gübrelerinin uygulandığı parsellerdir. Bu uygulama konusunda verim unsuru değerleri olarak ortalama bitki boyu 95 cm, 1 m²'de fertil başak sayısı 503 adet, bir başakta tane sayısı 38 adet, bintane ağırlığı 49 g ve hektolitreye ağırlığı 83 kg/hl olarak belirlenmiştir. Buna karşın verim unsurları bakımından dekar başına ortalama 251.0 kg/da ile en düşük verimi veren 1. nolu konu, buğday ekim öncesi toprak altına tabana ve üste hiç gübre verilmeyen kontrol (şahit) parsellerdir. Bu gübresiz şahit parsellerin ortalama verim unsuru değerleri olarak bitki boyu 60



cm, 1 m²'de fertil başak sayısı 341 adet, bir başakta tane sayısı 22 adet, bintane ağırlığı 47 g ve hektolitreye ağırlığı 83 kg/hl olarak ölçülmüştür. Benzer sonuçlar organomineral gübrelerle yağlık ayçiçeğinde (Süzer ve Çulhacı 2016), kineo bitkisinde (Makinde ve ark., 2011) ve bamya bitkisinde (Olaniyi ve ark., 2010) bulunmuştur.

İngiltere'de United Utilities Water şirketi tarafından yeni geliştirilmiş bir organomineral gübre olan SMART-PTM gübresi (Şekil-1) [kanalizasyon atıklarının, inorganik azot ve potasyum ilavesi ile (azot kaynağı olarak üre, potasyum kaynağı olarak potasyum klorür kullanılmıştır) 800 C'de kurutulup granüle edilmiş organomineral gübre] ile inorganik N ve K'lu gübreler verim açısından karşılaştırılmıştır. Bu amaçla gübreler araştırma bölgesinde (Broxton, Cheshire, UK) yaygın olarak uygulanan 4 ekim nöbeti sisteminde, 3 yıl süre ile denenmiştir. Ekim nöbetinde yeralan bitkiler Buğday, Kanola, Arpa, Fasulye ve Yemlik Mısır'dır. Araştırma sonucunda organomineral gübrenin verim üzerinde inorganik gübreler kadar etkili olduğu bulunmuştur (Deeks ve ark., 2013).

3.2. ORGANOMİNERAL VE İNORGANİK (MİNERAL) GÜBRE UYGULAMALARININ MISIR BİTKİSİNİN MİNERAL MADDE İÇERİĞİ ÜZERİNE ETKİSİ

Serada saksı denemesi şeklinde yürütülen, organomineral ve mineral gübre uygulamalarının mısır bitkisinin mineral madde (N, P, K, Ca, Mg) alımı üzere etkisine ait elde edilen analiz sonuçları ve istatistikî değerlendirmesi Tablo 6'da verilmiştir.

Tablo 6. Organomineral ve mineral gübre uygulamalarının mısır bitkisi mineral madde içeriği üzerine etkisi

Uygulamalar	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
Kontrol	2,58 f	0,24	1,66 e	0,27 d	0,24 d
11-11-11-11 SO ₃ +18 OM +ME	3,27d	0,26	2,01 d	0,32 c	0,33 c
12-12-12+20 SO ₃ +12 OM	3,64 b	0,29	2,73 b	0,40 a	0,45 a
12-12-12+12 SO ₃ +15 OM	3,82 a	0,29	2,95 a	0,42 a	0,44 a
13-13-13+13 SO ₃ + 15 OM+ ME	3,53 bc	0,28	2,65 b	0,38 b	0,36 b
13-24-12 14 SO ₃ +Fe+ Zn	3,49 c	0,27	2,58 c	0,40 a	0,40 ab
15-15-15+ Zn	3,25 d	0,25	2,50 c	0,34 c	0,30 c
DAP (18-46-0)	3,03 e	0,28	1,96 d	0,41 a	0,26 d
Maksimum	3,82	0,29	2,95	0,42	0,45
Minimum	2,58	0,24	1,66	0,27	0,24
Ortalama	3,33	0,27	2,38	0,37	0,35
Önem düzeyi	**	ns	**	*	**
Referens Değerler*	2,70-4,00	0,25-0,50	1,70-3,00	0,21-1,00	0,20-1,00

*:Jones ve ark., 1991

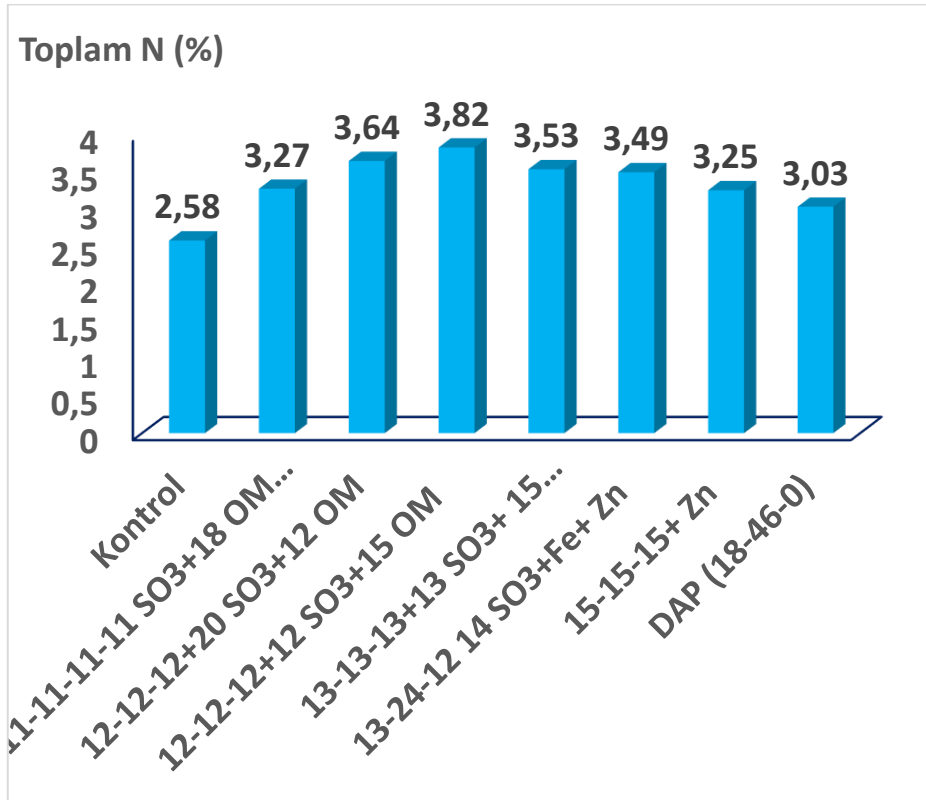
Organomineral ve mineral gübre uygulamalarının mısır bitkisi yapraklarının toplam azot, potasyum ve magnezyum içeriği üzerine etkisi istatistikî olarak p<0.1, toplam kalsiyum içeriği üzerine ise (p<0.05) seviyede önemli bulunmuştur (Çizelge 4). Uygulamaların mısır bitkisi yapraklarının toplam P içeriği üzerine etkisi istatistikî olarak önemsiz bulunmuştur. Gübre uygulamaları (organomineral ve inorganik) mısır bitkisi yapraklarının toplam N, P, K, Ca, ve Mg içeriklerinde kontrole göre önemli düzeyde artış sağlamıştır. Mısır bitkisi yapraklarındaki toplam N, P, K, Cave Mg içeriklerinin sırasıyla % 2.58-3.82; % 0.24-0.29; % 1.66-2.95; %0.27-0.42; ve %0.24-0.45 arasında değiştiği saptanmıştır. En düşük toplam N, P, K, Ca ve Mg içerikleri kontrol uygulamasında, en yüksek toplam N, P, K, Ca ve Mg içerikleri ise 12-12-



12+12 SO₃+15 OM ve 12-12-12+20 SO₃+12 OM (toplam P, Ca, ve Mg) uygulamasında elde edilmiştir (Tablo 6).

TOPLAM AZOT (N)

Organomineral ve inorganik gübrelerin uygulandığı araştırmada gübre uygulamaları mısır bitkisi bitkisinin toplam N içeriğinde kontrol uygulamasına göre artışlar sağlamış ve elde edilen bu artışların istatistiksel olarak önemli ($p<0.1$) olduğu belirlenmiştir (Tablo 6). Araştırmada en yüksek toplam azot içeriğinin elde edildiği 12-12-12+12 SO₃+15 OM (%3.82) organomineral gübre uygulamasını sırası ile 12-12-12+20 SO₃+12 OM (%3.64); 13-13-13+13 SO₃+ 15 OM+ ME (%3.53); 13-24-12 14 SO₃+Fe+ Zn (3.49); 11-11-11-11 SO₃+18 OM +ME (%3.27); 15-15-15+ Zn (%3.25) ve DAP (18-46-0) (3.03) uygulamaları izlemiş kontrol uygulamasında ise toplam azot değeri en düşük düzeyde (%2.58) belirlenmiştir (Şekil 5). Kontrol uygulaması hariç tüm uygulamalarda belirlenen toplam N değerleri mısır bitkisi için verilen kriter değerler arasında saptanmıştır.



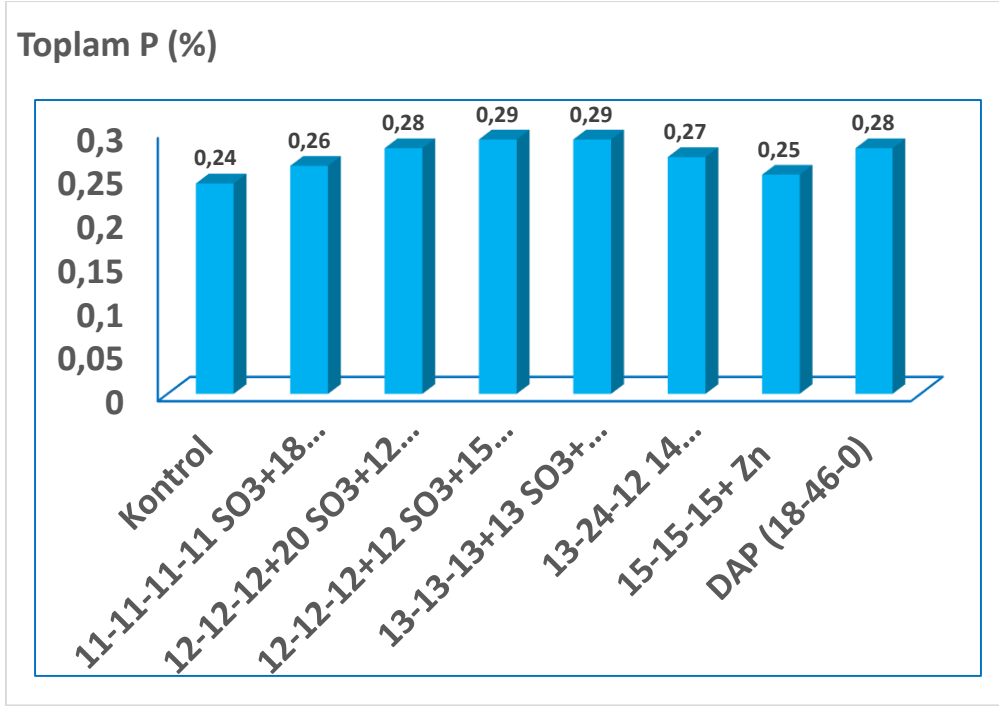
Şekil 5. Organomineral ve mineral (inorganik) gübre uygulamalarının mısır bitkisi toplam azot üzerine etkisi

TOPLAM FOSFOR (P)

Serada saksı denemesi şeklinde yürütülen araştırmada organomineral ve mineral gübre uygulamaları mısır bitkisinin toplam P içeriğinde kontrole göre artışlar sağlamış ancak bu artışlar istatistiksel olarak önemli bulunmamıştır (Tablo 6). Tüm uygulamalarda saptanan toplam P değerleri kontrole göre yüksek bulunmuş, en yüksek toplam P içeriği 12-12-12+20 SO₃+12 OM ve 12-12-12+12 SO₃+15OM (% 0.29) organomineral uygulamalarında, en düşük toplam P içeriği ise kontrol (% 0.24) uygulamasından elde edilmiştir. En yüksek toplam P içeriğinin elde edildiği 12-12-12+20 SO₃+12 OM ve 12-12-12+12 SO₃+15OM (% 0.29) organomineral gübre uygulamalarını, 13-13-13+13 SO₃+ 15 OM+ ME ve DAP (18-46-0) (% 0.28) ile 13-24-



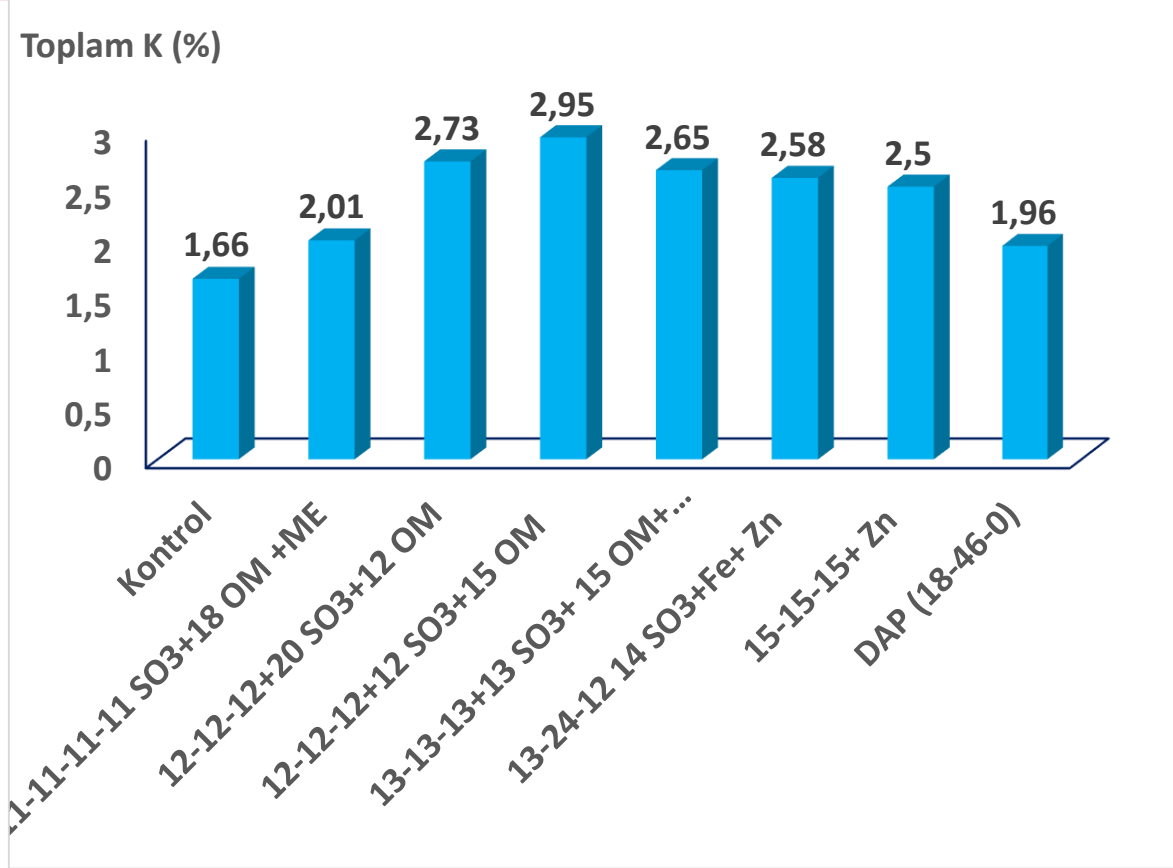
12 14 SO₃+Fe+ Zn (%0.27); 11-11-11-11 SO₃+18 OM +ME (%0.26) ve 15-15-15+ Zn (%0.25) uygulamaları bu uygulamaları takip eden uygulamalar olarak belirlenmiştir (Şekil 6). Kontrol uygulaması hariç tüm uygulamalardaki toplam P değerleri mısır bitkisi için verilen kriter değerler arasında bulunmuştur.



Şekil 6. Organomineral ve mineral (inorganik) gübre uygulamalarının mısır bitkisi toplam fosfor içeriği üzerine etkisi

TOPLAM POTASYUM (K)

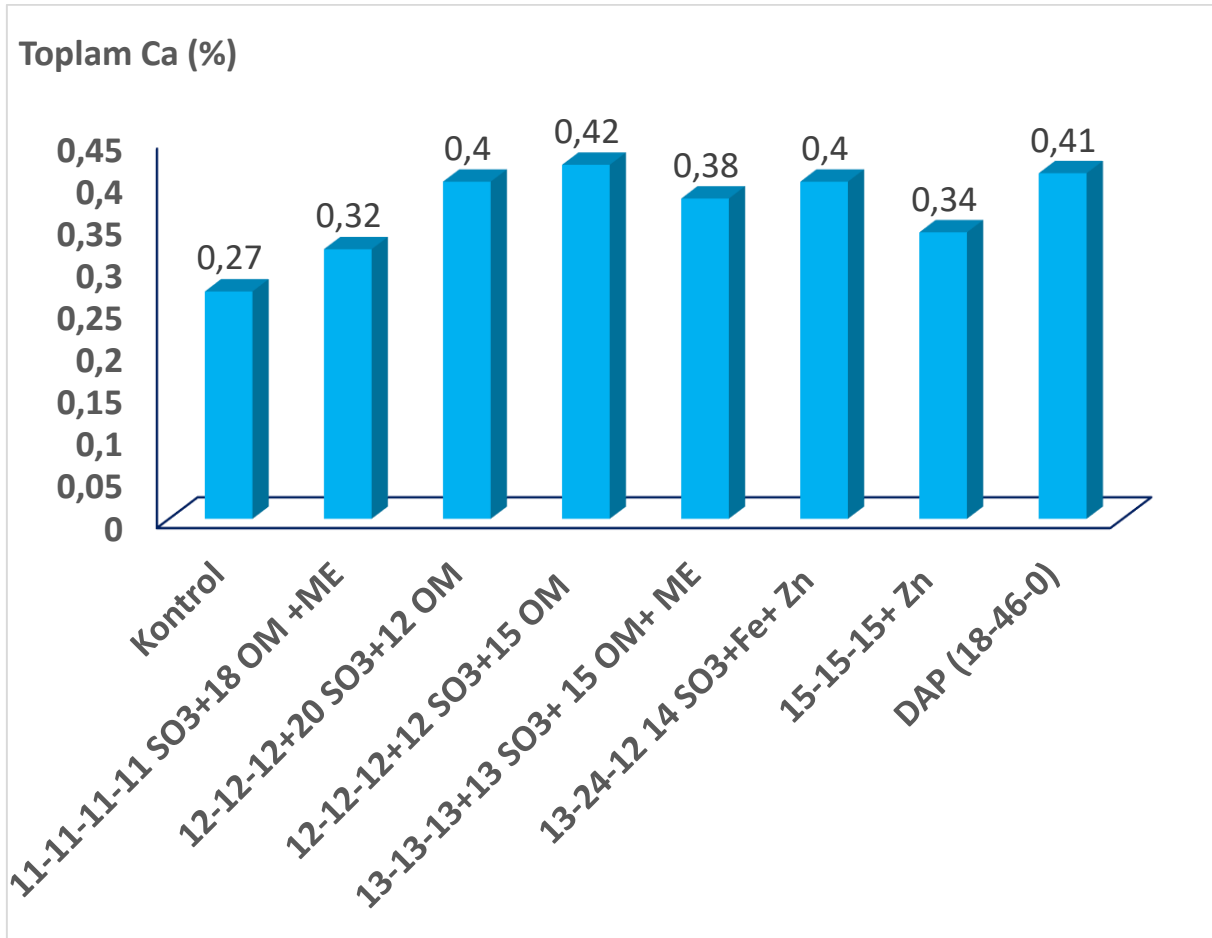
Organomineral ve inorganik (mineral) gübre uygulamalarının mısır bitkisinin toplam potasyum içeriği üzerine istatistiksel olarak önemli ($p < 0.1$) etkili olduğu bulunmuştur (Tablo 6). Gübre uygulamalarının yapıldığı (organomineral ve mineral) araştırma konularında saptanan toplam potasyum içerikleri kontrol uygulamasından daha yüksek bulunmuştur. En yüksek toplam potasyum içeriği 12-12-12+20 SO₃+12 OM (%2.73); 13-13-13+13 SO₃+ 15 OM+ ME (%2.65); 13-24-12 14 SO₃+Fe+ Zn (%2.58); 15-15-15+ Zn (%2.50) ve DAP (18-46-0) (%2.96) uygulamaları izlemiştir (Şekil 7). Kontrol uygulaması dışındaki tüm organomineral ve inorganik gübre uygulamalarında belirlenen toplam K değerleri mısır bitkisi için verilen kriter değerler arasında bulunmuştur.



Şekil 7. Organomineral ve mineral (inorganik) gübre uygulamalarının mısır bitkisi toplam potasyum içeriği üzerine etkisi

TOPLAM KALSİYUM (Ca)

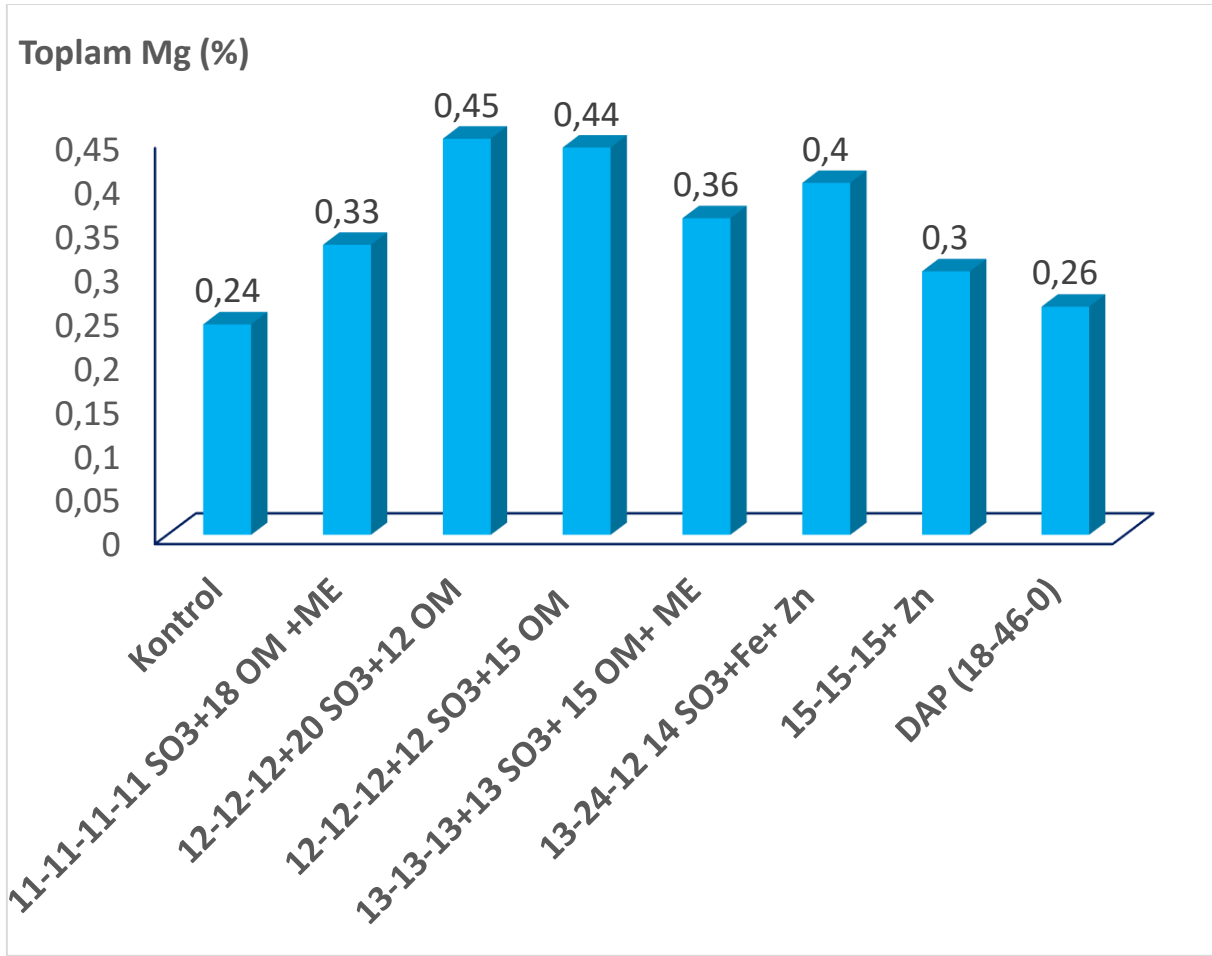
Organomineral ve mineral gübre uygulamalarının mısır bitkisi toplam kalsiyum içeriği üzerine istatistiksel olarak önemli ($p < 0.05$) etkili olduğu bulunmuştur (Tablo 6). Hem organomineral hemde mineral gübre uygulamalarında saptanan toplam kalsiyum değerleri kontrole uygulamasındaki toplam kalsiyum değerinden daha yüksek bulunmuştur. En yüksek kalsiyum değeri 12-12-12+12 SO₃+15 OM organomineral uygulamasında (%0.42), en düşük toplam kalsiyum değeri ise kontrol (%0.27) uygulamasında belirlenmiştir. En büyük bitki toplam Ca içeriği 12-12-12+12 SO₃+15 OM organomineral gübre uygulamasında elde edilmiş bu uygulamayı sırasıyla DAP (18-46-0) (%0.41) mineral gübre uygulaması; 12-12-12+20 SO₃+12 OM ve organomineral gübre uygulaması ve 13-24-12 14 SO₃+Fe+ Zn mineral gübre uygulaması (%0.40) izlemiştir; 13-13-13+13 SO₃+ 15 OM+ ME (% 0.38); 15-15-15+ Zn (%0.34) ve 11-11-11-11 SO₃+18 OM +ME (%0.41) uygulamaları bitki toplam Ca değerleri bakımından bu uygulamaları takip eden uygulamalar olarak belirlenmiştir (Şekil 8). Yapılan istatistiksel değerlendirmede 12-12-12+12 SO₃+15 OM ve 12-12-12+20 SO₃+12 OM organomineral gübre uygulamaları ile 13-24-12 14 SO₃+Fe+ Zn ve DAP (18-46-0) mineral gübre uygulamaları aynı grupta yer almıştır (Tablo 6). Kontrol uygulaması dahil tüm uygulamalardaki toplam Ca değerleri mısır bitkisi için verilen kriter değerleri arasında bulunmuştur.



Şekil 8. Organomineral ve mineral (inorganik) gübre uygulamalarının mısır bitkisi toplam kalsiyum içeriği üzerine etkisi

TOPLAM MAGNEZYUM (Mg)

Tablo 6 incelendiğinde organomineral ve mineral gübre uygulamalarının mısır bitkisi toplam magnezyum içeriği üzerine istatistiksel olarak önemli ($p < 0.1$) etkili olduğu bulunmuş, yapılan istatistiki değerlendirmede 12-12-12+20 SO₃+12 OM ve 12-12-12+12 SO₃+15 OM organomineral gübre uygulamaları aynı grupta yer almıştır (Tablo 6). Tüm uygulamalarda mısır bitkisi toplam magnezyum değerleri kontrole göre artış göstermiş, en yüksek toplam magnezyum değeri 12-12-12+12 SO₃+12 OM organomineral uygulamasında (%0.45), en düşük toplam magnezyum içeriği kontrol (%0.24) uygulamasında belirlenmiştir. En yüksek toplam Mg içeriğinin saptandığı 12-12-12+12 SO₃+12 OM organomineral gübre uygulamasını, 12-12-12+20 SO₃+15 OM (%0.44) organomineral gübre uygulaması ve 13-24-12 14 SO₃+Fe+ Zn mineral gübre uygulaması (%0.40) izlemiştir; 13-13-13+13 SO₃+ 15 OM+ ME (%0.36); 11-11-11-11 SO₃+18 OM +ME (%0.33); 15-15-15+ Zn (%0.30); DAP (18-46-0) (%0.26) uygulamaları mısır bitkisi toplam Mg içeriği açısından bu uygulamaları takip eden uygulamalar olarak belirlenmiştir (Şekil 9), tüm uygulamalar kontrole göre verim artışı sağlamıştır (Tablo 5). Kontrol uygulaması dahil tüm uygulamalardaki toplam Mg değerleri mısır bitkisi için verilen kriter değerler arasında bulunmuştur.



Şekil 9. Organomineral ve mineral (inorganik) gübre uygulamalarının mısır bitkisi toplam magnezyum içeriği üzerine etkisi

Kimyasal (13.24.12-10 SO₃+1 Zn) ve organomineral (7.16.10-15SO₃+ 1 Fe+ 0.5 Zn+ 20 OM) ve K K-Humat'ın uygulamalarının tane mısırın fosfor kullanımı üzerine etkilerini belirlemek için yapılan bir çalışmada uygulama konularının mısır yapraklarının N, K, Zn (p<0.01) ve Cu (p<0.05) içeriklerine etkisi istatistiki olarak önemli, diğer besin elementlerine etkisi ise önemsiz bulunmuş, mısır yapraklarının besin elementleri için Jones ve ark., (1991) tarafından bildirilen yeterlilik sınır değerleri ile karşılaştırıldığında bütün konularda herhangi bir besin elementinin eksikliği belirlenmemiştir (Korkmaz ve ark., 2020). Benzer sonuçlar organomineral organik ve kimyasal gübre uygulamaları ile yaprakların N içeriğinin organomineral gübre uygulamalarında önemli artışlar sağladığı belirlenmiştir (Adeleye ve ark., 2011; Ayeni ve ark., 2012). Sharif ve ark., (2002) tarafından farklı dozlarda humik asit ile birlikte uygulanan kimyasal gübrenin mısır bitkisinde N ve K içeriği üzerine istatistiki olarak önemli etkilerinin olduğu belirlenmiştir. Nijerya'da yapılan bir çalışmada farklı organomineral gübre çeşitlerinin iki lahana çeşidinin besin içeriğine, depolamadan önce ve depolama sonrası etkilerini belirlemek için bir araştırma yapılmış, Araştırmada 4 organik gübre (Neemorganicfertilizer (NOF), Cassava peel compost (CPC), Sunshine Unfortified Fertilizer (SUF) ve Alesinloye Organic Fertilizer), 3 Organomineral gübre (Alesinloye Organomineral Fertilizer, Sunshine Fortified Fertilizer (SFF) ve Pacesetter Fortified Fertilizer (PFF) ve 1 mineral gübre(15:15:15) kullanılmıştır. Araştırma



sonucunda, hemen yararlı N kaynağı olarak kabul edilen mineral gübre ile yavaş yararlı N kaynağı olarak kabul edilen organik gübre (sunshine organomineral fertilizer) kombinasyonun lahanada, başın mineral (Ca, Mg ve K) içeriğini depolamadan önce ve sonra artırabileceği belirlenmiştir. Araştırmada Pacesetter organomineral gübresi ve onu sıra ile takip eden Sunshine ve Alesinloye Organomineral gübrelerinin yalnızca NPK (15:15:15) kullanımına göre daha iyi sonuç verdikleri saptanmıştır (Ojetayo ve ark., 2011).

Organomineral ve inorganik (mineral) gübrelerin uygulandığı serada saksı denemesi şeklinde yürütülen çalışmada mısır bitkisi mineral madde içeriklerinin (toplam N, P, K, Ca, Mg) birçok araştırmacı tarafından bu bitki için önerilen referans değerlerle uyum içinde olduğu bitkilerin mineral beslenmesi açısından herhangi bir sorunun olmadığı belirlenmiştir (Reuter and Robinson, 1986; Jones ve ark., 1991; Bergmann, 1992; İbrikçi ve ark., 1994; Alpaslan ve ark., 1998, Yağmur ve ark., 2013).

4.SONUÇ ve ÖNERİLER

Sera koşullarında mısır yetiştiriciliğinde dört adet organomineral gübre (11-11-11+11 SO₃+18 OM +ME; 12-12-12+20 SO₃+12 OM; 12-12-12+12 SO₃+15 OM; 13-13-13+13 SO₃+ 15 OM+ ME) ve çiftçi uygulaması olarak 3 adet inorganik (mineral gübre kompoze gübre (13-24-12+14 SO₃+Fe+ Zn; 15-15-15+ Zn; DAP (18-46-0)) ile gübresiz (kontrol) olmak üzere 8 farklı uygulama konusuyla yapılan araştırma sonucunda dekara 66 kg organomineral gübre uygulamaları olan 3 nolu (12-12-12+20 SO₃+12 OM) ve 4 nolu (12-12-12+12 SO₃+15 OM) organo mineral gübre uygulamaları, çiftçi uygulaması olarak kabul edilen 3 farklı inorganik (mineral) gübre uygulamaları arasında ise 13-24-12+14 SO₃+Fe+ Zn kompoze gübre uygulaması mısır bitkisi verim parametreleri ve mineral madde içeriği yönünden en iyi sonucu veren gübre uygulamaları olarak belirlenmiştir.

Kontrol uygulaması tüm verilerde en düşük değerlerin elde edildiği uygulama olmuştur. Tüm uygulamalar kontrol uygulamasına göre mısır bitkisi verim parametreleri ve mineral madde içeriği yönünden artışlar sağlamıştır.

Araştırma sonucunda elde edilen besin maddesi içerikleri mısır bitkisi için verilen kriter değerler ile karşılaştırıldığında kontrol uygulaması hariç organomineral ve mineral gübre uygulamalarında mısır bitkisinde herhangi bir beslenme sorununun olmadığı belirlenmiştir.

Hem toprağa hem de bitkiye sağlamış olduğu yararlar göz önünde bulundurulduğunda, organomineral gübreler tarımsal üretime olumlu kazançlar sağlamaktadır. Organomineral gübreler yapılan çalışmalar sonucunda varılan genel görüş, bitki besin elementi sağlama durumu ve toprak özelliklerini onarıcı etkisinden dolayı, mineral gübrelere en iyi alternatifin organomineral gübreler olduğu savunulmaktadır.

Gerek ülkemizde ve gerekse dünya ölçeğinde bu görüşleri destekleyen çok sayıda araştırma çalışması sera veya tarla çalışmalarında yürütülerek organomineral gübrenin olumlu etkilerini gösteren bulgular elde edilmiştir (Akıncı ve ark., 2007; Özkan ve ark., 2013; Pekcan ve ark., 2008; Çalışkan ve Ayan 2011; Turgay ve ark., 2011; Tejada ve ark., 2005; Deeks ve ark., 2013; Onat 2015; Ojetayo ve ark., 2011; Antille 2013)

Dünya’da ve Türkiye’de gerçekleştirilen Organo-mineral gübre çalışmaları toprak özelliklerine olumlu etkide bulunduğu ve tarımsal üretimde verimin arttığını ispatlamıştır. Ülkemizde organo-mineral gübrelerin kullanım şekillerine bakacak olursak; çoğunluğun organo-mineral gübre kaynağı olarak ticari gübreleri tercih ettiği, bir kesimin organik gübre ile mineral gübreleri karıştırmak koşuluyla uygulama da bulunduğu, bir kesiminde kendisinin formül oluşturup organo-mineral gübreleri uyguladıkları gözlemlenmiştir. Yapılan araştırmaların çoğunluğunda organomineral gübre kullanımının ister toprak özelliklerine, isterse bitki gelişimi ve verimi ile mineral beslenmesine olumlu yönde etki ettiği tespit edilmiştir.



**3rd INTERNATIONAL CONFERENCE
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Bu araştırma sonucuna göre mısır yetiştiriciliğinde birim alandan yüksek verim almak için özellikle organik maddece fakir topraklara taban gübresi olarak organomineral ve üst gübreleme olarak inorganik gübrelerin birlikte kullanıldığı dengeli bir gübreleme programı yapılması önerilebilir



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ÇAYIR VE MERA ALANLARINDA NET BİRİNCİL ÜRETİM DÜZEYİNİN BELİRLENMESİ

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ÖZET

Net Birincil Üretim, sürdürülebilir kaynak yönetiminin önemli bir parametresi ve karbon döngüsünün önemli bir bileşenidir. Bu nedenle küresel iklim değişikliği ile ilgili çalışmalarda sıklıkla kullanılmaktadır. NPP (net birincil üretim)'nin belirlenmesi, ekosistem dinamiklerinin zamansal ve mekânsal ölçekli simülasyon modellerinin geliştirilmesi için de gereklidir. Çalışmamızın amacı, mera ekosistemlerinde NPP belirleme yöntemlerini kısaca gözden geçirmek ve bunların doğru tespitini kolaylaştırmak için bazı yol gösterici ilke ve öneriler sunmak, hataları ve örnekleme yöntemlerini tartışmaktır. Çayır ve meralarda NPP tespiti nispeten kolay olsa da zamansal, mekânsal değişkenlik; saha örnekleme ve laboratuvar işleme süresi zor olabilir. Bu bağlamda, elde edilen verilerin örnekleme, işlenmesi ve tahmin edilmesi için harcanan zamandan ve kaynaktan tasarruf sağlayan bazı yöntemler önerilmiştir. Meralarda NPP belirlenmesinde; Doğrudan hasat yöntemleri ve dolaylı veya “tahribatsız” teknikler olmak üzere iki genel yaklaşımda ele alınmaktadır. Bu yaklaşımların her biri için çok sayıda değişiklik önerilmiş olsa da çalışmamızda sadece birkaçını gözden geçireceğiz. Hasat yöntemiyle toprak üstü bitki biyokütlesini belirlemek için, bitkiler küçük arazi parçalarından hasat edilir, bu biyokütle bileşenlerine ayrılır ve tartılır. Çok sayıda numunenin işlenmesi ve kurutulması nedeniyle işçilik maliyeti laboratuvar aşamasındadır. Maliyeti önemli ölçüde azaltabilecek birkaç alternatif vardır. Dolaylı veya tahribatsız teknikleri kullanan ikinci yaklaşım, meralardaki NPP'yi tahmin etmek için çeşitli varyasyonları içerir. Kolayca ölçülen veya tahmin edilen parametrelerin hasat verileriyle ilişkilendirilme prensibine dayanmaktadır NPP'nin hızlı değişimini hesaba katmak için yüksek bir örnekleme frekansının gerekli olduğu veya geniş alanlarda hasatın zor olduğu durumlarda dolaylı yöntemler kullanılabilir. Ayrıca geniş alanlarda NDVI (normalize edilmiş fark bitki örtüsü indeksi) gibi bazı dolaylı yöntemler; NPP tahmininde oldukça kullanışlıdır. Uzaktan algılama ve modellemedeki son gelişmeler, NPP'nin daha yüksek doğrulukla tahmin edilebileceğini göstermektedir.

Anahtar Kelimeler: NPP, İklim değişikliği, Biyokütle, Karbon döngüsü, Ekosistem



DETERMINATION OF NET PRIMARY PRODUCTION IN MEADOWS AND PASTURES

ABSTRACT

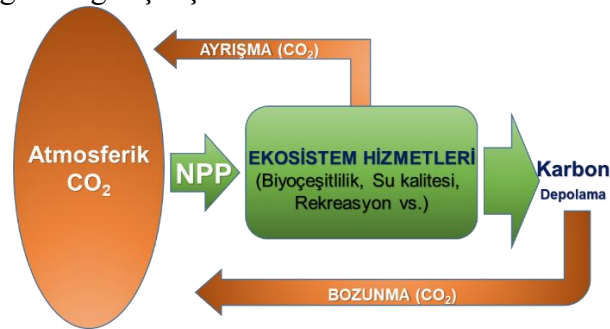
Net Primary Production is an important parameter of sustainable resource management and an important component of the carbon cycle. Therefore, it is frequently used in studies on global climate change. Determination of NPP (Net Primary Production) is also essential for the development of temporal and spatial scale simulation models of ecosystem dynamics. The aim of our study is to briefly review the NPP determination methods in rangeland ecosystems and to provide some guiding principles and suggestions to facilitate their correct detection, to discuss errors and sampling methods. Although NPP detection is relatively easy in meadows and pastures; temporal, spatial variability; field sampling and laboratory processing time can be challenging. In this context, some methods have been proposed that save time and resources spent on sampling, processing and estimating the obtained data. In the determination of NPP in pastures; It is handled in two general approaches as direct harvesting methods and indirect or “non-destructive” techniques. Although numerous modifications have been proposed for each of these approaches, we will review only a few in our study. To determine the aboveground plant biomass by the harvesting method, plants are harvested from small plots of land, this biomass is separated into components and weighed. Due to the processing and drying of large numbers of samples, the labor cost is at the laboratory stage. There are few alternatives that can significantly reduce the cost. The second approach, using indirect or non-destructive techniques, involves several variations for estimating NPP in rangelands. It is based on statistical correlation of easily measured or estimated parameters with harvest data. Indirect methods can be used where a high sampling frequency is required to account for the rapid change of NPP or where harvesting is difficult in large areas. In addition, some indirect methods such as NDVI (normalized difference vegetation index) in large areas; It is quite useful in estimating NPP. Recent advances in remote sensing and modeling show that NPP can be predicted with higher accuracy.

Keywords: NPP, climate change, biomass, carbon cycle, ecosystem



1.GİRİŞ

Birincil üreticiler; fotosentez yoluyla inorganik maddelerden yüksek enerji potansiyeline sahip organik bileşikler sentezleyen ve besin piramidinin ilk basamağını oluşturan organizmalardır. Birincil verimlilik, bu organik enerjinin, dünya yüzeyi birim alanı başına, bitkiler tarafından depolanma oranıdır. Bitkiler kendi solunum ihtiyaçları için önemli miktarda, üretmiş oldukları organik maddeyi kullanırlar; net birincil verimlilik (NPP), solunumdan sonra kalan organik madde miktarıdır (Roxburgh ve ark., 2005). Ayrıca, NPP, sürdürülebilir kaynak yönetiminin önemli bir parametresi ve karbon döngüsünün önemli bir bileşenidir (Şekil.1). Bu nedenle küresel iklim değişikliği ile ilgili çalışmalarda sıklıkla kullanılmaktadır (Zhang ve ark., 2011).



Şekil 1. NPP, kaynak yönetimi ve karbon döngüsü ilişkisi

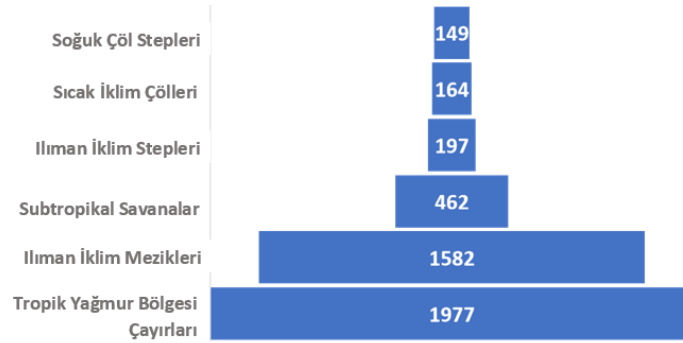
Ekosistemlerde birincil üretim ile ilgili çalışmalar, özellikle tarım ve ormancılık başta olmak üzere toplum ihtiyaçlarının ön planda olduğu alanlarda, ekosistem verimini ölçme gereksinimi ile gelişme göstermiştir. Uluslararası Biyolojik Program (IBP) himayesinde çayırarda net birincil verimliliği konu alan (NPP) çalışmaları yapılmıştır (Milner ve Hughes, 1970). Ekoloji bilimindeki ilerlemelerle birlikte, ilk önce sucul ekosistemlerde, sonrasında karasal biyomlarda (McIntosh, 1986) birincil üretimde verimlilik çalışmaları yapılmıştır. Bu çalışmalar NPP'yi belirlemek için yöntem ve yaklaşım sentezi sağlamışlardır. Bununla birlikte, Sala ve ark., (2000), NPP'yi ekosistem paradigması ile ele alıp daha yeni ve genel yaklaşımla ölçüm ve belirleme için ayrıntılı çözümler sunmuşlardır. Aynı zamanlarda, ekosistem dinamiklerinden faydalanıp NPP'yi yüksek doğrulukta belirlemeyi amaçlayan zamansal ve mekânsal ölçekli simülasyon modelleri geliştirilmeye çalışılmıştır. Bu amaçla Burkle ve ark., (1997), NPP tahmini için yağış, sıcaklık ve toprak özelliklerini girdi değişkenleri olarak kullanan model kullanmışlardır. Ilıman iklim çayırlarında bölgesel olarak yürüttükleri çalışmalarında sonuçların diğer ekosistemlerin çoğu için olmasa da benzer ekosistemlerde etkili olduğunu düşünmüşlerdir. Riedo ve ark., (2000), mera simülasyon modeli kullanarak artan CO₂ ve iklim değişikliği kombinasyonunun NPP ve C stoklarını etkilediğini ayrıca ılıman iklim koşulları altında otlatmanın, C stokları üzerinde olumlu bir etkiye sahip olduğunu ancak bu etkinin artan sıcaklıkla ile olumsuz etkilendiğini saptamışlardır. Zhang ve ark. (2020), NPP'nin zamansal ve mekânsal değişkenliği ve iklim faktörleri arasındaki ilişkiyi analiz etme amaçlı yaptıkları modellemede; en yüksek NPP'yi, daha fazla yağış ve daha yüksek kümülatif sıcaklık koşulları ile yaz aylarında, en düşük değerleri ise kış aylarında tespit etmişlerdir. Sonuçlarında, özellikle çayır-mera ekosistemlerinde güneş radyasyonu, nem indeksi ve NPP arasındaki pozitif korelasyona vurgu yapmışlardır. Kronolojik olarak özetlediğimiz literatürden de anlaşılacağı üzere, iklim değişikliği, çeşitli baskılar altında kalan hassas çayır-mera ekosistemleri ve NPP hep ilgili araştırmacıların dikkatinde olmuştur. Bu bağlamda çalışmamızın amacı çayır-mera vejetasyonu ağırlıklı ekosistemlerde yer üstü NPP'yi tahmin etme yöntemlerini kısaca gözden



geçirmek, yeryüzündeki NPP'lerin doğru şekilde tespit edilmesini kolaylaştırmak için bazı yol gösterici ilkeler ve öneriler sunmak, hataları ve örnekleme yöntemlerini tartışmaktır.

2. ÇAYIR-MERALARDA TOPRAK ÜSTÜ NPP'NİN BELİRLENMESİNDE ETKİLİ FAKTÖRLER

Çayır ve meralar yer küre üzerinde çok geniş iklim bölgelerinde yayılış göstermektedir. Dolayısıyla, meralarda NPP'yi etkileyebilecek çok farklı faktör vardır. Örneğin, savanalarda yangın, diğer meralarda otlatma rejimi gibi çeşitli sebeplerin yanı sıra; su, sıcaklık, besin maddeleri, ışık gibi ekolojik faktörlere bağlı olarak da yer üstü NPP sınırlanabilir (Collins ve Wallace, 1990; Knapp ve ark., 1998; Ni, 2004). Kıtasal ölçekte, yıllık yağışlar yerüstü NPP'leri ile güçlü bir şekilde ilişkilidir (Sala ve ark., 1988), birçok ılıman ve tropik çayırlarda, besinler veya ışık da sınırlayıcı olabilmektedir (Knapp ve Medina, 1999). Bazı durumlarda, bu faktörlerin tümü yerüstü NPP'yi eşzamanlı olarak veya vejetasyon dönemi boyunca sırayla sınırlayabilir (Knapp ve ark., 1998). İklim, yangın frekansı ve otlatma baskısı sonucu olarak, otlak ekosistemleri için yer üstü NPP tahminleri; çöl otlaklarında $<100 \text{ gr m}^{-2} \text{ yıl}^{-1}$ ile $<200 \text{ gr m}^{-2} \text{ yıl}^{-1}$ arasında değişebilir (Şekil.2). Ayrıca, otlaklarda yerüstü NPP; diğer biyomlardan daha fazla zamansal değişkenlik sergileyebilir (Knapp ve Smith, 2001) ve mekânsal değişkenlik de erozyona bağlı olarak varyasyon gösterebilir (Briggs ve Knapp, 1995). Meralarda yerüstü NPP geniş aralığı ve bu değişimin belirleyicileri arasındaki temel farklılıklar nedeniyle, her bir mera türü için örnekleme stratejileri ve yöntemleri özelleştirilmelidir.



Şekil 2. Dünya Geneline Yayılış Gösteren Otlakların Tahmini Net Birincil Üretim Ortalamaları ($\text{g m}^{-2} \text{ yr}^{-1}$) (Knapp ve ark., 2001; Scurlock ve ark., (2002); Mitsch ve Gosselink, (2015); Childers ve ark., (2013))

3. GEÇMİŞTEN GÜNÜMÜZE ÇAYIR-MERALARDA TOPRAK ÜSTÜ NPP'NİN BELİRLENMESİNDE KULLANILAN YÖNTEMLER

Yerüstü NPP'yi çayır ve meralarda belirlemek için yapılan örnekleme çalışmalarında nispi bir kolaylık olmasına rağmen; modelleme ve tahmin aşamalarında zamansal ve mekânsal faktörleri doğru belirlemek oldukça önemlidir. Ayrıca, elde edilen verileri optimize etmek, en uygun örnek sayısını belirlemek ve model başarısını artırmak için literatürde çok sayıda yöntem önerilmiştir. Çayır ve mera ekosistemleri için NPP hesaplanmasında iki genel yaklaşım mevcuttur: doğrudan hasat yöntemleri ve dolaylı ya da "tahribatsız" teknikler. Bu yaklaşımların her biri için sayısız değişiklik önerilmiş olmasına rağmen, burada sadece birkaçını gözden geçireceğiz.

Hasat yöntemiyle yerüstü bitki biyokütlesini belirlemek, çalışma alanında küçük parçalardan (genellikle $<1 \text{ m}^2$) bitkilerin toplanması, bu biyokütlenin toprak üstü vejetatif ve generatif organlarının tasnif edilmesi ardından kütlesi sabit bir değere ulaşmaya kadar kurutulması ve tartılması prensiplerine dayanmaktadır. Bu yöntemdeki varyasyonlar örneklem alanı büyüklüğü, şekli ve sayısından kaynaklanmaktadır (Brummer ve ark., 1994). Mekânsal



değişkenlikten kaynaklanan hata, hasat yöntemlerinde doğaldır ve bu sorun tipik olarak bir seferde birçok arazinin örneklenmesiyle giderilir. Bu nedenle, temel işgücü maliyeti çok sayıda numunenin ayrıştırılması ve kurutulmasından dolayı laboratuvar aşamasındadır. Kolayca ölçülen veya tahmin edilen parametrelerin (bitki boyu vb.) hasat verileriyle ilişkilendirildiği bir dizi örnekleme protokolü ve dolaylı teknikler geliştirilmiştir (Daoust ve Childers 1998; Vermeire ve Gillen 2001).

Dolaylı veya tahribatsız teknikleri kullanan ikinci bir genel yaklaşım, çayırlarda yer üstü NPP'yi tahmin etmek için çeşitli varyasyonları içerir. Bunlar arasında yer üstü NPP nokta yakalama yöntemleri ile ilişkili olarak yaprak alanını ve kanopi hacmini tahmin etmek için elektriksel kapasitans ve beta zayıflama cihazlarının kullanılması (Catchpole ve Wheeler 1992), görsel obstrüksiyon yöntemleri (Vermeire ve Gillen 2001), el cihazlarıyla veya uzaktan algılama yoluyla gölgelik optik özelliklerinin ölçümü ve simülasyon modellemeleridir (Tucker 1980; Turner ve ark., 1992). Kolayca ölçülen özneliklerin biyokütle ile ilişkili olduğu dolaylı teknikler, mahsulün sürekli büyümesi nedeniyle hasat edilmesi gereken tarlaların sayısının büyük olduğu arazilerde hasat yöntemlerine tercih edilen bir alternatif olabilir. Biyokütlenin hızlı dönüşümünü hesaba katmak için yüksek bir örnekleme frekansının gerekli olduğu veya büyük alanda hasatın zor olduğu durumlarda dolaylı yöntemler kullanılabilir. Ek olarak, bu dolaylı yöntemlerin birçoğu canlı bitkisel biyokütlenin kaba tahminleri için yararlı olabilir. Ayrıca büyük mekansal ölçekli çalışmalarda, NDVI gibi bazı dolaylı yöntemlerin tahminler için oldukça değerli olabileceğini vurgulamak önemlidir (Turner ve ark., 2006; Rafique 2016). Uzaktan algılama ve modellemedeki son gelişmeler, NPP'nin daha yüksek doğrulukla tahmin edilebileceğini göstermektedir.

4. SONUÇ VE ÖNERİLER

Küresel iklim değişikliği, insan faaliyetleri ve NPP arasındaki etkileşimler, Dünya'nın gelecekteki yaşana bilirliliğini şekillendirmede etkili olacaktır. Net Birincil Üretim, sürdürülebilir kaynak yönetiminin önemli bir parametresi ve karbon döngüsünün önemli bir bileşenidir. Bu nedenle küresel iklim değişikliği ile ilgili çalışmalarda sıklıkla kullanılmaktadır. Ayrıca, Çayır ve meralarda NPP tespiti nispeten kolay olsa da zamansal, mekansal değişkenlik; saha örnekleme ve laboratuvar süreci zor olabilmektedir. Bu bağlamda, elde edilen verilerin örnekleme, işlenmesi ve tahmin edilmesi için harcanan zamandan ve kaynaktan tasarruf sağlayan bazı yöntemler önerilmiştir. Özellikle, uzaktan algılama ve modellemedeki son gelişmeler, NPP'nin daha yüksek doğrulukla ve büyük alanda tahmin edilebileceğini göstermektedir.



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SAĞLIKLI BİR ATIŞTIRMALIK OLARAK DAĞ MEYVELERİ: KURUTULMUŞ KIZILCIK (*Cornus mas L.*) VE KURUTULMUŞ KOCAYEMİŞ (*Arbutus unedo*)

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ÖZET

Günümüzde tüketicilerin çoğu atıştırmalık gıdaları iyi vakit geçirmek için tüketmektedir. Cips, bisküvi, kraker, çikolata ve şeker gibi atıştırmalık gıdalar büyük oranda rafine şeker, tuz ve yağ içermektedir. Ne yazık ki bu tür bileşenler; obezite, diyabet, kalp hastalıkları ve besin yetersizliği gibi pek çok hastalığa neden olabilmektedir. Bununla birlikte şu da var ki, son zamanlarda, insanların diyet alışkanlıklarının sağlıklı gıdalar yönünde değişmesi ile gıda üreticileri, yüksek duyuşal çekiciliği ve sağlık üzerine olumlu özelliklere sahip yeni ürünler geliştirmeye dikkat etmektedirler. Birçok araştırmada da bahsedildiği üzere, meyveler vitamin, mineral, antioksidan ve diyet lif içermektedir ve bu bileşenler birçok hastalığı önleyebilmektedir. Meyvelerin sağlık üzerine olumlu etkileri bilinmesine rağmen, insanların çoğunun meyve hazırlamak için gereken zaman nedeni ile meyve yeme alışkanlığı yoktur. Kuru meyveler, tüketime hazır şekilde olmaları nedeni ile insanların meyve tüketim alışkanlığı kazanmalarını sağlayabilir. Bu çalışmada orman meyveleri olan kızılçık ve kocayemiş meyvelerinin, toplam fenolik bileşen, antioksidan aktivite ve *in-vitro* ortamda simüle edilmiş biyoalınabilirlik değerleri belirlenerek alternatif birer sağlıklı atıştırmalık gıda olma potansiyeli araştırılmıştır. Elde edilen sonuçlara göre; meyvelerin toplam fenolik içeriği taze meyvelerde kızılçık ve kocayemiş için sırası ile 852.47 ile 1846.4 mg GAE/100g olarak tespit edilirken, kurutulmuş meyvelerde bu oran kızılçık için 3465.97 mg GAE/100g, kocayemiş için ise 3696.54 mg GAE/100g olarak tespit edilmiştir. Diğer taraftan, toplam fenollerin biyoalınabilirlik değeri, en yüksek kurutulmuş kocayemiş (1165.39 mg GAE/100g) örneğinde gözlenmiştir. Çalışmada araştırılan dağ meyvelerinin antioksidan kapasitesi değerlendirildiğinde, tüm metotlarda (ABTS, CUPRAC ve DPPH), kuru meyvelerin bağlı antioksidan kapasitesinin taze meyvelerin antioksidan kapasitesinden daha yüksek değerlere sahip olduğu gözlenmiştir. Öte yandan, dağ meyvelerinin biyoalınabilir antioksidan kapasitelerinin kurutulmuş örneklerde 21.83 ile 320.75 µmol trolox/100g arasında değiştiği tespit edilmiştir. Araştırmada kullanılan dağ meyvelerinin % biyoalınabilir antioksidan kapasitesi taze örnekler için % 2.88 (kocayemiş) değeri ile en düşük DPPH metodunda, en yüksek ise %35.60 (kızılçık) değeri ile CUPRAC metodunda belirlenmiştir. Benzer şekilde % biyoalınabilir antioksidan kapasite kurutulmuş örneklerde %2.82 (kocayemiş) değeri ile en düşük DPPH metodunda, %28.88 (kızılçık) değeri ile ise en yüksek CUPRAC metodunda tespit edilmiştir. Elde edilen tüm veriler karşılaştırıldığında, özellikle kurutulmuş dağ meyvelerinin toplam fenolik bileşen, antioksidan kapasite ve biyoalınabilirlik değerleri açısından iyi birer doğal kaynak olduğu sonucuna varılabilir ki bu da besinsel açıdan kaliteli olan bu meyvelerin potansiyel olarak sağlıklı birer atıştırmalık gıda olarak tüketilebileceğini göstermektedir.

Anahtar Kelimeler: Dağ meyvesi, kızılçık, kocayemiş, atıştırmalık gıda, toplam fenolik bileşen, antioksidan kapasite, biyoalınabilirlik



FOREST FRUITS AS A HEALTHY SNACK: DRIED CORNELIAN CHERRY (*Cornus mas* L.) AND DRIED ARBUTUS BERRY (*Arbutus unedo*)

ABSTRACT

Nowadays most of the consumers eat up the snack foods to have a good time. Snack foods such as chips, cookies, crackers, chocolates and candies contain large amounts of refined sugar, salt and fat. Unfortunately, these kinds of ingredients can cause most of the diseases just as obesity, diabetes, heart disease and malnutrition. However, in addition to this, with the change in people's dietary habits towards healthy foods; food manufacturers have been paying attention to developing new products with high sensory appeal and positive health properties. As mentioned in most of the research, fruits include; mineral, vitamin, antioxidant, and dietary fiber content, these might prevent most of the diseases. Although the positive effects of fruits on health are known, most people do not have the habit of consuming fruit due to the time required to prepare the fruit. The dried fruits can get people to adopt a fruit consumption habit with its ready to eat shape. In this study, the total phenolic content, antioxidant capacity and in vitro bioaccessibility of cornelian cherry and arbutus berry, which are forest fruits, were investigated to prove these fruits can have the potential as an alternative healthy snack food. According to the results; the total phenolic content of the fresh fruits was found to be between 852.47 to 1846.4 mg GAE/100g for cornelian cherry and arbutus berry, respectively. This ratio was determined for dried fruits as 3465.97 mg GAE/100g for cornelian cherry and 3696.54 mg GAE/100g for arbutus berry. On the other hand, the bioaccessibility of total phenolics was found to be higher in the dried arbutus berry (1165.39 mg GAE/100g). When the antioxidant capacity of the forest fruits investigated in the study was evaluated, it was observed that in all methods (ABTS, CUPRAC and DPPH), the antioxidant capacity of dried fruits was higher than the fresh fruits. In the other respect, it was determined that the bioaccessible antioxidant capacities of dried forest fruits varied between 21.83 and 320.75 $\mu\text{mol Trolox}/100\text{g}$. The bioaccessible antioxidant capacity of the forest fruits used in the study was found to be the lowest in the DPPH method (2.88% fresh arbutus berry) and the highest value in the CUPRAC method (35.60% fresh cornelian cherry). Similarly, the bioaccessible antioxidant capacity of the dried samples was determined to be the lowest in the DPPH method with a value of 2.82% (dried arbutus berry) and the highest in the CUPRAC method with 28.88% (dried cornelian cherry). When the obtained data are compared, it can be concluded that especially dried forest fruits are good natural sources in terms of total phenolic component, antioxidant capacity and bioaccessible values, which indicates that these nutritionally high-quality fruits can potentially be consumed as a healthy snack food.

Keywords: Forest fruit, cornelian cherry, arbutus berry, snack food, total phenolic component, antioxidant capacity, bioaccessibility



GİRİŞ

Az miktarda meyve ve sebze tüketiminin aksine fazla miktarda doymamış yağ ve şeker içeriği yüksek olan gıdaların tüketimi (Vik ve ark., 2020), aşırı kilo/obezite (WHO, 2016a), yüksek kan basıncı, yüksek kan şekeri ve kolesterol (WHO, 2016b) gibi metabolik/fizyolojik değişikliklerle ilişkilendirilmektedir.

Yapılan epidemiyolojik çalışmalar düzenli olarak ya da artan miktarda meyve ve sebze tüketiminin kronik hastalık risklerini azaltabileceğini göstermektedir (Rimm ve ark., 1996; Sun-Waterhouse ve ark., 2010) ki söz konusu bu sağlık faydaları temel olarak meyve ve sebzelerin antioksidan ve diyet lif içerikleri ile ilişkilendirilir (Williamson ve ark., 2000; Sun-Waterhouse ve ark., 2010).

Sağlıklı, doğal ve kullanışlı atıştırılabilirler dünya pazarında bir trend haline gelmiştir (Monteiro ve ark., 2020). Özellikle meyve ve sebze cipslerinin sahip oldukları duyu ve besinsel karakteristikler tüketicilerin tercih sebebinin arttırmaktadır (Yi ve ark., 2016). Bu nedenle, atıştırılabilir meyveler, tüketicilerin sağlıklı gıdalara karşı artan taleplerini karşılamakta günlük diyetin vazgeçilmezidir (Feng ve ark., 2021).

Oksidatif stress sonucu meydana gelen bir çok hastalığı önlemede olumlu etkileri nedeni ile antioksidan içeren gıdalara olan talep günümüzde oldukça artmıştır (Frankel ve Meyer, 2000). Fenolik bileşikler ise; serbest radikal temizleyici, hidrolitik ve oksidatif enzimleri inhibe edici ve anti-inflamatuar etki gibi sağlık üzerine faydalı özellikleri ile bilinmektedir (Wootton-Beard ve ark., 2011). Bu özellikleri nedeni ile fenolik bileşiklerin antioksidan özellikleri yüksektir (Lu ve Foo 2001; Murty ve ark., 2002). Yapılan bir çok araştırma meyve ve sebzelerin fenolik bileşenler ve antioksidan aktivite bakımından zengin bir kaynak olduğunu göstermektedir (Kumar- Reddy ve ark., 2010).

Son yıllarda yapılan çalışmalar sonucunda, gıdalar ile alınan besin öğelerinin tamamının biyolojik olarak kullanılmadığı tespit edilmiştir. Biyoalınabilirlik, gıda maddesinin fiziksel özelliği, kimyasal bileşimi ve bireysel sindirim kapasitesi gibi birçok nedene bağlı olarak değişmektedir (Sandström, 2001). Kısacası biyoalınabilirlik gıda maddelerinde bulunan bileşenlerin sindirim sisteminde emilen miktarıdır (House, 1999). Bu nedenle bir gıdanın besin bileşenlerinin biyoalınabilirliğinin belirlenmesi potansiyel sağlık faydalarının ortaya koyulmasında büyük önem arz etmektedir.

Kızılçık ve kocayemiş genellikle doğal olarak ve sezonluk yetişen dağ meyveleridir. Her iki meyvenin de hasat süresi çok kısadır. Bu nedenle kızılçık genellikle marmelat olarak tüketilirken, kocayemiş ise taze halinde tüketilmektedir. Bu çalışmanın amacı kurutularak raf ömrü uzatılmış kızılçık ve kocayemiş meyvelerinin toplam fenolik madde, antioksidan kapasite ve *in-vitro* biyoalınabilirliklerinin belirlenmesidir. Bu sayede doğal olarak yetişen dağ meyvelerinin potansiyel sağlık faydaları belirlenecek ve sağlıklı birer atıştırılabilir gıda olarak kullanılabilirlikleri hakkında yorum yapılabilecektir.



MATERYAL ve YÖNTEM

MATERYAL

Bu çalışmada kullanılan kızılçık (*Cornus mas L.*) ve kocayemiş (*Arbutus unedo*) meyveleri Batı Karadeniz Bölgesinde bulunan Düzce ilinin dağlarından toplanmıştır. Taze dağ meyvelerine ait fotoğrafı Şekil 1’de verilmiştir.



Kızılçık (Cornus mas L.)



Kocayemiş (Arbutus unedo)

Şekil 1. Taze dağ meyveleri

2.2. YÖNTEM

2.2.1. MEYVELERİN KURUTULMASI

Hasat zamanı tam olgunluk durumuna gelmiş olan dağ meyveleri toplanmış. Yabancı maddelerden arındırıldıktan sonra 45°C’deki hava akımlı kurutucuda nem içeriği yaklaşık %10-12 oluncaya kadar kurutulmuştur. Kurutulmuş dağ meyvelerine ait fotoğraf Şekil 2’de verilmiştir. Kurutulmuş meyveler analizler yapılncaya kadar hava almayacak şekilde cam kavanozlar içerisinde muhafaza edilmiştir.



Kızılçık (Cornus mas L.)



Kocayemiş (Arbutus unedo)

Şekil 2. Kurutulmuş dağ meyveleri

2.2.2. FENOLİK BİLEŞENLERİN SERBEST, BAĞLI VE BİYOALINABİLİR FRAKSİYONLARININ EKSTRAKSİYONU

Dağ meyvelerinin serbest, bağlı ve biyoalınabilir fraksiyonları Vitali ve ark. (2009) tarafından geliştirilen metot üzerinde küçük modifikasyonlar yapılarak belirlenmiştir. Her bir örnek ve her bir ekstraksiyon fraksiyonu için üç tekrar yapılmıştır. Serbest fraksiyon, bağlı fraksiyondan elde



edilen kalıntı kullanılarak belirlenmiştir. Her iki fraksiyonda da toplanan supernatantlar analizler yapıncaya kadar -20°C’de muhafaza edilmiştir.

Biyoalınabilir fraksiyonların belirlenmesinde *in-vitro* ortamda oluşturulan enzimatik ekstraksiyon metodu kullanılmıştır. Bu *in-vitro* metot sindirim ve bağırsak sistemini taklit etmektedir (Vitali ve ark., 2009).

2.2.3. TOPLAM FENOLİK BİLEŞENLERİN BELİRLENMESİ

Tüm fraksiyonlarda toplam fenolik bileşenlerin belirlenmesinde Folin-Ciocalteu kolorimetrik metodunun modifiye versiyonu kullanılmıştır (Xu ve ark., 2009). Örneklere uygulanan prosedür sonunda, absorbas değerleri 750 nm’de (Shimadzu UV-VIS Spektrofotometre) okunmuştur. Toplam fenolik bileşen miktarı serbest ve bağlı fraksiyonlar toplanarak hesaplanmıştır. Elde edilen sonuçlar kurumadede mg gallik asit ekuvalent/100 g cinsinden (mg GAE/100g dw) verilmiştir.

2.2.4. ANTIOKSİDAN KAPASİTENİN BELİRLENMESİ

Gıdalarda bulunan antioksidan kapasitenin belirlenmesinde kullanılan çok sayıda literatür bulunmaktadır. Bu çalışmada, serbest, bağlı ve biyoalınabilir fraksiyonların antioksidan kapasitesinin belirlenmesinde ABTS (Apak ve ark., 2007), CUPRAC (Apak ve ark., 2004) ve DPPH (Brand-Williams ve ark., 1995) yöntemleri kullanılmıştır. Örneklerin absorbansları her bir yöntem için sırası ile 734 nm, 450 nm ve 515 nm’de ölçülmüştür. Elde edilen sonuçlar μ mol Troloks ekuvalent ağırlığı (μ mol Troloks/100g) üzerinden hesaplanmıştır.

2.2.5. BİYOALINABİLİR FENOLİKLERİN BELİRLENMESİ

Biyoalınabilir fenoliklerin belirlenmesinde Folin-Ciocalteu spektrofotometrik yöntemi kullanılmış ve sonuçlar mg gallik asit ekuvalent (mg GAE/100g) cinsinden verilmiştir. Mevcut çalışmada, antioksidanların biyoalınabilirliği ve fenoliklerin biyoalınabilirliği (%) de hesaplanmıştır (Anson ve ark., 2009).

2.3. İSTATİSTİKSEL ANALİZ

Dağ meyvelerinin analizlerinden elde edilen veriler istatistiksel olarak JMP In 7.0.0 (Statistical Discovery from SAS 2005. Institute Inc., Chicago, USA) programında varyans analizi yapılarak değerlendirilmiştir. Ortalama değerler arasındaki istatistiksel farklılıkların belirlenmesinde en küçük önemli fark (LSD) testi uygulanmıştır.

3. BULGULAR ve TARTIŞMA

3.1. DAĞ MEYVELERİNİN TOPLAM FENOLİK BİLEŞEN MİKTARI

Dağ meyvelerinin serbest, bağlı ve toplam fenolik bileşen içerikleri Tablo 1’de gösterilmiştir. Elde edilen sonuçlara göre, taze örneklerin toplam fenolik bileşen içeriği kızılcık meyvesinde 852.47 mg GAE/100 g, kocayemiş meyvesinde ise 1846.4 mg GAE/100 g olarak tespit edilmiştir. Kuru örneklerde tespit edilen toplam fenolik bileşen içeriği kızılcık ve kocayemiş meyveleri için sırası ile 3465.97 mg GAE/100 g ve 3696.54 mg GAE/100 g olarak hesaplanmıştır.



Table 1. Dağ meyvelerinin farklı fraksiyonlarının toplam fenolik bileşen içeriği

Örnek	Serbest Fraksiyon (mg GAE/100 g)		Bağlı Fraksiyon (mg GAE/100 g)		Toplam Fenolik Bileşen* (mg GAE/100 g)	
	Taze**	Kuru***	Taze**	Kuru***	Taze**	Kuru***
Kızılcık	418.80 ^b ±1.7 3	1701.35 ^b ±3.7 2	433.67 ^b ±3.78	1764.62 ^b ±3.7 2	852.47 ^b ±10.5 1	3465.97 ^b ±14.4 7
Kocayemiş	808.28 ^a ±1.68	891.47 ^a ±1.31	1038.12 ^a ±1.3 2	2805.07 ^a ±1.65	1846.4 ^a ±16.25	3696.54 ^a ±13.53

* Toplam fenolik bileşen miktarı ekstrakte ve hidrolize fraksiyonlar toplanarak hesaplanmıştır.

** Taze ağırlık

*** Kuru ağırlık

Aynı sütunda aynı harfler ile gösterilen ortalama değerler arasında istatistiksel ($p \leq 0.05$) olarak önemli fark bulunmamaktadır

Veriler ortalama \pm standart sapma olarak ifade edilmiştir (n=3)

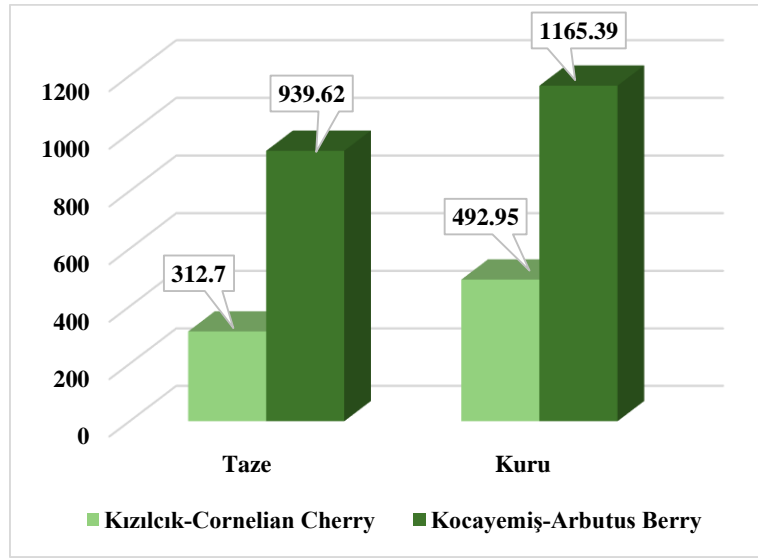
Kılmanoğlu (2010) çalışmasında kızılçık meyvesinin toplam fenolik madde miktarını 1124 mg GA/100 g olarak tespit edildiğini bildirmiştir. Kızılcık (vermio cinsi) üzerine yapılan bir çalışmada toplam fenol miktarı 1592 mg GA/100g kuru ağırlık olarak bildirilmiştir (Pantelidis ve ark. 2007). Bir başka çalışmada ise kızılçık meyvesinin toplam fenol içeriği kuru ağırlık üzerinden 1600 mg GA/100g olarak bildirilmiştir. Uygun ve Özbey'in (2008) yaptığı çalışmada farklı kızılçık çeşitlerinin toplam fenolik madde içeriği 224.25, 898.25 ve 1124.91 mg GA/100g olarak bildirilmiştir. Söz konusu bu farklılıkların bitki çeşidinden ve içerdikleri fenolik bileşenlerden kaynaklandığı düşünülmektedir.

Kocayemiş meyvesi ile çalışan Yıldız (2014) bu meyvenin toplam fenolik madde miktarının 160.79-346.91mg GAE/100g (kuru ağırlık) arasında tespit edildiğini bildirmiştir. Benzer bir çalışmada Özgen ve ark. (2009), turuncu-kırmızı ve kırmızı renge sahip kocayemiş meyvelerinin toplam fenolik madde miktarını sırası ile 2858 mg GA/kg ve 3904 mg GA/kg olarak bildirmişlerdir.

Sonuç olarak mevcut çalışmada kurutulmuş kızılçık meyvesinin taze kızılçık meyvesinden yaklaşık olarak 4 kat, kurutulmuş kocayemiş meyvesinin ise taze kocayemiş meyvesinden yaklaşık 2 kat daha fazla toplam fenolik bileşen içerdiği tespit edilmiştir. Elde edilen veriler değerlendirildiğinde mevcut çalışmanın ana konusu olan kurutulmuş kızılçık ve kocayemiş meyvelerinin toplam fenolik bileşen miktarlarının diğer çalışmalara kıyasla oldukça yüksek tespit edilmesi, bu meyvelerin iyi bir fenolik madde içeriği ile alternatif bir atıştırma olarak tüketilebileceğini göstermektedir.

3.2. DAĞ MEYVELERİNİN FENOLİK BİLEŞENLERİN BİYOALINABİLİRLİĞİ

Mevcut çalışmada fenolik bileşenlerin biyoalınabilirliği tespit edilmiş ve elde edilen veriler Şekil 3'de verilmiştir. Elde edilen sonuçlar değerlendirildiğinde hem kurutulmuş örneklerin biyoalınabilir fenolik bileşenlerinin taze örneklerden daha yüksek olduğu tespit edilmiştir.



Şekil 3. Fenolik bileşenlerin biyoalınabilirliği (mg GAE/100g)

Bir çok çalışmada da belirtildiği gibi, tüketilen gıdaların içerdiği tüm besin bileşenleri vücut tarafından emilemez. Bu nedenle gıdaların biyoalınabilirlik oranı çok önemlidir. Tüketilen her gıdanın biyoalınabilirliği, gıda bileşenlerinin hücre zarından bağırsağa geçişi ile ilgilidir. Buna göre; fenolik bileşenlerin biyoalınabilirliği (%) fenolik bileşenlerin hücre zarından, bağırsaklara geçişi ile ilgilidir. Kısaca, gıda örneklerinin orjinal fenolik bileşen miktarı, bu hücrelerdeki fenoliklerin miktarına bağlıdır (Gunathilake ve ark., 2018).

3.3. DAĞ MEYVELERİNİN ANTIOKSİDAN KAPASİTESİ

Dağ meyvelerinin serbest ve bağlı fraksiyonlarının antioksidan kapasiteleri ABTS, CUPRAC ve DPPH metotlarına göre belirlenmiştir. Elde edilen sonuçlar Tablo 2’de verilmiştir. ABTS yönteminde hem taze hem de kurutulmuş örnekler incelendiğinde kocayemiş meyvesinin antioksidan kapasitesinin daha yüksek olduğu tespit edilmiştir. CUPRAC yönteminde kızılçık meyvesinin, kocayemiş’ten daha yüksek bağlı antioksidan kapasiteye sahip olduğu gözlenirken, kocayemişlerin serbest antioksidan kapasitesi kızılçıktan daha yüksek olduğu tespit edilmiştir. DPPH yönteminde ise kurutulmuş kocayemiş meyvelerinin hem serbest hem de bağlı antioksidan kapasitesi, kızılçık meyvesinden yüksek bulunmuştur.

Tablo 2. Dağ meyvelerinde farklı fraksiyonların antioksidan kapasitesi ($\mu\text{mol Trolox mg}/100\text{ g}$)

Örnek	Metot	Taze		Kuru	
		Serbest Fraksiyon	Bağlı Fraksiyon	Serbest Fraksiyon	Bağlı Fraksiyon
Kızılcık Kocayemiş	ABTS	190.40 ^c ± 0.21	361.17 ^c ± 0.10	301.40 ^c ± 0.12	369.72 ^f ± 0.11
		343.92 ^a ± 0.06	411.22 ^a ± 0.04	365.31 ^a ± 0.16	447.69 ^e ± 0.02
Kızılcık Kocayemiş	CUPRAC	119.10 ^e ± 4.59	347.06 ^d ± 1.31	145.50 ^f ± 1.85	844.13 ^a ± 1.24
		254.82 ^b ± 1.13	371.52 ^b ± 4.10	317.06 ^b ± 2.80	803.30 ^b ± 1.31
Kızılcık Kocayemiş	DPPH	111.25 ^f ± 0.15	231.4 ^f ± 2.98	278.51 ^d ± 0.74	774.23 ^c ± 0.42
		149.51 ^d ± 0.60	298.00 ^e ± 1.68	158.31 ^e ± 0.04	767.12 ^d ± 1.11

Aynı sütunda aynı harfler ile gösterilen ortalama değerler arasında istatistiksel ($p \leq 0.05$) olarak önemli fark bulunmamaktadır.

Veriler ortalama \pm standart sapma olarak ifade edilmiştir (n=3)



Celep ve ark. (2012) yaptıkları çalışmada, kızılçık meyvesinin antioksidan kapasitesini CUPRAC, DPPH ve FRAP yöntemleri ile analiz etmiş ve antioksidan kapasitesi değerlerini sırası ile 20.9mg askorbik asit/g, 725 $\mu\text{g}/\text{mL}$ ve 0.42 mM FeSO_4 olarak tespit etmiştir. Kızılçık meyvesi ile çalışan Tarko ve ark. (2014) ise bu meyvenin antioksidan kapasitesini 7123.0 μM Trolox/100g olarak tespit ettiklerini bildirmişlerdir.

Yıldız (2014) kocayemiş ile yaptığı çalışmada DPPH yöntemi ile belirlediği antioksidan kapasitenin 15.59-26.21 $\mu\text{g}/\text{mg}$ arasında değiştiğini bildirmiştir. Bir başka çalışmada turuncukırmızı ve kırmızı kocayemiş meyvesinin antioksidan kapasitesi FRAP yöntemi ile sırası ile 17.6 ve 25.8 $\mu\text{mol TE}/\text{g}$ olarak belirlenmiştir.

Tüm örnekler karşılaştırıldığında kurutulmuş meyvelerin antioksidan kapasitesi, taze meyvelerin antioksidan kapasitesinden daha yüksek tespit edilmiştir. Elde edilen bu sonuç da kurutulmuş dağ meyvelerinin antioksidan kapasite açısından alternatif bir atıştırılabilirlik olarak tüketilebileceğini göstermektedir.

3.4. BİYOALINABİLİRLİK

Usal ve Sahan (2020) bildirildiği üzere, gıdaların toplam fenolik bileşen ve antioksidan kapasitesi bir diyete bağlı besinsel içeriği her zaman göstermeyebilir. Bu nedenle, besinlerin gerçek biyoalınabilirliğinin doğrulanması gerekmektedir. Biyoalınabilirlik, tüketilen besinlerdeki biyoaktif bileşenlerin fizyolojik işlevlerde kullanıldıktan sonra, organizma tarafından emilmesi ve depolanmasıdır (Fernandez-Garcia ve ark., 2009; Rebellato ve ark., 2015).

Yapılan literatür araştırmasında kızılçık ve kocayemiş meyvelerinin biyoalınabilirliği ile ilgili yapılmış herhangi bir çalışmaya rastlanmamıştır. Bu çalışmada araştırılan kızılçık ve kocayemiş meyvelerinin antioksidan kapasitenin biyoalınabilirliği Table 3’de verilmiştir.

Table 3. Dağ meyvelerinin antioksidan kapasitesinin biyoalınabilirliği ($\mu\text{mol Trolox}/\text{g}$)

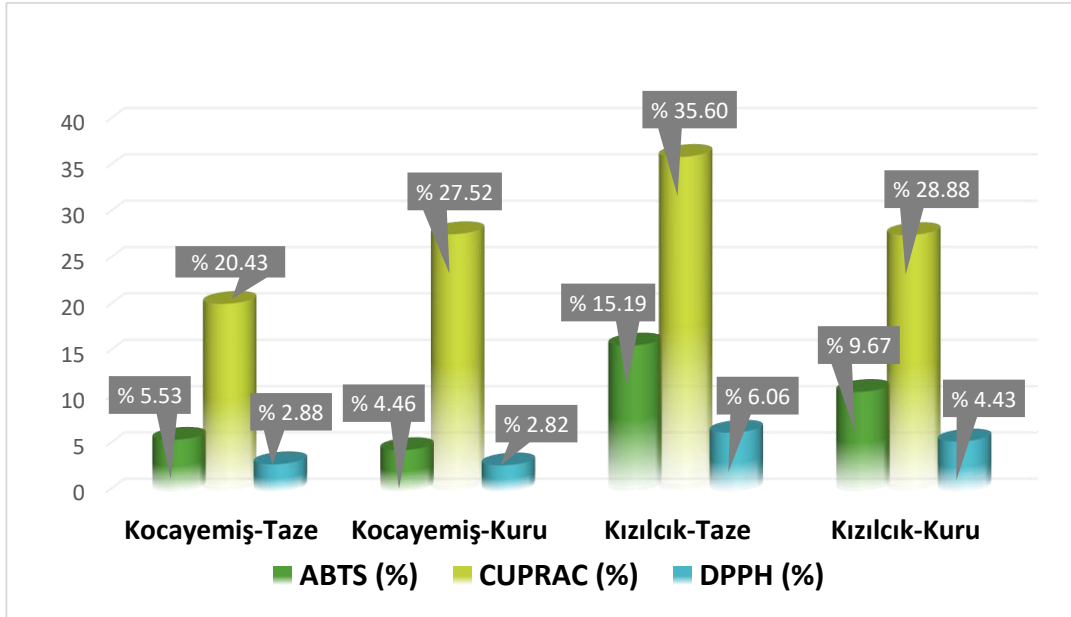
Örnek	Metot	Taze	Kuru
Kızılçık	ABTS	47.50 ^b ± 1.32	47.67 ^b ± 1.29
Kocayemiş		51.99 ^a ± 4.25	52.02 ^a ± 4.24
Kızılçık	CUPRAC	111.29 ^b ± 3.92	142.34 ^b ± 8.49
Kocayemiş		192.05 ^a ± 4.94	320.75 ^a ± 2.26
Kızılçık	DPPH	18.95 ^b ± 4.87	21.83 ^b ± 1.10
Kocayemiş		27.03 ^a ± 1.36	32.88 ^a ± 2.15

Aynı sütunda aynı harfler ile gösterilen ortalama değerler arasında istatistiksel ($p \leq 0.05$) olarak önemli fark bulunmamaktadır.

Veriler ortalama \pm standart sapma olarak ifade edilmiştir (n=3)

Elde edilen sonuçlar incelendiğinde dağ meyvelerinin antioksidan kapasitesinin biyoalınabilirlik değerlerinin taze örneklerde 18.95 $\mu\text{mol Trolox}/\text{g}$ ile 111.29 $\mu\text{mol Trolox}/\text{g}$ arasında değiştiği, kuru örneklerde ise 21.83 $\mu\text{mol Trolox}/\text{g}$ ile 320.75 $\mu\text{mol Trolox}/\text{g}$ arasında değiştiği tespit edilmiştir. Tüm sonuçlar incelendiğinde CUPRAC metodunda elde edilen verilerin istatistiksel olarak en yüksek değerlere sahip olduğu gözlenmiştir. Öte yandan, kurutulmuş dağ meyvelerinin biyoalınabilir antioksidan kapasitesinin taze örneklerden daha yüksek olduğu da gözlenmiştir.

Çalışma kapsamında dağ meyvelerinin % biyoalınabilirlik değerleri de hesaplanmış ve sonuçları Şekil 4’de verilmiştir.



Şekil 4. Antioksidan kapasitenin % biyoalınabilirliği

Sonuçlara göre; metotlar açısından değerlendirme yapıldığında en düşük değerlerin DPPH metodunda (taze kocayemiş meyvesinde %2.82) elde edildiği, en yüksek değerlerin ise CUPRAC metodunda (taze kızılcık meyvesinde %35.60) elde edildiği gözlemlenmiştir.

SONUÇ

Bu çalışmada raf ömürleri oldukça kısa olan dağ meyvelerinin (kızılcık ve kocayemiş) kurutularak alternatif bir sağlıklı atıştırma gıda olarak tüketilme potansiyeli araştırılmıştır. Elde edilen tüm veriler karşılaştırıldığında, özellikle kurutulmuş dağ meyvelerinin toplam fenolik bileşen ve antioksidan kapasite açısından iyi birer doğal kaynak olduğu sonucuna varılabilir. Biyoalınabilirlik değerleri de oldukça iyi çıkan meyvelerin besinsel açıdan kaliteli olduğu ve incir, üzüm, kayısı, dut gibi diğer kurutulmuş meyvelere alternatif olarak potansiyel birer sağlıklı atıştırma gıda olarak tüketilebileceği düşünülmektedir. Taze ya da marmelat halinde tüketilen bu meyveler kurutularak farklı bir ürün formuna dönüştürülmüştür. Söz konusu bu dağ meyveleri kurutulduğu için raf ömürleri uzamış ve yıl boyunca tüketilebilme olanağı doğmuştur. Bu sayede sağlıklı, doğal ve kullanışlı ürünler olarak tüketiciler tarafından satın alınabilecek ticari bir ürün olarak ekonomiye de katkı sağlayabilecekleri düşünülmektedir.



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THE INVESTIGATION OF THE IMPACT OF SMOKING PROCESS ON THE DNA DEGRADATION IN DIFFERENT FISH SPECIES

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ABSTRACT

Seafood products have gained importance in the food industry owing to their nutritional benefits and easily digestibility. Fish species have a great proportion of seafood market. While consuming of fish species as fresh form was common in the past, within technological improvements in food industry and globalized, processed fish products by different techniques have started to consume frequently. Smoking is one of the most commonly applied processing technique due to it can be easily apply to various fish species and its aromatic benefits. In Turkey, eel (*Anguilla anguilla* L.), rainbow trout (*Onchorhynchus mykiss*), mackerel (*Scomber scombrus*) species commonly used for smoking. Smoked salmon (*Salmo salar*) has started sell commonly in national seafood industry and has exported to different countries, recently. While the species identification of fish and other aquatic species morphologically is very easy when they are raw form. However, when fish and other species thermally processed, lost their physical integrity or packaged form, the species identification has become difficult. Molecular techniques used very commonly in traceability analyses in seafood like other food commodities due to they are more reliable methods than other methods. The quality and yield of extracted DNA are the initial requirements for the achievements of molecular based traceability analyses. Thermal processing or treating with some aroma additives cause to DNA degradation and make difficult to species identification procedure. This research was aimed at the determination of DNA degradation during smoking different species, which have the economic importance in national seafood market and exporting market. For this aim, the DNA extracted from prior and post stages of thermal smoked trout, eel, mackerel and salmon and quality analyses performed for assessing DNA yield, purity and contamination of any substances. The results revealed that smoking procedure, reduce the DNA yield in all fish species. While the DNA yield was determined as 697.5, 871.7, 724.6 and 414.1 ug/uL for raw trout, salmon, mackerel and eel., respectively, these values determined as 293.4, 355.9, 49.1 and 116.4 ug/uL following to smoking process in the same order. There was no statistically significance determined among groups in terms of purity. Smoking process caused to increase in contamination value. This could be a caused by salt and aromatic compounds used during the smoking process

Keywords: smoking, fish, DNA degradation, food security, thermal processing



1. INTRODUCTION

Seafood products have considered important food commodities owing to their nutritional and functional benefits. While, consumption of seafood especially fish species was fresh in the past, within consumer demands and technological improvements, processed fish species by several techniques have gained importances over the last years. Smoking is one of the most commonly applied processing methods globally depending on local fisheries stocks and consumer preference. The specific taste and aroma of smoked fish are the main reason of the most of the consumer demands (Kobajashi et al.,2012).Relatively fatty fish species are considered as more suitable for smoking process due to they absorb the flavour which cause to admirable taste of end product (Tenyang et al.,2017).Tuna,mackerel,salmon,anchovy and eel are the most commonly smoked fish species globally owing to their high lipid content. Similar to other countries, the market size of smoked fish products have increased in Turkey depending on consumer demands. Smoked fish products have not only taken a part in national market, they also have exported to another countries.Eel, mackerel and trout have frequently smoked in most of the seafood processing plant in Turkey, smoking of salmon has become

Fraduelent activities in food products have become serious problem globally.Species substitution, mislabelling and species adulteration are most commonly known fraduelent activities in food industry. These types of activities have caused to more dangerous results in seafood products due to their toxic and allergic risk. Species identification is a main challenge in processed and packaged fish products due to the differences in shape,size and other physical properties during processing stage.Fraduelent activities also cause to negative impact on ecology and biodiversity by excessive usage of some species and unreported fishing (Giusti et al., 2019). Within the increasing fraduelent food products scandal; precautions for these activities and controlling sytems have improved. For controlling the fraduelent activites in food products, some instumental methods such as chromatographic and spectroscopic analyses have utilized over the last years, molecular analyses have started to being popular owing to their relatively higher reliability rate. The achievement of molecular based methods depends on DNA quality, amplification, sequencing and bioinformatic stages. The extracted DNA is the primary requirements for succesfully tracebility analyses. Thermal process, salt, used aroma components and extraction process effect the quality of DNA (Chapela et al.,2007). Low DNA yield and DNA purity or any contamination during the DNA extraction limits the sequencing and tracebility analyses.

Due to smoking of fish sepecies consisting salting, thermal process and smoking practice, all these processes cause to degredation of DNA. Fat content of fish species also effect the smoking process and thermal treatment impacts on the raw material. In the light of this, the aim of present study was to assess the DNA degradation in different fish species impacted by smoking rocess. DNA quality and yield are assessed from fish smoking; trout, eel, mackerel and salmon species considered as different species and the yield, quality and contamination o extraction was tested in raw and smoked fish species.

2. MATERIAL and METHOD

2.1 PRODUCTS SAMPLING

Both raw and smoked fish sample obtained from Turkish fish processing plant. All the sample chosen from the same origin in terms of catching season and area for avoiding any variation originated from fish sample.Eel (*Anguilla anguilla L.*), rainbow trout (*Onchorhynchus mykiss*), mackerel (*Scomber scombrus*) and salmon (*Salmo salar*) species obtained from same origin.All the raw samples were stored at -80° C. Hot smoking procedure procedure performed according



to commercial protocol as filleting, salting, cooking, smoking and vacuum packaged. All the smoked samples were stored at -80°C following to smoking and reaching to ambient temperature.

2.2 DNA EXTRACTION

Raw, and smoked fish samples were pre-treated for removing oils and any contaminants by blotting with sterile filter paper and each sample was then subjected to extraction method according to commercial kit. The DNA extraction from raw and smoked fish was carried out through the manufacturer's procedure and the following minor modifications. Initially, 20 mg sample, 250 μL Buffer ATL and 20 μL Proteinase K were mixed and heated at 56°C until the tissue was entirely lysed. Then, the mixture was centrifuged at 12000 g for 30 second and supernatant transferred to another tube. 250 μL extraction buffer and heated at 56°C for 10 minutes. The spin column washed with AW1 and AW2 with the 650 μL and 500 μL volume, respectively. Finally, the purified DNA was eluted with 200 μL pre-heated at 37°C Buffer AE. The purified DNA from fish materials was stored at -20°C until for next steps.

2.3 DETERMINATION OF DNA QUALITY

The yield of extracted DNA ($\mu\text{g}/\text{mL}$) from both raw and smoked fish species and quality parameter as purity and contamination determined by 260/230 and 260/280 ratios measured by means of a NanoDrop 1000 spectrophotometer (Thermo Scientific, Pittsburgh, Pa, USA).

2.4. STATISTICAL ANALYSIS

All statistical analyses were performed using Software IBM SPSS version 16.0. For comparison of the yield of DNA extracted from all fish sample (raw and smoked), a two-way cross-classification analysis of variance (ANOVA) was performed. Differences were considered statistically significant at a level of 5% ($P < 0.05$) All the DNA quality analyses were conducted in triplicate assays for each fish sample.

3 RESULTS and DISCUSSION

3.1. DETERMINATION OF DNA QUALITY

The results of extracted DNA from raw and smoked fish samples are shown in Figure 1 and Table 1. The DNA yield was calculated based on DNA concentration, initial fish muscle weight and obtained the final volume. There were significant differences found among raw and smoked fish sample ($P < 0.05$) in terms of DNA yield (Table 1, Figure 1)., DNA yield was significantly higher in raw (unprocessed) fish when compared to smoked fish species in all fish groups. Similar results stated by (Piskatá and Pospíšilová, 2016) who found the lower DNA yield from processed fish samples than raw fish muscle. This decline could be related to thermal treatment, salting or smoking processes during hot smoking procedure.

While DNA yield declined from 697.5 to 293.4 $\mu\text{g}/\mu\text{L}$ in raw and smoked trout, respectively, DNA yield was determined as 871.7 to 355.9 $\mu\text{g}/\mu\text{L}$ in raw and smoked salmon., respectively. Similarly, DNA yield determined as 724.6 $\mu\text{g}/\mu\text{L}$ from mackerel and 149.1 $\mu\text{g}/\mu\text{L}$ from smoked mackerel. Initial DNA yield reduced from 414.1 to 116.4 $\mu\text{g}/\mu\text{L}$ in eel sample. The highest differences rate was observed in mackerel samples that can be related to proximate composition differences among fish species groups. Mackerel and eel have relatively higher fat content than trout and salmon. The decline in extracted DNA yield can be related to salt and smoking flavour. It is known that thermal processing of fish species cause to degradation of DNA which are the key requirements for successful traceability analyses (Pollack et al., 2018). Salting also cause to degradation of DNA. Pepe et al., (2007) reported that surimi preparation stages such as

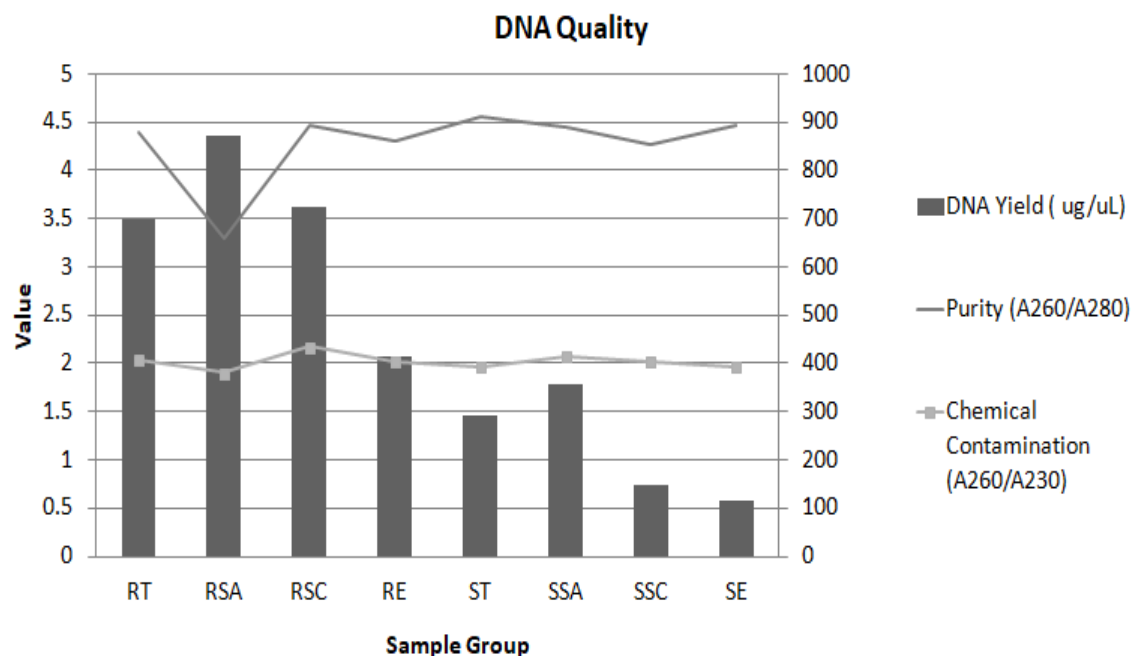


salting, sahping, heating.etc., cause to degradation of DNA and reaching the well extracted DNA become serious problem from these types of products.

Table 4: Quality differences among the raw and smoked fish groups

Type of Fish Muscle	Quality assessment		
	DNA Yield (ug/uL)	Purity (A260/A280)	Chemical Contamination (A260/A230)
Raw trout	697.5±5,23	2.37±0,12	2.03±0,04
Raw salmon	871.7±3,12	1.4±0,03	1.9±0,01
Raw mackerel	724.6±1,22	2.29±0,04	2.17±0,02
Raw eel	414.1±10,25	2.28±0,06	2.02±0,03
Smoked trout	293.4±13,02	2.59±0,03	1.96±0,04
Smoked salmon	355.9±14,02	2.37±0,02	2.07±0,03
Smoked mackerel	149.1±7,62	2.24±0,04	2.02±0,02
Smoked eel	116.4±6,31	2.5±0,03	1.96±0,04

Data are expressed as mean value ± standard deviation of triplicates. Values followed by different letters indicate significant differences (P<0.05) Values in a same column followed by different numbers indicate significant differences of the parameter with respect to (RT:Raw trout;RSA:Raw salmon,RSC:Raw mackerel ;RE:Raw eel , ST: Smoked trout ,SSA: Smoked salmon ,SSC: Smoked mackerel ,SE:Smoked eel)



RT:Raw trout;RSA:Raw salmon,RSC:Raw mackerel ;RE:Raw eel , ST: Smoked trout ,SSA: Smoked salmon ,SSC: Smoked mackerel ,SE:Smoked eel)

Figure 6: Variation of DNA Quality Parameters During the smoking process in different species



The purity of the gDNA is other key factor that can strongly affect the achievements of PCR amplification and sequencing processes in traceability studies. The purity of DNA evaluated with A260/A280 ratio. The most commonly accepted optimal range for purity ratio is between 1.8-2.0 (Piskata et al., 2017). There were some significantly differences were observed among the raw and smoked fish samples (Table 1). While the highest and the lowest values obtained in raw salmon muscle and smoked trout sample with 1.40 and 2.59, respectively,. Smoking process also reduce to purity of DNA except mackerel groups;while the purity was determined as 2.29 and 2.24 in raw and smoked mackerel., respectively.

Another important factor for the achievements of DNA based traceability analyses is the A260/A230 ratio, which is a sign of organic contaminants such as carbohydrates and salts and the value should differ from 2.0 to 2.2 optimally (Lucena-Aguilar et al., 2016). The contamination level was found in accepted limit in most of the fish groups. The differences between raw and smoked samples could be explained by salting process during the smoking application. In the raw material groups the highest contaminant value observed from mackerel samples with is related to high fat content and the highest contamination value was determined in salmon samples among the smoked fish groups. All these differences related to fat content and protein level of different fish species.

4 CONCLUSION

The results of this research clearly show that how the quality, yield and degradation level of DNA change depending on thermal processing, treatment with salt and smoking process. These results will benefits for not only seafood industry but also producer for other food products, which are consumed as smoked such as cheese and olive, or other meat products.



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PREHARVEST SALICYLIC ACID TREATMENT IMPACT ON THE FRUIT QUALITY PROPERTIES OF PEACH cv. MONREO

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ABSTRACT

As with all fruit, improving the quality at harvest time increases the marketability of peaches. In this study, the effects of preharvest salicylic acid treatments on some fruit quality characteristics and biochemical properties of peach cv. Monreo were investigated. The study was carried out in an orchard (in Antalya-Korkuteli, at 2020 year) where routine cultural practices were performed. Different concentrations of salicylic acid (0.5, 1 and 2 mM) were treated to peaches at different times before the estimated harvest date. For control group, distilled water was treated to the peaches. The experiment was set up with three replications according to the randomized block design and each tree was considered a replication. The peaches were harvest at commercial harvest time and transferred to the laboratory. Immediately after harvest, fruit weight (g), fruit width (mm), fruit length (mm), fruit flesh firmness (N), total phenolic content (mg GAE 100 g⁻¹), antioxidant activity (μmol TE g⁻¹), and total sugar (%) and external appearance evaluation were measured. Salicylic acid treatments were more effective than the control group in terms of increasing fruit weight, fruit width and fruit length. There was no statistical difference between the 0.5 mM salicylic acid and the control group in terms of fruit flesh firmness. The external appearance of the fruit treated with salicylic acid was slightly better than the control group. However, no significant difference was found in terms of taste. As a result, it was determined that all salicylic acid concentrations were more effective in improving the quality characteristics examined in the study compared to the control group. Especially 2 mM dose of salicylic acid was found to be more effective in improving the harvest quality of peach cv. Monreo. These positive effects vary according to cultivars, application time and doses, so new studies with different species and cultivars are needed.

Keywords: Quality, preharvest treatment, *Prunus persica*, salicylic acid



1. INTRODUCTION

Peach (*Prunus persica*) belongs to the *Roseaceae* family (Haider et al., 2018). The production of peach in Turkey in 2020 year were about 830.577 ton (FAO, 2021). Peaches are appreciated by consumers as a result of phytochemical compounds. Peach is highly perishable climacteric fruit and is a rich sources of antioxidants, carotenoids and ascorbic acid (Razavi et al., 2018; Shokri Heydari et al., 2020). So its quality at harvest or postharvest period is increasingly taken into consideration.

The fruit quality of peach is greatly affected by several pre-harvest and postharvest factors (Tareen et al., 2012). These factors leads to serious problems in the marketing and transportation of peaches (Ekinci, 2018). In recent years, different preharvest technics have been carried out aiming to improve the quality criteria of peach at harvest time, such as aminoethoxyvinylglycine (Küçüker et al., 2015), putrescine (Ali et al., 2014), oxalic acid (Razavi and Hajilou, 2016) and salicylic acid (SA) (Heydari et al., 2020). SA treatment also leading to increases in total anthocyanins, total phenolics and antioxidant activity (Razavi et al., 2018; Benati et al., 2021).

SA is a hormonal substance and a natural phenolic compounds that are widely distributed in the plants (Giménez et al., 2017). SA is a safe chemical and has been widely treated either at the pre-harvest or postharvest period (Koyuncu et al., 2018). As shown in studies, SA can enhance physical attributes of fruit such as firmness (Salyari et al., 2021), weight and size (Ali et al., 2014). In addition, SA was found to delayed ripening of both non-climacteric and climacteric fruit like grape (Lo'ay, 2017), apricot (Cui et al., 2020), tomato (Changwal et al., 2021) and plum (Martínez-Esplá et al., 2018).

This research aimed to investigate the effect of preharvest SA treatments on some fruit quality characteristics and biochemical properties of peach cv. Monreo.

2. MATERIAL AND METHODS

2.1. Material

Peach cv. Monreo was used as plant material. The ground color of the fruit skin of Monreo peach is orange, the skin has a red color in proportion to the upper color and the flesh has a yellow color.

The study was carried out in an orchard (in Turkey-Antalya-Korkuteli, at 2020 year) where routine cultural practices were performed. Uniform trees, 8-years-old cv. 'Monroe' peach on *P. persica* rootstock, spaced at 6 × 5 m were used.

2.2. Methods

Different doses of SA (0.5, 1 and 2 mM + surfactant Tween 20) were treated to peaches at different times before the commercial harvest date. The spraying was performed with a hand pump sprayer at 7, 21 and 30 days before commercial harvest. For control group, distilled water was treated to the peaches. The peaches were harvest at commercial harvest time and transferred to the laboratory. Immediately after harvest, fruit width (mm), fruit weight (g), fruit length (mm), fruit flesh firmness (N), antioxidant activity ($\mu\text{mol TE g}^{-1}$), total phenolic content (mg GAE 100 g^{-1}) and total sugar (%), sensory evaluation (external appearance) were measured.

Fruit weight was weighed (30 fruit for each replicate) with a scale sensitive to 0.01 g. Fruit length and fruit width were measured by a digital compass (30 fruit for each replicate). Fruit flesh firmness of peaches was measured (30 fruit for each replicate) by using a penetrometer having a plunger of diameter 8 mm. Total phenolic content was determined using the Folin-



Cioalciu method as described by Thaipong et al. (2006). The absorbance was read by a spectrophotometer at 725 nm. Results were calculated as mg of gallic acid equivalent (GAE) per 100 g⁻¹ FW. The ferric reducing antioxidant power (FRAP) assay were used for evaluation of antioxidant activity (Thaipong et al., 2006). The calibration curve was developed using Trolox standard. The absorbance was read by a spectrophotometer at 593 nm. Results were calculated as Trolox equivalents (TE) in mg g⁻¹ FW. The total sugar (%) of peaches was determined to Anthrone method. External appearance was performed on a scale of 1–9 (1–3 = unmarketable, 5 = marketable, 7 = good, 9 = excellent) (Onursal et al., 2015).

2.3. Statistical Analysis

The experiment was set up with three replications according to the randomized block design and each tree was considered a replication. The data were analyzed using Minitab 18 statistics software. The differences among means were compared with LSD test (5%).

3. RESULT AND DISCUSSION

3.1. Fruit Weight (g), Fruit Width (mm) and Fruit Length (mm)

Preharvest SA treatments significantly increased fruit weight compared to control samples. At harvest, the weight of SA treated peaches were 235.99 g (2 mM), 227.82 g (1 mM) and 222.63 g (0.5 mM) whereas, control fruit had 210.72 g fruit weight. No statistical significant differences in fruit width values were observed among treatments. The highest fruit length value (73.53 mm) was obtained from 2 mM SA treated peaches followed by 0.5 mM SA (71.78 mm), 1 mM SA (71.61 mm) and control group (71.26 mm). As a result, it can be stated that SA treatments are more effective in increasing fruit weight, fruit width and fruit length than the control group (Table 1). Likewise, Salyari et al. (2021) indicated that preharvest SA applications generally enhanced the fruit weight, length and width. At the same time, Champa et al. (2015) stated that preharvest SA is effective in improving the fruit quality such as weight and length.

Table 1. The effect of different doses of SA on fruit weight, fruit width and fruit length of Monreio peaches

Treatments	Fruit weight (g)	Fruit width (mm)	Fruit length (mm)
Control	210.72 b	73.45	71.26 b
0.5 mM SA	222.63 ab	74.54	71.78 ab
1 mM SA	227.82 ab	74.02	71.61 ab
2 mM SA	235.99 a	75.04	73.53 a
<i>P values</i>	*	<i>ns</i>	*

ns: represents non-significance at $P < 0.05$; * Represents significance at the 0.05 level. Means followed by different letters are significantly different ($P < 0.05$).

3.2. Fruit Flesh Firmness

Fruit firmness is, probably, one of the most important quality characteristics in peaches for consumer acceptance (Velooso et al., 2021). As shown in Table 2, significant differences were detected between treated and control fruit, but no significant differences were observed among 1 mM and 2 mM SA treated fruits. Higher flesh firmness values were observed in SA treated fruit compared to control. The highest fruit flesh firmness (81.40 N) was detected in 2 mM SA-treated fruit, whereas untreated (control) fruit gave lowest (63.95 N). Similar findings were also stated by Giménez et al. (2017).



Table 2. The effect of different doses of SA on fruit flesh firmness of Monreo peaches

Treatments	Fruit flesh firmness (N)
Control	63.95 c
0.5 mM SA	69.98 b
1 mM SA	77.26 a
2 mM SA	81.40 a
<i>P values</i>	**

** Represents significance at the 0.01 level. Means followed by different letters are significantly different ($P < 0.05$).

3.3. Total Phenol Content and Antioxidant Activity

Peach is an important source of phenolic compounds, which exhibit high antioxidant activity and are essential for human diet. Phenolic compounds also have important role on some quality characteristics of fruit such as color, taste and aroma (Lara et al., 2020). In the present study, the TPC was significantly affected by SA treatment. The preharvest SA treatment enhanced the accumulation of TPC peaches compared to control during fruit growth period. In accordance to TPC, the antioxidant activity of all SA treated fruit (especially 2 mM SA) was higher compared to control fruit as expected (Table 3). There is a highly correlated relationship between total antioxidant activity and total phenolic in fruit. Similarly, it was stated that preharvest SA application had a positive effect on total phenolic content and total antioxidant activity (Giménez et al., 2014; Serna-Escolano et al., 2021).

Table 3. The effect of different doses of SA on total phenol content and antioxidant activity of Monreo peaches

Treatments	Total phenol content (mg GAE 100 g ⁻¹ FW)	Antioxidant activity (μ mol TE g ⁻¹ FW)
Control	62.46 b	8.10 c
0.5 mM SA	63.57 ab	9.44 b
1 mM SA	63.49 ab	9.01 bc
2 mM SA	66.18 a	11.12 a
<i>P values</i>	*	**

** Represents significance at the 0.01 level; * Represents significance at the 0.05 level. Means followed by different letters are significantly different ($P < 0.05$).

3.4. Total Sugar

As shown in Table 4, the highest total sugar content was found in control group. All the SA treatments partially lower this enhancement compared to control group. The highest impact was by 2 mM SA treatment. The result might due to the SA impact on respiration decrease. It was reported that SA treatments was lead to decrease sugar accumulation (Salyari et al., 2021).

Table 4. The effect of different doses of SA on total sugar of Monreo peaches

Treatments	Total sugar (%)
Control	5.36 a
0.5 mM SA	5.24 ab
1 mM SA	5.28 ab
2 mM SA	5.13 b
<i>P values</i>	*

* Represents significance at the 0.05 level. Means followed by different letters are significantly different ($P < 0.05$).



3.5. External Appearance

Treatments were not significant effects on the scores of external appearances. However, the positive effect of SA on external quality appears to have appeared in higher doses (2 mM). As shown in Figure 1, 2 mM SA treatment had the highest external appearance score (8.83), followed by 1 mM SA (8.56), 0.5 mM SA (8.50) and Control (8.39) treatments.

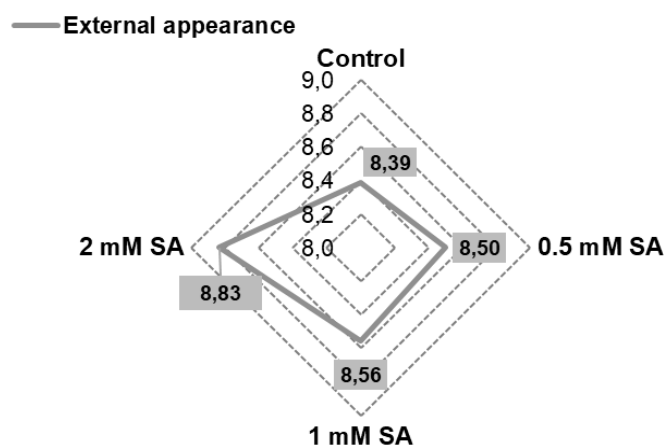


Figure 1. The effect of different doses of SA on external appearance (1-9 score) of Monreo peaches

4. CONCLUSION

Salicylic acid treatments were more effective than the control group in terms of increasing fruit weight and fruit flesh firmness. The external appearance of the fruit treated with salicylic acid was slightly better than the control group. However, no significant difference was found in terms of external appearance. As a result, it was determined that all salicylic acid concentrations were more effective in improving the quality characteristics examined in the study compared to the control group. Especially 2 mM dose of salicylic acid was found to be more effective in improving the harvest quality of peach cv. Monreo. These positive effects vary according to cultivars, application time and doses, so new studies with different species and cultivars are needed.



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REOSURCES AND USES OF THE FOREST SECTOR IN ROMANIA

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ABSTRACT

The forestry sector in Romania has experienced, after 1989, significant structural changes, both at the level of the legislative framework, but especially of the economic behavior, with a direct impact on the level of efficiency. The importance of the forestry sector at national level derives from at least two essential considerations, namely the existence of important resources, but also the capacity to use on them, both at primary level and the manufacturing industry (furniture, pulp, paper etc.). To these is added the ecological component of forests that resides in their essential contribution to soil protection against erosion, but also in ensuring water circulation and climate balance, being, at the same time, habitat for many species and having a primary character in conservation and improving the biodiversity of forest ecosystems. In addition, the social component of forest resources, which is mainly reflected in job creation, especially in rural areas, should not be overlooked. In the context of the above, the present approach aims to perform a SWOT analysis of the forestry sector in Romania, by reference to the stock of resources and the level of the sector's performance.

Keywords: Forest sector, resources, efficiency.



JEL Classification: Q01, Q23, Q57.

Forests management has a particular interest at global, European and national level, given the multitude of ecosystem services they provide. Forests play a key role in achieving global goals, while also playing a crucial role in mitigating climate change and its effects, but also in ensuring sustainable consumption and production patterns [1].

As an important field of activity in the national economy as a whole, the forestry sector in Romania has undergone, after 1989, significant structural changes, related, on the one hand, to the transition to a market economy and, on the other hand, to the need for adjustment and permanent adaptation to the rigors / requirements in the field, including those of protection of the forest fund, or those of the environment.

Forestry in Romania contributes to the development of rural communities by diversifying the economy, supporting the superior capitalization of the products obtained, retaining income in the local economy, ensuring the preservation of the cultural identity of rural communities.

In Romania, in 2019, the forestry sector occupied 27.7% of the total area of the country, increasing compared to 2007 by 0.5 percentage points. Of the 27.7 percent, 27 percent belongs to forested areas, while 0.7 percent is owned by other forest land.

Compared to the area occupied by forests from the total forest lands, in the period 2007-2019 it registered a slight increase by 1.8%, respectively from 6314.9 thousand ha (2007) to 6427.3 thousand ha (2019).

Of the area occupied by forests, in 2019, conifers represent 29.8%, decreasing by 0.6 percent, while deciduous trees group 70.2% of the total forests, respectively 4512.3 thousand ha, increasing by 0, 6% compared to 2007.

Organized administratively in the form of villages, communes, cities, counties, the latter grouped in turn in eight development regions, in 2019, the territorial distribution of the latter in the total areas occupied by forests reveals, except for the Bucharest-Ilfov region, a relatively uniform distribution of forests in the other seven regions, with percentages ranging between 10% (South-Muntenia region) and 19.4% (Center region) (Table 1).

Table 1. The share of forests at regional level in the total forests area in 2019 compared to 2007 (%)

Development region	2007	2019
North-West	15.0	15.3
Center	19.5	19.4
North-East	18.3	18.2
South-East	8.3	8.2
South-Muntenia	10.1	10.0
Bucharest-Ilfov	0.4	0.4
South-West Oltenia	12.4	12.2
West	15.9	16.3

Source: Calculations based on data from Tempo-Online, National Institute of Statistics (NIS), 2021.

By species, in the period 2007-2019 there is a differentiated distribution at regional level between conifers and broad-leaved tree forests. So, in 2019, the area occupied by conifers in the total forests oscillates, except for the Bucharest-Ilfov region, between 5.7% (South-East) and 28.9% (North-East), with small variations compared to 2007. At the same time, in 2019, the area occupied by broad-leaved tree forests does not exceed 20.6% (West region) (Table no. 2).



Table 2. Structure of forests by species at regional level (%)

Development region	Coniferous tree forests		Broad-leaved tree forests	
	2007	2019	2007	2019
North-West				
Center	15.4	16.0	14.9	15.3
North-East	29.0	28.6	15.4	15.9
South-East	29.3	28.9	13.6	14.0
South-Muntenia	5.5	5.7	9.5	9.5
Bucharest-Ilfov	6.6	6.9	11.7	11.6
South-West Oltenia	0.0	0.0	0.6	0.6
West	6.5	6.4	15.0	15.1
	7.8	7.3	19.4	20.6

Source: Calculations based on data from Tempo-Online, National Institute of Statistics (NIS), 2021.

Compared to other EU Member States, Romania ranks 8th in terms of forest lands, holding 4% of the total area with forests, being surpassed by: Sweden (17.4%), Finland (14%), Spain (11.6%), France (10.7%), Germany (7.1%), Italy (5.9%) and Poland (5.9%), while Luxembourg ranks last with only 0.1%.

Speaking of the economic performance of forests in the national economy as a whole, it should be mentioned that national statistics provide relevant information at the level of activity classes included in NACE, both in terms of employees, number of active local units, the value of market output, its use on the main sectors, as well as gross value added.

Compared to the first indicator, in the period 2007-2018 (for which relevant statistical data are available), if at national level the number of employees has risen, with regard to the forestry sector and areas of activity using forest products, the number of employees registered a significant decline, especially in the field of wood and furniture processing (Table no. 3).

This decrease is justified, mainly, by marketing wood mainly in the primary state (in the form of a log) and less in the form of processed products. This has the effect of losing gross value added in wood products, with a direct effect on sectoral competitiveness.

Table 3. Evolution of the number of employees by activity classes in the period 2007-2018 (number)

Activities	2007	2008	2018	2018/2007(%)
Total economy	4885319	5046317	5068063	3.74
Forestry and logging; Fishing and aquaculture	36045	32443	37097	2.92
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	71919	68269	54489	-24.24
Manufacture of paper and paper products	15042	13261	14247	-5.29
Manufacture of furniture	85960	79962	64279	-25.22

Source: Calculations based on data from Tempo-Online, National Institute of Statistics (NIS), 2021.

The slight increase in the number of employees in the field of forestry is due, among others, and increasing the number of active local units in the primary sector, while in the processing sector there is a visible downward trend (Table 4).



Table 4. Evolution of the number of local units active on the main activities in the forestry sector and of the sectors of processing / capitalization of forest products (number)

Activities	2008	2019	2019/2008 (%)
Total	567146	606390	6.9
Forestry and others forestry activities	754	883	17.1
Logging	1950	2856	46.5
Collection of non-wood forest products from spontaneous flora	25	111	344.0
Service activities ancillary to forestry	236	114	-51.7
Sawmills and planning of wood	4337	2624	-39.5
Manufacture of wood products, cork, straw and other vegetable materials	3670	2469	-32.7
Manufacture of cellulose, paper and cardboard	43	50	16.3
Manufacture of paper and paper products	774	824	6.5
Manufacture of paper and paper products	4472	4402	-1.6

Source: Calculations based on data from Tempo-Online, National Institute of Statistics (NIS), 2021.

With all the oscillations in the field related to the workforce and the number of enterprises, the market output value of both the forestry sector, as well as those who use its products, enrolled in the period 2007-2018, on an ascending slope, with oscillations ranging between + 11.1% (manufacture of paper and paper products) and doubling production in forestry and logging, motivated, among others, of the significant increase of the areas with cuts from the national forest lands (Table no. 5).

Table 5. Evolution of the value of market production on the main activities in the forestry sector and of the sectors of processing / capitalization of forest products (mill.euro)

	2007	2008	2018	2018/2007 (%)
Forestry and logging	733.1	757.3	1741.5	137.6
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2622.4	2686.9	3669.9	39.9
Manufacture of paper and paper products	1110.7	1380.8	1234.3	11.1
Manufacture of furniture	2172.2	2229.8	2715.7	25.0

Source: Calculations based on data from Tempo-Online, National Institute of Statistics (NIS), 2021.

The predominantly primary recovery of the wood mass is also highlighted by the distribution of the production of the forestry sector on the main activities. Practically, at the level of 2018, 82.5% of the production of the forestry sector was dedicated to primary exploitation and wood processing, wood products and articles of straw and plaiting materials, the difference being allocated to paper processing and furniture production.

Interestingly, the production of furniture (as an activity that creates significant added value) is not the main utility of forest products, but the processing of some products with much lower economic value (Table no.6).



Table 6. Distribution of market production of the forestry sector by main activities (mill.euro)

	2007	2008	2018	2018/2007 (%)
Forestry and logging	273.6	148.7	528.2	93.0
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	334.2	497.6	743.1	122.4
Manufacture of paper and paper products	14.5	29.4	150.6	936.6
Manufacture of furniture	20.3	36.5	119.7	490.9

Source: Calculations based on data from Tempo-Online, National Institute of Statistics (NIS), 2021.

The above-mentioned aspects are also confirmed in terms of gross value added which, in the period 2007-2018, it has followed an upward trend mainly in the field of forestry and logging, as well as woodworking.

As an activity with significant added value, the gross value added of furniture production increased by 15.4% in 2018 compared to 2007, which reflects, on the one hand, activity efficiency and on the other hand, capitalization of the products obtained at prices clearly higher than those in the primary processing field (Table no. 7).

Table7. Evolution of the gross value added of the forestry sector and of the processing / recovery sectors of forest products (mill.euro)

	2007	2008	2018	2018/2007 (%)
Forestry and logging	435.5	455.3	872.9	100.4
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	1096.4	1159.1	1145.2	4.4
Manufacture of paper and paper products	461.0	591.1	321.7	-30.2
Manufacture of furniture	934.8	940.3	1079.0	15.4

Source: Calculations based on data from Tempo-Online, National Institute of Statistics (NIS), 2021.

In the context of the above, we consider that the development of the forestry sector in Romania still faces a series of problems, among which the following can be mentioned, but without limiting ourselves to these [2]:

- legislative framework, often incoherent and inapplicable, to which is added the lack of correlation with regulations in other fields;
- inefficient management of the forest lands, including from the perspective of preventing illegal deforestation;
- lack of computerized records of forest lands and boundaries between owners;
- lack of information on the forest products market, internal and external, correlated with the lack of sector-specific indicators to ensure a real x-ray and provide predictability;
- lack of a national policy on wood recovery so as to maximize the value of wood on the market, with minimal costs and low environmental impact;
- lack of reaction or delayed response to events in the sector.

In the context of the above, the intervention of decision makers, both at the level of sectoral policy and strategy, as well as locally, by specific means of intervention, may result in better management of the national forest lands, especially from the perspective of sectoral gross value added, but also the maintenance and development of existing ecosystems, in line with environmental objectives, but also with those of ensuring the necessary resources for future generations.



The overall objective of any strategy must thus be to manage forest resources efficiently, by implementing particular measures, grouped on different level of action, respectively: natural, economic, administrative, technical, social and political [3].

In this regard, implementation of the national forestry strategy, as well as developing a strategy in the field of bioeconomy, which ensures, practically, the relationship between forestry and the processing of derived products, are important factors in the sustainable development of the forestry sector in Romania.

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ENFEKSİYÖZ PANKREATİK NEKROZİS VİRÜS (IPNV) ENFEKSİYONU VE BALIKÇILIK ENDÜSTRİSİNE OLAN ETKİLERİ

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ÖZET

Enfeksiyöz pankreatik nekrozis (IPN), ülkemiz ve tüm dünya genelinde alabalıkların (*salmonidae*) sağlığını etkileyen ekonomik olarak önemli bir viral hastalıktır. Ülkemiz 2020 yılında 785 bin 811 ton su ürünleri üretimi gerçekleştirmiştir ve Dünya’da 12. Sırada yer almaktadır. Bu miktarın %53,6’sı olan 421 bin 195 ton yetiştiricilik ile üretilmiştir. Türkiye alabalık ve somon balığı yetiştiriciliği açısından önemli bir konumda bulunmaktadır ve 125 bin 464 ton üretim gerçekleşmiştir. *IPN* ilk olarak 1957 yılında *Salvelinus fontinalis* türü alabalıklardan izole edilmiştir. *IPNV Aquabirnavirus* cinsinin *Birnaviridae* ailesine aittir. *Aquabirnavirus* cinsinin üç onaylanmış türü bulunmaktadır. Bunlar; *Enfeksiyöz Pankreatik Nekrozis* virüsü, *Tellina* virüsü ve *Yellowtail* virüsüdür ve *Marine birnavirüs* ayrı bir tür olarak onaylanmamıştır. Çiftliklerde ölümler çoğunlukla yavru (smolt) aşamalarında meydana gelir, ancak son yıllarda Atlantik somon balığının post-smolts dönemlerinde, özellikle Norveç ve İskoçya’da, *IPN*’ye bağlı olarak görülen ölümler bildirilmiştir. Hem tatlı hem de deniz suyu ortamlarındaki tüm balık grupları asemptomatik olarak enfekte olabilir ve virüsü bulaştırabilir. İskoçya’da, deniz suyunda yetiştirilen ünlü Atlantik somon balıklarında *IPNV* enfeksiyonunun görülme sıklığı çok yüksektir. Tatlı su somon çiftliklerinde, enfeksiyon prevalansı ve hastalık insidansı oldukça düşüktür, ancak son yıllarda arttığı bildirilmektedir. Özellikle Atlantik somonu yavrularında hem tatlı suda hem de deniz suyuna transfer sonrası smolt evresinde hastalığa bağlı ekonomik kayıpların büyük olduğu ve salgınların meydana gelebildiği bildirilmektedir. Bu çalışmanın amacı ülkemizde de görüldüğü bildirilen önemli viral enfeksiyonun güncel veriler ile yeniden değerlendirilmesidir. Bu hastalık zoonoz değildir.

Anahtar Kelimeler: Enfeksiyöz Pankreatik Nekrozis Virüsü, Alabalık, Salmon, Somon Balığı



INFECTIOUS PANCREATIC NECROSIS VIRUS (IPNV) INFECTION AND ITS IMPACTS ON THE AQUACULTURE INDUSTRY

ABSTRACT

Infectious pancreatic necrosis (IPN) is an economically important viral disease that affects the health of salmonids in Turkey and all over the world. Turkey produced 785 thousand 811 tons of fishery products in 2020 and ranks 12th in the world. Aquaculture production was 421 thousand 195 tons, which is equal to 53.6% of the total production. Turkey is in an important position of trout and salmon farming and 125 thousand 464 tons of production was realized. *Infectious pancreatic necrosis virus (IPNV)* was first isolated in 1957 from *Salvelinus fontinalis* trout. *IPNV* belongs to the *Birnaviridae* family of the *Aquabirnavirus* genus. There are three confirmed species of the genus *Aquabirnavirus*. These; *Infectious Pancreatic Necrosis virus*, *Tellina virus* and *Yellowtail virus*, and *Marine birnavirus* is not confirmed as a separate species. Mortality on farms mostly occur at the smolt stage, but in recent years fish deaths due to *IPN* have been reported in the post-smolt periods of Atlantic salmon, particularly in Norway and Scotland. All groups of fish in both fresh and marine environments, can become asymptotically infected and transmit the virus. In Scotland, the incidence of *IPNV* infection is very high in the well-known Atlantic salmon raised in seawater. In freshwater salmon farms, the prevalence of infection and incidence of disease are quite low, but have been reported to have increased in recent years. It has been reported that economic losses due to the disease are great and epidemics may occur, especially in Atlantic salmon fry, both in fresh water and in the smolt stage after transfer to seawater. The aim of this study is to re-evaluate this important viral infection was reported previously in our country with current data. This is not a zoonotic disease.

Keywords: Infectious pancreatic necrosis virus, salmon, salmonids, trout



1. GİRİŞ

Enfeksiyöz pankreatik nekrozis (IPN), ülkemiz ve tüm dünya genelinde alabalıkların (salmonidae) sağlığını etkileyen ekonomik olarak önemli ciddi bir viral hastalığıdır ve etkeni *enfeksiyöz pankreatik nekrozis virüsüdür (IPNV)*. *IPNV Aquabirnavirus* cinsinin *Birnaviridae* ailesine aittir. İlk olarak 1941 yılında Kuzey Amerika'da rapor edilmiştir ve 1957 yılında *Salvelinus fontinalis* türü alabalıklardan izole edilmiştir (6,11,15). *Aquabirnavirus* cinsinin üç onaylanmış türü bulunmaktadır. Bunlar; *Enfeksiyöz Pankreatik Nekrozis virüsü (IPNV)*, *Tellina* virüsü ve *Yellowtail* virüsüdür ve *Marine birnavirüs* ayrı bir tür olarak onaylanmamıştır (14). Enfeksiyon genel olarak altı aylık ve daha genç yaştaki alabalık veya somon gibi salmonidleri etkiler. Yetişkin balıklarda virüsü taşıyabilir ve hastalık semptomu göstermeyebilirler (6,11,15). Enfeksiyona karşı direnç, ılık suda daha hızlı gelişir. Oldukça bulaşıcıdır ve dünya genelinde bulunurlar, ancak bazı bölgeler hastalık insidansını ortadan kaldırmayı veya büyük ölçüde azaltmayı başarmıştır. Hastalık normalde enfekte suyoluyla yatay olarak yayılır, ancak yayılma dikey olarak da gerçekleşir. Memelileri enfekte edemez (6,11,15).

Birnavirüsler 60 nm çapında, ikosahedral simetridir, çift RNA segmentlidirler, viryonları zarfsız ve altıgen şeklindedir. Genom toplam boyutu 7 kbp olan iki lineer çift sarmallı RNA molekülünden oluşur. Virionlar konakçı hücrenin sitoplazmasında toplanır ve hücrenin lizisi ile buradan hücreler arası sıvıya serbest bırakılırlar. Doğal konakçılar arasında tavuklar, ördekler, hindiler ve diğer evcil kümes hayvanları, somon balığı, diğer tatlı su ve deniz balıkları ve çift kabuklu yumuşakçalar bulunmaktadır. Üç bulaşıcı serotip vardır ve pankreatik hepsi patojeniktir (6,11,15).

Çiftliklerde ölümler çoğunlukla yavru (smolt) aşamalarında meydana gelir, ancak son yıllarda Atlantik somon balığının post-smolts dönemlerinde, özellikle Norveç ve İskoçya'da, *IPN*'ye bağlı olarak görülen ölümler bildirilmiştir. Hem tatlı hem de deniz suyu ortamlarındaki tüm balık grupları asemptomatik olarak enfekte olabilir ve virüsü bulaştırabilir. İskoçya'da, deniz suyunda yetiştirilen ünlü Atlantik somon balıklarında *IPNV* enfeksiyonunun görülme sıklığı çok yüksektir. Tatlı su somon çiftliklerinde, enfeksiyon prevalansı ve hastalık insidansı oldukça düşüktür, ancak son yıllarda arttığı bildirilmektedir. Özellikle Atlantik somonu yavrularında hem tatlı suda hem de deniz suyuna transfer sonrası smolt evresinde hastalığa bağlı ekonomik kayıpların büyük olduğu ve salgınların meydana gelebileceği bildirilmektedir. Hastalık günümüzde ülkemizde ve birçok ülkede görülmektedir ve muhtemelen dünya çapında yumurta ve canlı balık sevkiyatı nedeniyle yayılım gösterdiği düşünülmektedir (1,2,8,18,19,22).

Ülkemiz 2020 yılında 785 bin 811 ton su ürünleri üretimi gerçekleştirmiştir ve Dünya genelinde 12. sırada yer almaktadır. Bu miktarın %53,6'sı olan 421 bin 195 ton yetiştiricilik ile üretilmiştir. Türkiye alabalık ve somon balığı yetiştiriciliği açısından önemli bir konumda bulunmaktadır ve 125 bin 464 ton üretim gerçekleştirmiştir (2,16,17,19). Bu çalışmanın amacı, ülkemizde daha önce bildirilen bu önemli viral enfeksiyonun güncel verilerle yeniden değerlendirilmesidir.

2. KLİNİK BELİRTİLER, PATOGENEZ ve TEŞHİS

Hastalık genellikle yumurta kesesi emilimi evresinde olan veya ilk beslemeye başladıktan sonraki dönemde çok genç alabalık yavrularında görülür. Salmonidler çoğunlukla duyarlıdır. Yetişkinlerde enfeksiyon subklinik hale gelir. *IPN* hastalığının spesifik patognomonik belirtileri yoktur. Etkilenen balıklarda genel olarak renk koyuluğu, genişlemiş abdomen, ekzoftalmus, ventral kutanöz kanamalar ve burğu şeklinde ya da tirbuşon hareketi olarak tanımlanan, dikine kendi etrafında dönerek ve sonrasında yüzeyde hareketsiz kalma şeklinde



tanımlanan karakteristik yüzme hareketine rastlanmaktadır. İç organlarda lezyonlar ise soluk renkte karaciğer, dalak ve iç organlar olarak tanımlanmaktadır ve organlar genellikle çoklu visseral peteşilerle kaplıdır ve sarı veya sütsü bir eksüdat içeren boş mide ve bağırsaklar olarak tanımlanmaktadır. Fakat hasta balıklar bu belirtilerin sadece birkaçını veya hiçbirini de göstermeyebilir ve asemptomatik olabilirler. Mortalite %10 ile %90 arasında değişmektedir. IPNV terimi salmonidleri etkileyen suşların olduğu ve hastalığın spesifik semptomlarının geliştiği durumlarda kullanılmaktadır. Farklı semptomlarla non-salmonid balık türlerini etkileyen enfeksiyonlarda ise *IPNV-benzeri* enfeksiyon terimi kullanılmaktadır ve genel olarak *aquabirnavirüsleri* olarak adlandırılır (4,5,6,11). Hayatta kalan balıklar kendiliğinden 1-2 hafta içerisinde iyileşirler. Epizootik enfeksiyonlardan kurtulan veya hastalığı olmayan balıkların iç organlarından yüksek titrelerde virüs izole edildiği bildirilmiştir. Bu balıklar hastalığı taşıyıcı hale gelirler ve atlantik somonunda, bağırsağın lamina propriasında nekrotik görünen, 'McKnight hücreleri' olarak adlandırılan interstisyel hücreler bulunduğu bildirilmiştir (9).

IPN tanısı hastalığın klinik belirtilerine, etiyolojik ajanın hücre kültürü yöntemleriyle izolasyonu ve tanımlanmasına ve serolojik yöntemlerle doğrulamaya dayandırılmaktadır. Suda yaşayan birnavirüslerinin, hücre kültürü sistemleri kullanılarak tutarlı bir şekilde saptanmasının uygun olduğu kanıtlanmıştır ve virüs izolasyonu teşhiste altın standart olarak kabul edilmektedir ve OIE rehberinde yayınlanmıştır. Yüksek virüs titreleri genellikle böbrek dokusunda mevcuttur ve inokulum olarak bu organ tercih edilir (6,11,12). Birnavirüslerin hücre kültürlerinde izole edilebilmeleri için RTG-2 (rainbow trout gonad), CHSE-214 (chinook salmon embryo), FHM (fathead minnow), BF-2 (bluegill fry) ve EPC (epithelioma papulosum cyprini) standart hücre hatları kullanılmaktadır (6,11).

Suda yaşayan *birnavirüslerin* tanımlanması ve sınıflandırılmasında serolojik teknikler yaygın olarak kullanılmaktadır. Bunlar arasında nötralizasyon testi, komplement fiksasyon testi, flöresan antikör testi, immunoperoxidaz testi, Staphylococcus koagglutinasyon testi, enzyme-linked immunosorbent assay (ELISA), immunodot ve immunopresipitasyon testleri bulunmaktadır. Serolojik tanımlama yöntemlerinin duyarlılığı yıllar içinde artmıştır, ancak nötralizasyon testi, doğal duyarlılığı ve virüsleri sınıflandırmak için kullanılması nedeniyle diğer testler için referans noktası olmaya devam etmektedir. Serogrup A *birnavirüslerini* tanımlamak için polivalan antiserumların kullanıldığı nötralizasyon testleri kullanılmaktadır (6). Hem hücre kültüründe hem de balıklarda sucul *birnavirüslerin* tespiti için birçok Reverse transkriptaz-polimeraz zincir reaksiyonu (RT-PCR) test protokolü geliştirilmiştir (1,6,8,11).

3. AŞI ve İMMÜNİTE

Aşılama, büyük ölçekli ticari balık yetiştiriciliğinde önemli bir rol oynamaktadır. Özellikle somon yetiştiriciliğinin başarısının anahtarlarından birisi olarak kabul edilmektedir. İnaktive virüs aşılarının pahalı ancak etkili olduğu bildirilmiştir. Formalin ve rekombinant VP2 IPNV aşıları ile inaktive edilmiş virüsler, somonda yüksek titrelerde nötralize edici antikörler üretebilir ve gökkuşağı alabalığına karşı etkili koruma sağlayabilir. İnaktive virüs ile oral yoldan aşılama, daldırma ve enjeksiyon mümkün olduğu ancak enfeksiyona karşı korumanın sadece enjeksiyon uygulaması ile sağlandığı bildirilmiştir (3).

Genç balıkların hastalığa karşı en duyarlı oldukları dönemde aşılama yapılması önemlidir. Maternal antikörler tarafından veya etkili aktif immünite genç balıkları 30 günlüğe kadar bir dereceye kadar koruyabilmektedir. Ayrıca, serotipler arasında çapraz koruma olmaması etkili bir aşı için gereksinimleri daha önemli hale getirmektedir (11).

Somon ve Alabalıklar için ticari IPNV aşısı mevcuttur. Yaygın olarak Norveç, İrlanda ve İskoçya'daki endemik bölgelerdeki Atlantik somon çiftliklerinde kullanılmaktadır. Ölüm oranında azalma etkisinin olduğunu bildirilmektedir (3,12).



E. coli tarafından eksprese edilen IPNV proteinlerine dayalı alt birim aşılar, test edilmekte ve koruyucu bağışıklığı vaat etmektedir. Ticari IPNV aşılarının çoğu, deniz suyunda smolt sonrası aşamada somon balığını korumayı amaçlar. Ticari olarak rVP2 antijeni içeren bir aşı ile bağışıklama ve sonraki banyo ve birlikte yaşama tehdidi, bu antijeni içermeyen bir aşı ile karşılaştırıldığında yaklaşık %70 koruma sağladığı bildirilmiştir (3).

4. EPİDEMİYOLOJİ, KORUNMA ve KONTROL

IPNV kuluçkahaneye yumurtalar, yavrular, insan, fomitler, farklı hayvanlar ve su ile bulaşabilirler (6). IPN'nin epizootiyolojisi karmaşıktır ve tam olarak anlaşılmamıştır. Hastalık genç balıkları ve smolt sonrası balıkları etkiler, virüs yaşlı balıklarda klinik belirtilere neden olmadan birincil enfeksiyondan sonra vücutta kalabilir ve virüs vertikal olarak bulaşabilir.

IPN enfeksiyonu için başlıca hazırlayıcı faktörler sıcaklık, yaş ve stres olarak tanımlanmaktadır. 3 gram ağırlıktaki altı aylık alabalıkların klinik IPN hastalığına dirençli oldukları; ancak, konağın virüsten tamamen temizlenip temizlenmediği veya tipik IPN taşıyıcılarında olduğu gibi artık virüsün mevcut olup olmadığı tam olarak bilinmemektedir. Maksimum ölümlerin meydana geldiği sıcaklıklar balık türlerine göre değişkenlik gösterebildiği bilinmektedir (6).

Aquabirnavirüslerin farklı çevresel koşullarda ve geniş bir sıcaklık, pH ve tuzluluk aralığında varlıklarını devam ettirdikleri ve uzun süre hayatta kalabildikleri bilinmektedir (4,5,10). Bir enfeksiyondan kurtulan balıklar asemptomatik hale gelirler ve yıllarca virüsün taşıyıcı rezervuarları olarak hayatlarını sürdürürler. Virüs bu taşıyıcı rezervuar balıklar aracılığıyla özellikle stres dönemleri sırasında su - dışkı yoluyla horizontal olarak ve üreme yoluyla vertikal olarak yetiştiriciler tarafından yayılabilirler (13). Vertikal bulaşma genellikle virüsün bir nesilden diğerine bulaşması olarak tanımlanır. Virüs ya genellikle gerçek vertikal geçiş olarak adlandırılan gametlerin içeriğinde ya da alternatif olarak gametlerin yüzeyinde veya yumurtalık ve seminal sıvılarda ve mukusta bulunabilir (4,5,6). Yumurtaya tam giriş mekanizması veya virüsün yumurta içindeki yeri hala belirsizdir ancak vertikal bulaşmanın IPNV'nin hızlı bir şekilde yayılmasına neden olduğu bilinmektedir (6). IPN enfeksiyonunun prevalansı IPN virüsünün ortamdaki yüksek varlığında bile tam olarak belirlenemeyebilir (6).

Duyarlı türlerin tatlı suda enfeksiyonu yüksek ölüm oranlarına neden olabilmektedir. Virüsle ilişkili ölüm oranının 10 ila 14°C arasında hızlı oluşu ve daha düşük sıcaklıklarda uzadığı bilinmektedir. Su sıcaklığı, balıkların yaşı ve virüs suşu, balıklarda gizli enfeksiyonların oluşumunun yanı sıra hastalığın şiddetini de etkilemektedir. IPNV böbrek, pankreas, gonad, dalak ve bağırsak epitelinde çoğalır ve taşıyıcı balıklardan dışkı ve ayrıca seminal ve yumurtalık sıvıları yoluyla atılabilir (4,5,6).

Etanol, metanol, iyodofor ve klorun IPNV'yi etkisiz hale getirdiği bilinmektedir (7), ancak 60 dakika boyunca pH 3.0'da kloroform veya etil eter ile muameleden sonra enfektivitesinin %90'ından fazlasını koruduğu da bildirilmiştir. IPNV'nin -70°C'de birkaç yıl ve 4°C'de birkaç ay boyunca enfektif olduğu gösterilmiştir. Tüm bunlar IPNV'nin çevrede uzun süre hayatta kalan sağlam bir virüs olduğunu doğrulamaktadır.

5. TARTIŞMA ve SONUÇ

IPN enfeksiyonu küresel boyutta su ürünleri endüstrisi üzerinde önemli ekonomik etki yaratmaktadır ve bu nedenle hastalığın kontrolü için büyük çaba harcanmaktadır. Virüs yayılımının strese bağlı olduğu düşünülmektedir. Stresin özellikle 6-11 aylık balıklarda IPN enfeksiyonunun tekrarlamasına neden olduğu, daha yaşlı balıklarda ise hiçbir klinik belirti göstermeden varlığını devam ettirdiği ve taşıyıcı hale geçen bu balıklar ile yayılmaya devam ettiği bilinmektedir.



Hayatta kalan balıklar, virüsün ömür boyu taşıyıcısı olurlar. Dışkı, yumurta, sperm ve genital sıvılarla virüsü yaymaları ve virüsün çeşitli ortam koşullarına oldukça dayanıklı olması ve hayatta kalması ve aylarca yaşayabilmesi hastalıkla mücadeleyi zorlaştırmaktadır (11). Hastalığın kontrolü çok sıkı uygulanan hijyene bağlıdır. İyi su kalitesi ve temel olarak ve yaygın kullanımı olan iyodofor dezenfeksiyonu ile bir salgın meydana geldiğinde erken tanı ve bütün stokların hasat edilmesi ve kafeslerin tam boşaltılması bilinen etkili yöntemler arasında yer almaktadır (11).

IPNV salmonidlerden başka ekonomik öneme sahip olan yılan balığı, yumuşakçalar ve kabukluları da enfekte edebilir ve bu türlerin tümü taşıyıcı hale geçebilirler. Denizde yetiştirilen Atlantik somonunun *IPN* ölümünün ekonomik etkisi, kısmen hasat boyutuna yaklaşmış büyük boyutlu balıklar nedeniyle artan bir endişe kaynağı olmaktadır. *IPN* enfeksiyonu Şili'de %30,2 ile en sık rastlanılan 2. balık enfeksiyonu olarak bildirilmiştir (6,20)

İzlanda, büyük ölçekte somon balığı yetiştiren ülkelerden birisidir ve *IPN* enfeksiyonunun bildirilmediği ve kapsamlı balık sağlığı denetimlerinin rutin olarak gerçekleştirildiği az sayıdaki ülkeden biridir. Ülkenin balık ithalatı için çok katı tedbirler uyguladığı bir balık sağlığı güvenliği politikası bulunmaktadır. Bununla birlikte, *Birnavirüs serogrup B'nin*, İzlanda'da yetiştirilen halibut balığından (*Hippoglossus hippoglossus*) izole edildiği bildirilmiştir (6,21). *IPNV* doğal ortamda uzun süre hayatta kalabilme yeteneğine sahip sağlam bir virüs olduğu bilinmektedir (6,7). Etanol, metanol, iyodofor ve klor *IPNV*'yi etkisiz hale getirir, ancak 60 dakika boyunca pH 3.0'da kloroform veya etil eter ile muameleden sonra enfektivitesinin %90'ından fazlasını korur *IPNV*'nin -70°C'de birkaç yıl ve 4°C'de birkaç ay boyunca enfektif olduğu gösterilmiştir (6,7).

IPN enfeksiyonu farklı koruyucu önlemler ile kontrol altına alınmaya çalışılmaktadır. Bunlar arasında erken tanı ve risk değerlendirmesi önemlidir. Bu önlemler arasında doğal popülasyonların taranması, ticari balıkçılık hareketlerinin takip edilmesi ve hastalığın kapsamlı epidemiyolojik incelemelerinin yapılarak taşıyıcıların saptanması ile aşı geliştirilmesi önemli yer tutmaktadır. Yumurtalardan çıkan larva ve genç balıklar hastalığa karşı korumasızdırlar. Ayrıca, serotipler arasında çapraz koruma da bulunmamaktadır. Özellikle canlı balık ve yumurtaların uluslararası ticareti enfeksiyonun önemli bir yayılma yoludur. Bu nedenle menşei çiftlikte patolojik değişikliklerin en az 12 ay öncesinden takip edilmesi ve yumurta, sperm ve balık ve havuz suyundan *IPNV*'nin izole edilmemesi gereklidir.

IPN, Norveç'te çiftlik balıklarında en önemli bulaşıcı hastalık olduğu ve yıllık yaklaşık 60 milyon USD'lik ekonomik kayıplara neden olabildiği bildirilmiştir (3). Şili'de ise %30,2 ile en sık rastlanılan 2. balık enfeksiyonu olarak bildirilmiştir (6,20). Ülkemizde ise ekonomik kayıplar ile ilgili bir bilgi bulunmamakla birlikte hastalığın varlığı ortaya konulmuştur (1,2,8,18,19). Ülkemizde farklı bölgelerde (Düzce, Şanlıurfa, Tokat, K. Maraş, Trabzon ve Gaziantep) 2004 ve 2013 yılları arasında yapılan çalışmalarda izole edilen virüslerin tüm genomik verilerinin filogenetik analizleri yapılmış ve altı izolatin segment A ve B verilerine dayalı olarak elde edilen bulgulara göre genogrup 5 ve grup 1 de kümelendiğini bildirilmiştir (8).

PN enfeksiyonuna yakalanan ve ölmeyip hayatta kalan balıklar, virüsün ömür boyu taşıyıcısı haline gelirler ve virüsü dışkı, yumurta, sperm ve genital akıntılar ile saçarlar. Virüs, çeşitli dış ortam koşullarına dayanıklıdır ve tatlı su veya deniz suyunda aylarca yaşayabilir ve enfektivitesini devam ettirebilir. Hastalığın temel anlamda kontrolü çok yönlü hijyene dayalıdır, su ve yumurtaların iyodoforlarla dezenfeksiyonu ve bir salgın meydana geldiğinde tüm balıkların hasat edilmeleri hastalıkla mücadelede önerilen önemli uygulamalar olarak kabul edilmektedir.



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A STUDY ON AGRICULTURAL BANKS IN INDIA

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ABSTRACT

In this changing scenario, Agricultural banks are promoting various developmental activities in agriculture. Agricultural banks provide monetary benefits to farmers across the country. Agricultural loans are available for farming-related activities. National Bank for Agriculture and Rural Development (NABARD) is about up to supply and regulate credit and other facilities for the promotion and development of agriculture. NABARD is working under the Government of India to boost the agricultural sector. Kisan Credit Cards are provided as monetary support to the Indian farmers. Agricultural Sector was recognized as the backbone of the economy. A small farmers' agri-business consortium was formed to provide better employment opportunities to farmers by way of diversified agricultural activities and improvement in efficiency of production through technological upgrading. A sharper thrust on improving agricultural production, which was sought to be achieved by various policy measures and institutional changes, concomitantly necessitated expanding and diversifying the operations of rural and agricultural credit delivery agencies, with the ultimate objective of enhancing the quality of rural lending. Apart from strengthening commercial banks and RRBs, several measures were initiated to ameliorate problems in the flow of agricultural credit. Other measures were also initiated that covered delegation of more powers to branch managers, simplification of applications, opening of more SSI specialized branches, an enhancement in the limit for composite loans and strengthening of the recovery mechanism. In this study it is focus to identify the support of the agricultural banks to the Indian agricultural sector.

Keywords: Banking, agriculture, development, gdp, insurance, kerala, India



INTRODUCTION

Agriculture plays an important role in the development of India Economy. Agricultural sector in India contributes about 20 percent to the total GDP. In India two third of the populations depends on agriculture, 60 percent companies are based on agriculture produces, 50 percent of National Income are came by Indian farmers. India ranking the second in farming outputs in the world. Agriculture is the backbone of Indian Economy. Banks also referred as the Backbone for the developing countries. Indian banking sector consists of commercial and co-operative banks.

As per the reports of Reserve Bank of India (RBI) in the financial year 2021, Growth in credit to the agriculture sector has hike into a four year high. Strong monsoons help the farming sector to remain relatively immune from the Covid-19 pandemic. In the reports of February 2021, outstanding credit to agriculture and allied activities were increased 10.2% year on year to Rs.12.74 lakh crore. It was doubling from the 5.8% year on year growth which was recorded in February 2020. It was published in the Reserve Bank of India's monetary policy published on April 1st 2021. According to Barkat Ali, Chief General Manager for Business Development-Financial Inclusion and Micro-market at State Bank of India, there was a rise in agricultural credit growth. A rotation of Government measures like emergency credit line guarantee scheme, interest subvention scheme and loan moratorium that kept the agriculture credit growth buoyant. Good harvest is the main reason for introducing Government measures at the time of Covid-19 pandemic. It helps to ease of credit flow to the agriculture sector that remained unaffected by the Covid-19 Lockdown curbs. Disbursement to the agriculture sector increases to 5 percent to Rs. 2.10 lakh crore for the India's largest lender.

Types of Agricultural Loans in India

Agricultural loans are available for different kinds of farming-related activities. One can avail a loan for the following activities related to agriculture;

1. Running day to day operations.
2. Buying farm machinery such as tractors, harvesters, et cetera.
3. Purchasing land.
4. Storage purposes.
5. Product marketing loans
6. Expansion.

Other than these, financials aids are offered in the form of grants and subsidies too, which are usually meant to protect the farmer in an event of crop damage or loss of crops. Agricultural loans in India are not only available to farmers working towards the cultivation of food crops, but they are available to anyone who was engage in agriculture, aquaculture, animal husbandry, silk farming, apiculture and floriculture.

Leading banks that offer Agricultural loans in India

Coming to the public sector banks in India, there are several leading financial institutions that are known for their exceptional credit services in agriculture-related sectors. The following are some of these banks;

1. State Bank of India Agricultural Loans
2. HDFC Bank Agricultural Loans
3. Allahabad Bank Agricultural Loans
4. Bank of Baroda Agricultural Loans
5. Punjab National Bank Agricultural Loans
6. ICICI Bank Agricultural Loans
7. Axis Bank Agricultural Loans.



NAME OF THE LENDER	MAJOR TYPES OF AGRICULTURAL LOANS OFFERED
STATE BANK OF INDIA	<ul style="list-style-type: none"> ● Crop Loan ● Kisan Credit Card (KCC) ● Drip Irrigation Loan ● Combine Harvester Loan
ICICI Bank	<ul style="list-style-type: none"> ● Retail Agricultural Loan ● Long Term Agricultural Loan
Central Bank of India	<ul style="list-style-type: none"> ● Cent Kisan Tatkal Scheme ● Cent Vermicompost Scheme ● Cent Solar Water Heater Scheme ● Kisan Credit Card
Union Bank of India	<ul style="list-style-type: none"> ● Crop Loan ● Union Gold Loan ● Kisan Credit Card ● Bio Gas Loan ● Farm Mechanization Loan
Axis Bank	<ul style="list-style-type: none"> ● Kisan Power ● Kisan Matsya ● Kisan Mitra ● AGPRO Power
National Bank for Agriculture and Rural Development (NABARD)	<ul style="list-style-type: none"> ● Agriclinic and Agribusiness Centres Scheme ● National Livestock Mission ● New Agricultural Marketing Infrastructure

Features of Agricultural Loan

The following are the features of the agricultural loan;

1. End use facility



Agricultural loans were helps to meet different expenses which are related to farm activities such as purchase of new farm land, cattle field or to managing the operating costs and other agriculture allied activities.

2. Various types

Various types of agricultural loans were provided on the basis of types of agricultural activities. Many types of agricultural loan exist on the basis of end use as well as the repayment tenure.

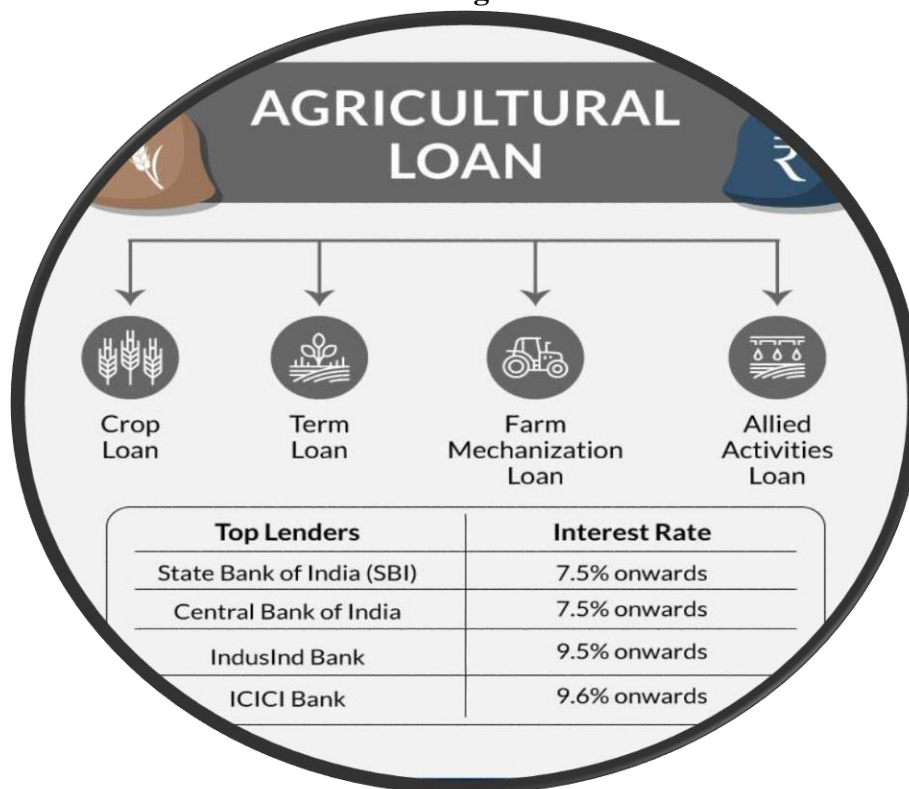
3. Minimal documentation

The agricultural loan can be availed with simple and minimal documentation. It minimizes the need of documentation.

4. Collateral optional

Secured and unsecured loans were provided with the basis of applicants profile and on loan quantum.

Interest Rate of Agricultural Loan



Source: Paisabazaar.com

State Bank of India (SBI) and Central Bank offers 7.50% rate of interest for the agricultural activities. IndusInd Bank offers 9.50% rate of interest, ICICI Bank offers 9.60% rate of interest onwards. Axis Bank provides the rate of interest on the basis of Government schemes and depends on the applicant's profile.



Types of Agriculture Loan

The major types of loans provided by banks and lenders in India are as follows;

1. On the basis of loan tenure
 - Crop loan / Kisan Credit Card
 - Agriculture Term Loan
2. On the basis of end use
 - Farm Mechanization loan
 - Solar pump set loan
 - Loan for allied agricultural activities
3. Other loan types
 - Horticultural loans
 - Agricultural gold loan
 - Forestry loan

1. On the basis of loan tenure

On the basis of loan tenure the loans are divided into two. They are;

- Crop loan / Kisan Credit Card (Retail Agri Loan)

The Kisan Credit Card (KCC) Scheme is a Government of India Scheme with the aim of providing credit facilities to the farmers. The Kisan Credit Card was created and launched by NABARD (National Bank for Agricultural and Rural Development) in the year 1998. The KCC scheme were introduced to ensure that the credit requirements for farmers in the agriculture, fisheries and animal husbandry. It was done by helping the farmers for avail short-term loans. It also provides them a credit limit to purchase equipment and for meet their other expenses. The card is generally available in the form of an Electronic Rupay Card, which the farmers can use to draw money from ATMs to make the required purchase.

- Agriculture Term Loan

Agriculture term loans are the long term loans of up to 48 months. It was offered by various lenders for meeting the agricultural expenditures which are not seasonal in nature. This loan can be used for purchasing new machinery or upgrading the existing machinery, install solar power, windmills etc. Banks allow repayment tenure of 3 to 4 years for the loan. It can be payback in monthly, bi annual or yearly installments as per the borrower's convenience.

2. On the basis of end use

On the basis of end use, the loans were divided into three;

- Farm Mechanization Loan

Farm Mechanization Loan can be used for purchase new machinery, repairing or replacing old machinery, purchase tractors or harvesters or any other agricultural equipment. But some banks provide a general purpose loan; other will categorized these loans into different types based on the end use.

For eg:- State Bank of India offers tractors loans, combine harvester loans and loans for irrigation equipment.

- Solar Pump Set Loan

Solar Pump Set Loan was offered for the purpose of photo voltaic pumping system for small irrigation projects. It is generally a long term loan with repayment tenure of up to 10 years.

- Loan for allied agricultural activities

Loans offered to the farmers for meet working capital requirements and long term investment needs for allied agricultural activities.

3. Other Loan Types



Other loan types are as follows;

● Horticultural Loan

Agricultural loan has provided for the development of the land for setting up orchard or vegetable farms, clearing of undergrowth or wild trees, minor irrigation activities, setting up of orchards or vegetable farms, clearing of undergrowth or wild trees, minor irrigation activities, setting up boundary walls or fencing and other horticultural reasons.

● Agricultural Gold Loan

The Agricultural Gold Loan is provided to farmers against the pledge of gold ornaments. It has offered for crop cultivation as well as for other agricultural purposes. This loan features relatively low interest rates and helps the farmers to unlock the value of their gold jewellery that is usually lying idle in the house or bank locker.

● Forestry Loan

Forestry Loan is offered for raising crops that grow on trees. It was same as horticulture loans it can be given to clear the undergrowth or wild trees, turn barren land into cultivable land, prepare land by setting up irrigation channels.

National Bank for Agriculture and Rural Development (NABARD)

National Bank for Agriculture and Rural Development (NABARD) was established in the year 1982 by an Act of Parliament and was entrusted with all matters concerning policy, planning and operation in the field of credit for agriculture and other economic activities in rural areas. The Bill for setting up the Bank was passed by the Parliament in December, 1981 and National Bank for Agriculture and Rural Development came into existence on 12th July, 1982. Before that, this job was being done by Reserve Bank of India.

Objectives of NABARD

NABARD works for progressive institutionalization of the rural credit and ensures that the demands for credit from agriculture including the new and upcoming areas like floriculture, tissue culture, bio-fertilizers, sprinkler irrigation, drip irrigation etc. are met. It is also vested with the responsibility of promoting and integrating rural development activities through refinance.

Functions of NABARD

1. It helps in planning and operational matters related to credit for agriculture and allied activities, rural artisans, village industries and other rural development activities;
2. It extends refinance to commercial banks for term loans in relation to agriculture and rural development;
3. It provides short term credit to state cooperative banks, RRBs, and other financial institution notified by RBI for a period not exceeding 18 months by way of refinance for agricultural operations, marketing of crops and marketing and distribution of agricultural inputs.
4. It offers direct loan by way of refinance to all eligible institutions for a period not exceeding 25 years.
5. It provides finance for production and marketing activities of rural artisans, cottage industries, small-scale industries, handicrafts etc. in the rural areas.
6. It facilitates all eligible financial institutions for conversion of production loans into term loans in the times of natural calamities,
7. It contributes to share capital and securities of eligible institutions and State Governments concerned with agriculture and rural development.
8. It also helps State Governments to contribute to the share capital of eligible institutions working for rural development.



9. It offers advice and guidance to State Governments, Cooperative federations and National Cooperative Development Corporation (NCDC) and functions in close contact with Central Government in matters related to agriculture and rural development.
10. It coordinates and monitors all agricultural and rural lending activities with a view to tying-up with extension and planned development activities in rural areas
11. It conducts training, consultancy and research relating to agricultural finance and agricultural and rural development.

Agricultural Loans were given for various agricultural purposes like purchase of land, tools or machinery, crop insurance, maintenance of farm, etc. A farmer has the need for financial support for many other agricultural related purposes.

LITERATURE REVIEW

Report of the Working Group on Outreach of Institutional Finance: The 12th Five Year Plan (2012-17) - In November, 2011, the Planning Commission of the Government of India formed above Working Group under the chairmanship of Dr. Y.S.P. Thorat, (the former chairman of NABARD) to review the flow of credit to agriculture and allied sectors during the 12th five year plan. This working group was also directed for giving subsector analysis and recommending measures to ease the flow of credit at reasonable rate of interest throughout the country with special reference to disadvantaged sections including small and marginal farmers, women farmers, tenant farmers, landless laborers etc. The working group was also asked assess the performance of credit cooperatives and suggest measures for their increased participation. The Group observed that after implementation of the Debt waiver Scheme, a large number of units providing short-term cooperative credit were in profit and as a result, their mounting losses started to decline. The group found that despite the better financial health of the STCCS, their share in agricultural credit continuously declined. According to this working group, poor resource base, poor management, inefficient governance and lack of active members were the significant barriers to credit flow.

V.Balakrishnama Naidu, A.Siva Sankar and P.Surya Kumar (2013) stated that about 66 percent population in India depends on agriculture. Therefore, agricultural credit is an essential input for higher agricultural productivity. Agricultural production and productivity should be improved to produce food for all population. Together with agricultural credit, other factors like seed quality, minimum support prices, rainfall, irrigation and environmental conditions were also considered significant in improving agricultural productivity. Because of the misuse of credit, it was very difficult to estimate the exact use of credit for agricultural purpose.

Report of the Expert Committee on Three- tier Short Term Cooperative Credit Structure (January 2013) - This expert committee was nominated by the RBI under the chairmanship of Prakash Bakshi, the chairman of NABARD. This expert committee on three tier short term cooperative credit structure was assigned the responsibility of

- a. Examining the functioning of the short-term cooperative credit structure and
- b. Suggesting appropriate mechanism for consolidation of the STCCS and make recommendations for action to be taken by various stakeholders.
- c. The expert committee made following observations and suggestions:
- d. This expert committee recognized that the share of short term cooperative societies in supplying agricultural credit declined to 14% at the aggregate. But, there were small pockets where its share was more than 50%.
- e. The committee was of the view that STCCS constituted mainly for providing agricultural credit, must met at least 15% of the agriculture credit requirements and gradually increase it to 30%.



- f. The committee also found that about 40% of the loans disbursed by PACS and almost half the loans supplied by the CCBs were for nonagricultural purposes.
- g. The share of many of these PACS and CCBs in agricultural credit was less than 30% in their operational area. Hence, the committee remarked that these PACS and CCBs were not performing the role for which they were constituted.
- h. Therefore, the committee firmly stated that the CCBs should do the best efforts for providing at least 70% of their loans for agriculture.
- i. The committee also recommended that if a CCB or SCB constantly underperforms and provides less than 15% of aggregate agricultural credit in the operational area, then such bank should be declared as an urban co-operative bank.
- j. SCBs in the smaller states and union territories like Delhi, Goa, Chandigarh, etc. provided insignificant credit to agriculture and were mainly catering to the needs of the urban population only. Therefore these SCBs should be declared and treated as urban cooperative banks.
- k. The committee suggested that the RBI should permit the Central Cooperative Banks (CCBs) to issue fixed deposits of 10 years or more with a lock-in period of five years to its members. Further, these deposits could be converted into regular shares. The CCBs should be permitted to issue permanent bonds or debt instruments which will be contributed by the state governments, individuals and other bodies.

OBJECTIVES

- To identify the support of the agricultural banks to the Indian agricultural sector.
- To analyze the financial and the non financial supports provided by the banks to the agricultural sector.

SCOPE OF THE STUDY

Banks has an essential role for supporting the agricultural sector in India. In Indian economy, about 20 percentage of the GDP was contributed by the agricultural sector. So there is a wide scope for studying the role of agricultural banks in the development of the agricultural sector in India.

RESEARCH METHODOLOGY

The data has been taken for the time period of last Five years. The data has been collected from secondary sources such as Research papers, Journals, Newsletters and websites.

RESULTS AND DISCUSSION

Financial need for agriculture is an important output which has used for agricultural production. Technical inputs for the agricultural purpose can be purchased and used by farmer if he has the money of funds. But the farmers own money is always inadequate and he needs outside finance or credit. Till 14 major commercial banks were nationalized in 1969, co-operative banks were the most institutional agencies providing finance to agriculture. After nationalization, it had been made mandatory for these banks to provide finance to agriculture as a priority sector. These banks undertook special programs of branch expansion and created a network of banking services throughout the country and began financing agriculture on large scale. Thus agriculture credit acquired multi-agency dimension. Development and adoption of latest technologies and availability of finance go hand in hand. In bringing “Green Revolution”, “White Revolution” and “Yellow Revolution” finance has played an important role.

Now the agriculture credit, through multi agency approach has come to remain. The procedures and amount of loans for various purposes are standardized. Among the varied purposes “Crop loans” (Short-term loan) has the main share. In addition, farmers get loans for purchase of electrical motor with pump, tractor and other machinery, digging wells or boring wells, installation of pipe lines, drip irrigation, planting fruit orchards, purchase of dairy animals and



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feeds/fodder for them, poultry, sheep/goat keeping and for several other allied enterprises. The government sector banks extend both short term also as long-term loans. These loans are popularly mentioned as “Taccavi loans” which are generally advanced in times of natural calamities. The rate of interest is low and it's not a serious source of agricultural finance. Creating a web portal for identifying the accurate information about the loans will help the farmers for identifying the apt loans which helps to fulfill his needs. Appointing an assistant in the financial institutions will helps, support and convince the terms and conditions of each loans in a clearly manner.

CONCLUSION

From this study, it is identified that the role of credit to agriculture can't be viewed even as a support to food-producing activity but it should focus “need to enhance the general income and economic well-being of the farmers” as agriculture has been the essential requisite for national sovereignty. The analysis of the relationship between agricultural and non-agricultural growth in India confirms that farm & non-farm sector in rural areas are complementary to each other and risks mitigating. Rural credit policy and programs need to focus on the farm & rural non-farm sector development to alleviate rural poverty, deprivation, and suffering. Besides, above-mentioned banks, there are many other banks that also offer various sorts of agriculture loans to the farmers, to assist them increase their production also as income. Some of these banks are UCO Bank, Vijaya Bank, Syndicate Bank, United Bank of India, Indian Overseas Bank, and Bank of Maharashtra, etc. Also at the present, many banks are merged hence the there might be some changes in their loan policies.



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A NEW METHOD FOR OPTIMUM DESIGN OF THE BLOCKED END FURROW SYSTEM: I. METHOD

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ABSTRACT

A high level of water application efficiency and a uniform moisture distribution in the soil profile can be obtained when surface irrigation systems are designed and operated correctly. As the cost of investment in surface irrigation systems is lower than that of pressurized systems, it provides an advantage from the economic aspect. However, a high level of deep percolation and non-uniform moisture distribution in the soil profile are the most important problems encountered, especially in furrow irrigation systems. The aim of this investigation was to devise a new solution model for optimum design of the blocked end furrow system. The methodology has been devised for running of various soil infiltration characteristics, different irrigation water requirements of crops and inflow values. Thus, the system can be designed correctly and easily in a short time with a set of data which is not very complicated. Most importantly, it was intended in this investigation to minimize deep percolation and to provide a high level of water distribution uniformity in the wetting pattern by running this new method. In addition, it was aimed to maximize the cross-sectional area of the wetting pattern in the root zone where net irrigation water requirement of the crop was met completely along the furrow. These objectives were taken into consideration simultaneously in the design process of the new methodology. Therefore, it was enabled to obtain high level of water application efficiency. A computer program was devised in order to determine the optimum length of furrow and cut-off time. Therefore, complicated calculations were performed easily in a very short time.

Keywords: Furrow irrigation, mathematical modeling, wetting pattern in furrow irrigation, minimization of deep percolation



1. INTRODUCTION

Surface irrigation is the most common method of irrigation, due to the lower cost of investment and energy requirements than in pressurized systems. About 90% of irrigated crops across the world are irrigated using surface irrigation, including basin, border or furrow irrigation methods (Tiercelin and Vidal, 2006; Bristow et al., 2020). Because of its low capital cost and simplicity, furrow irrigation is the most commonly used method (Walker and Skogerboe, 1987; Bristow et al., 2020). However, low water application efficiency, a high level of deep percolation and poor water distribution uniformity are the main problems, especially of a furrow irrigation system which is not designed and managed appropriately. Efficient use of deficient water resources is very important especially in arid regions. The blocked end furrow system does not require a surface drainage system unlike the open ended furrows. This property reduces the labor and investment costs of the blocked end furrow system by a significant amount. As outflow of water does not occur in the blocked end furrows, a high level of water application efficiency is obtained by controlled irrigation. Therefore, another name for the blocked end furrow system is ponded irrigation in furrows (Yıldırım, 2013). The increasing demand for fresh water from different sectors reduces significantly the share of water available for irrigation. Therefore, many investigations have been carried out to increase the efficiency of surface irrigation systems.

The key element is efficient irrigation to improve water management (Sanchez et al., 2009). Different models and software have been developed to design and evaluate surface irrigation systems. The main objective of the investigations was to improve the efficiency of surface irrigation (Gillies and Smith, 2015; Naghedifar et al., 2018; Chavez and Fountes, 2019; Mazarei et al., 2020). Modernization of surface irrigation systems is very important in developing countries because of the socio-economical properties of those regions. Mailhol et al., (1999) developed a furrow irrigation model to improve irrigation practices in the Gharb Valley of Morocco. The impact of deterministic and stochastic heterogeneity factors on the infiltration process was investigated. Then, a model was developed which was based on the spatio-temporal variability of infiltration. In this process, the effect of irrigation applications on water saving was also evaluated.

Real time optimization and management of spatio-temporal variations in infiltration have been proposed for the improvement of irrigation performance (Walker, 2003; Khatri and Smith, 2007; Gilles et al., 2010). Koech et al (2014) carried out an investigation on the evaluation of the performance of furrow irrigation under real time conditions. In order to improve the performance of the system, the SISCO model was used in order to observe the effects of the variations of the system design components. In this process, the objective function, irrigation deficit, the flow rate, and the infiltration characteristics of the soil were taken into consideration. It was found in this investigation that maximization of the efficiency in the objective function could deliver an accurate prediction of the irrigation performance. In addition, it was determined that when a suitable flow rate was selected, no further change was warranted. Also, it was found that the cut-off time was relatively insensitive on the irrigation deficiency. On the other hand, the application efficiency was affected directly by the variations of irrigation deficit. Ebrahimian et al. (2020) evaluated various infiltration estimation methods for furrow irrigation under different field conditions. The analyses indicated that variations in relative error for estimating infiltration parameters are a function of soil texture, furrow length, inflow and field slope. Movement of water on the soil surface and in the subsurface is important for optimal management of water and fertilizer in a furrow irrigation system. These dynamic processes



must be described by mathematical models. Liu et al. (2019) proposed a coupled model for the description of surface water flow and solute transport. The zero-inertia equation and the average cross-sectional convection-dispersion equations were used. Numerical computations were carried out for the solution of the models. Good simulations were achieved by fine temporal resolution. It was stated that numerical oscillations could be eliminated by adopting suitable time steps. In order to increase the efficiency of furrow irrigation, accurate design and optimum management are the important components. Mazarei et al. (2020) carried out an investigation to optimize the performance of furrow irrigation. The WinSRFR software was used in the design and evaluation of the field experiment. The study was carried out on blocked end furrows with lengths of 200 m, 250 m and 300 m, and in three inflow treatments. Such components as cut-off time, inflow and field geometry were optimized by the WinSRFR software. Different combinations of these components were evaluated.

Water application efficiency, moisture distribution uniformity, deep percolation and runoff volume were taken into consideration as indicators by Kifle et al. (2017). Bristow et al. (2020) investigated the numerical simulations of the furrow surface conditions and fertilizer locations. The effects of different soil surface treatments and furrow irrigation rates on deep drainage in furrow irrigated systems were evaluated using the HYDRUS model, together with some other parameters.

The aim of this investigation was to devise a new method which enables determination of the optimum length of irrigation period (cut-off time) and the furrow length in a blocked end furrow system, which is valid in various infiltration characteristics of soils and different inflows of water resource, and the irrigation water requirements of crops. In this process, it is intended that minimum deep percolation, maximum uniformity of moisture distribution and maximum water application efficiency will be obtained.

2. DESCRIPTION OF THE METHODOLOGY

The wetting pattern of the blocked end furrow system, which occurs in the soil profile at any time t_0 , can be placed on a coordinate system (Bautista et al., 2012; USDA SCS, 2012). The head part, where water is supplied to the furrow, is placed on the origin (Figure 1). The cross-section of the wetting pattern in Figure 1 changes continuously during the irrigation application. Wang et al. (2014) stated that two dimensional models should be used for soil water dynamics for furrow irrigation.

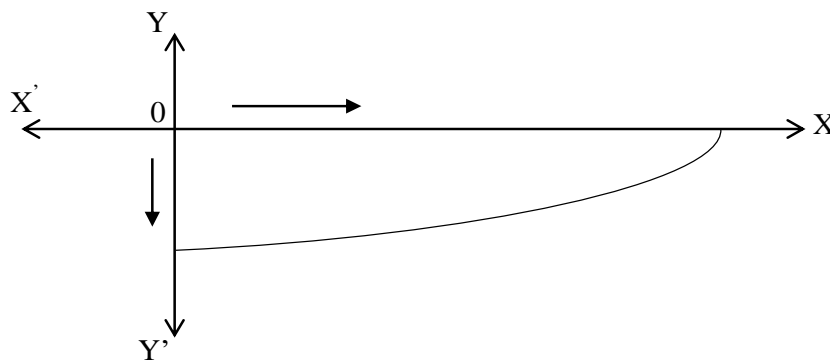


Figure 1. Water movement in the wetting pattern of the blocked end furrow system.

One of the most important disadvantages encountered in the furrow irrigation method is the deep percolation caused by inaccurate system design and irrigation applications. A high level of deep percolation occurs when the components of infiltration characteristics of the soil, inflow



to the furrow, length of irrigation time, net irrigation water requirement of the crop, net infiltration period and length of the furrow are not designed interactively and compatibly with each other. As a result of this, a uniform water distribution pattern cannot be obtained in the soil profile.

The shape of the wetting pattern which occurs in a blocked end furrow system was described by Walker and Skogerboe (1987), Bautista et al. (2012) and USDA SCS (2012). The deep percolation which occurs in the blocked end furrow system is shown schematically in Figure 2. When the net irrigation water requirement of the crop is met, deep percolation occurs along the length of the furrow (Walker and Skogerboe, 1987; Bautista et al., 2012; USDA SCS, 2012; Yıdırım, 2013). The net irrigation water requirement of the crop is represented with the symbol D_{net} in Figure 2.

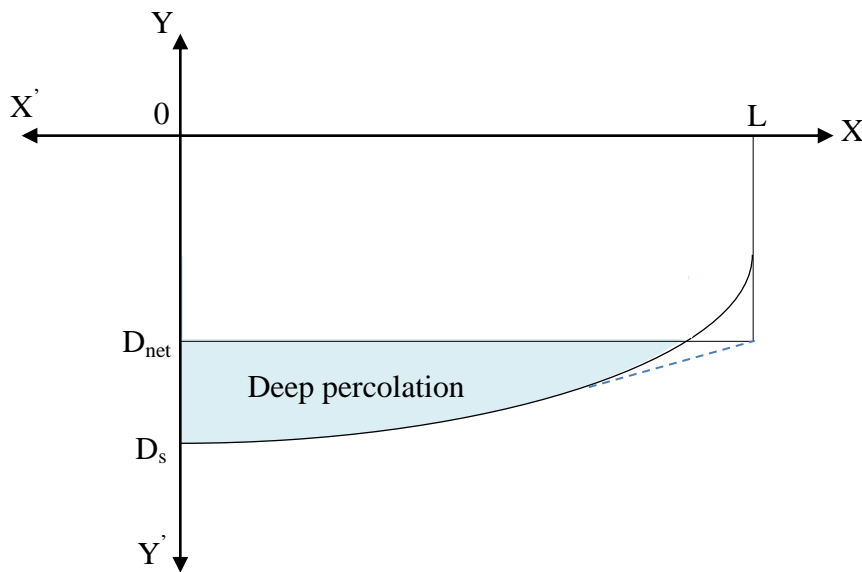


Figure 2. Schematic view of deep percolation in a blocked end furrow system.

When the cross section of deep percolation in Figure 2 is investigated, it is seen that this shape is similar to that of a quarter ellipsoid (Figure 3).

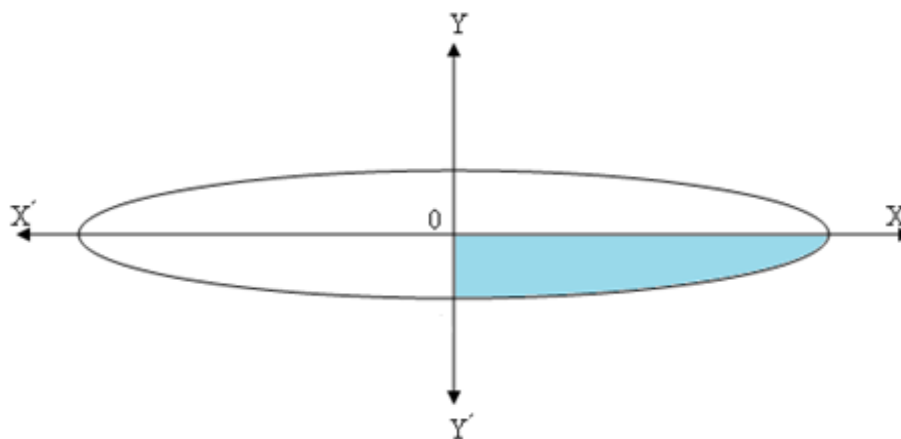


Figure 3. The shape of an ellipsoid placed on the coordinate system.

The colored zone in Figure 3 is similar to the cross-sectional area of deep percolation in Figure 2. The flatness or swelling of the colored area in Figure 2 varies depending on the amount of deep percolation which occurs in the irrigation application.



The aim of this investigation was to minimize the amount of deep percolation in a blocked end furrow system. Water loss will be reduced and uniform water distribution will be provided at a maximum level in the soil profile. In consequence, a very high level of water application efficiency will be obtainable in the blocked end furrow system.

In the modeling process, both the horizontal advance of water in the furrow and the (vertical) infiltration of water to the soil will be described as functions of time (Figure 4).

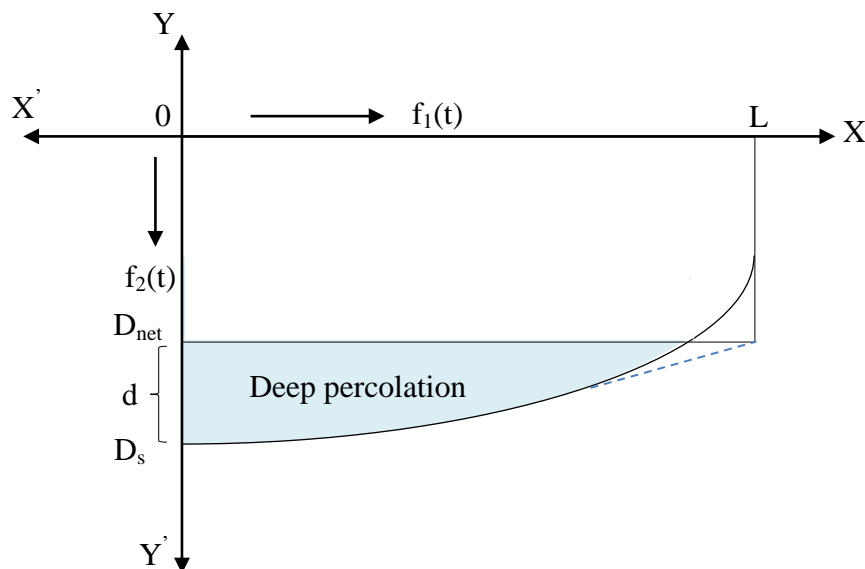


Figure 4. Simultaneous movement of water in horizontal and vertical directions.

The function $f_1(t)$ in Figure 4, which describes the horizontal movement of water is:

$$f_1(t) = V_{orty} * t \quad (1)$$

V_{orty} represents the average velocity of horizontal advance of water in the blocked end furrow in m/min. t is the elapsed time from the beginning of the irrigation application in min.

The value of the parameter V_{orty} can be determined by the inflow-outflow infiltration method. This parameter represents the average velocity of the horizontal advance of water on the soil surface. The distance between the two definite points where water advances on the soil surface is measured. At the same time, the length of time of the advance period of the water is determined between these two points. The velocity of the horizontal advance of the water can be determined using the formula given below.

$$\text{Horizontal advance velocity of water on the soil surface (m/min)} = \frac{\text{Distance between two definite points where water advances on the soil surface (m)}}{\text{Advance time of water between two definite points (min)}}$$

If this process is repeated, for example three times, and the average value of the results from these repetitions is determined, the average velocity of the horizontal advance of water on the soil surface is obtained. The value of this parameter represents the V_{orty} in m/min in the new model.



The amount of water (mm) which infiltrates the soil during the elapsed time t (min) from the beginning of the irrigation application is determined by the infiltration equation in the furrow system as below (USDA SCS, 2012; Yıldırım, 2013; Ebrahimian et al., 2020);

$$f_2(t) = (a * t^b + c) * \frac{p}{w} \quad (2)$$

In the equation above, the symbols a , b , c represent the coefficients for the soil type according to the USDA-SCS infiltration groups. t is the elapsed time from the beginning of the irrigation application in min. p represents the wetted perimeter of the furrow in m, and w is the distance between the two furrows in m.

As was stated before, the cross section of the deep percolation in Figure 4 has the form of a quarter part of the colored ellipsoid in Figure 3. Let the length of the line $[D_S D_{net}]$ equal d in Figure 4. That is, $d = [D_S D_{net}]$.

$$d = D_S - D_{net} \quad (3)$$

In equation (3), D_S is the total amount of water in mm infiltrating the soil at any moment t from the beginning of the irrigation application. D_{net} represents the net irrigation water requirement of the crop in mm. In this case, the dependent variable d is described by the formula given below.

$$d = f_2(t) - D_{net}$$

$$d = (a * t^b + c) * \frac{p}{w} - D_{net} \quad (4)$$

Thus, the size of the colored area in the shape of a quarter ellipsoid which shows the deep percolation in Figure 4 is as given below.

$$A(DP) = \frac{\pi}{4} * d * f_1(t) \quad (5)$$

When equation 4 and equation 1 are inserted respectively instead of d and $f_1(t)$ in equation 5 , equation 6 below is obtained.

$$A(DP) = \frac{\pi}{4} * \left[(a * t^b + c) * \frac{p}{w} - D_{net} \right] * [V_{orty} * t] \quad (6)$$

The wetted perimeter p in equation 6 above is calculated as explained by Bautista et al. (2009), USDA SCS (2012), Bautista et al. (2012) and Yıldırım (2013) as given below.

$$p = 0.265 * \left(\frac{q * n}{S_0^{0.5}} \right)^{0.425} + 0.227 \quad (7)$$

In equation 7, q represents the inflow to the furrow (L/sec). n is the Manning Roughness Coefficient ($n=0.04$ for furrow irrigation). S_0 is the average hydraulic slope (m/m). The value of the average hydraulic slope is calculated by the formula as given below (Bautista et al., 2009; USDA SCS, 2012; Bautista et al., 2012; Yıldırım, 2013).

$$S_0 = \frac{0.0875 * q^{0.342}}{L} \quad (8)$$

When equation (8) is inserted instead of S_0 in equation 7, formula 9 is obtained below.

$$p = 0.265 * \left(\frac{q * n}{\left(\frac{0.0875 * q^{0.342}}{L} \right)^{0.5}} \right)^{0.425} + 0.227 \quad (9)$$

Length of furrow (L) at any moment t from the beginning of the irrigation application equals $f_1(t)$. That is, $f_1(t) = V_{orty} * t = L$

When equation 9 is arranged, formula 10 is obtained below.



$$p = 0.265 * \left[\frac{n^{0.425} * (V_{orty} * t)^{0.2125}}{0.5959} * q^{0.3523} \right] + 0.227 \quad (10)$$

When equation 10 is rearranged and described exponentially, it becomes form 11 below.

$$p = 0.4447 * n^{0.425} * V_{orty}^{0.2125} * q^{0.3523} * t^{0.2125} + 0.227 \quad (11)$$

Let M be equal to the formula below:

$$M = 0.4447 * n^{0.425} * V_{orty}^{0.2125} * q^{0.3523} \quad (12)$$

M represents a coefficient in equation 11. In this case, p is described in formula 13 below:

$$p = M * t^{0.2125} + 0.227 \quad (13)$$

When equation 13 above is inserted instead of p in equation 6, equation 14 below is obtained:

$$A(DP) = \frac{\pi}{4} * \left[\left((a * t^b + c) * \frac{(M * t^{0.2125} + 0.227)}{w} - D_{net} \right) * V_{orty} * t \right] \quad (14)$$

By arranging equation 14, formula 15 below is obtained.

$$A(DP) = \frac{\pi}{4} * V_{orty} * t * (a * t^b + c) * \frac{(M * t^{0.2125} + 0.227)}{w} - \frac{\pi}{4} * V_{orty} * t * D_{net}$$

$$A(DP) = \frac{\pi}{4} * V_{orty} * \left[t * (a * t^b + c) * \frac{(M * t^{0.2125} + 0.227)}{w} - t * D_{net} \right] \quad (15)$$

When the first degree derivative of equation 15 is taken for the variable t , and the root of the equation is found, this value represents the optimum length of irrigation time which minimizes the deep percolation. The first degree derivative of equation 15 is given in equation 16 below:

$$\frac{\partial A(DP)}{\partial t} = \frac{\pi}{4} * V_{orty} * \left[(a * t^b + c) * \frac{(M * t^{0.2125} + 0.227)}{w} + a * b * t^{b-1} * t * \left(\frac{M * t^{0.2125} + 0.227}{w} \right) + \frac{M}{w} * 0.2125 * t^{-0.7875} * t * (a * t^b + c) - D_{net} \right] = 0 \quad (16)$$

When equation 16 is arranged, equation 17 is obtained. By solution of the equation 17, the optimum length of irrigation period t is obtained, which minimizes deep percolation. In other words, formula 17 given below constitutes the main and the general equation which minimizes deep percolation, and it provides a uniform moisture distribution at maximum level in the soil profile in the blocked end furrow system.

$$\frac{a * M}{w} * t^{b+0.2125} + a * t^b * \frac{0.227}{w} + \frac{c * M}{w} * t^{0.2125} + \frac{c * 0.227}{w} + \frac{a * b * M}{w} * t^{b+0.2125} + \frac{a * b * t^b * 0.227}{w} + \frac{M * a}{w} * 0.2125 * t^{b+0.2125} + \frac{M * c}{w} * 0.2125 * t^{0.2125} = D_{net} \quad (17)$$

Equation 17 above was solved by the computer program devised by Kilic (2019) (Figure 5). The sensitivity and validity of the model solution is confirmed from the amount of the net irrigation water requirement of the crop, which is calculated separately from the left side of Eq. 17 by the computer program for verification of the solution process. That is, if equation 17 is investigated, the right side value of the model is equal to D_{net} . The calculation process in the left side formula of Eq. 17, by using the related variables, parameters and coefficients, must be



equal to D_{net} with ± 0.1 mm sensitivity, which is the right side value of Eq. 17. Also, this value is taken into consideration in the confirmation of the model solution and the sensitivity. This value is shown in the interface form of the computer program as “ D_{net} (verification of the solution) (mm),” as an output (Figure 5). The sensitivity level of the program is ± 0.1 mm of water applied to the system. The interface of the software is given below.

Figure 5. The interface form of the computer program which determines the optimum length of irrigation period t and the optimum length of the blocked end furrow system L .

2.1 DETERMINATION OF THE OPTIMUM LENGTH OF THE BLOCKED END FURROW SYSTEM

The optimum length of the blocked end furrow L is determined by using the optimum length of irrigation period t , which was obtained from the solution of equation 17 above by the computer program devised by Kilic (2019) (Figure 5).

The optimum length of the blocked end furrow L is determined depending on the length of the optimum irrigation period t by using the formula for length of irrigation time given by USDA SCS (2012) and Yıldırım (2013).

$$d_t = \frac{60 * q * T_a}{w * L} \Rightarrow L = \frac{60 * q * T_a}{w * d_t} \quad (18)$$

In the equation above, d_t is the total amount of irrigation water given to the furrow in mm. When the value of the net irrigation water requirement of the crop (D_{net}) is inserted instead of d_t , this approach minimizes the deep percolation in the soil profile. That is, it must be taken into consideration that $d_t = D_{net}$ for 100% water application efficiency. On the other hand, the above approach will increase the deficit level in the furrow. In other words, while intending to minimize the amount of deep percolation, the water deficit in the furrow system will increase. Because of this, alternative solutions were carried out different from the above $d_t = D_{net}$ approach, for the sample applications in this investigation. The value of d_t was rearranged according to the 97% water application efficiency for the sample applications. The value of d_t was determined in accordance with the following coefficient for both of the sample applications;

$$D_{net} = d_t * \frac{97}{100} \Rightarrow d_t = 1.031 * D_{net}$$

This alternative solution increases the amount of water (d_t) applied to the furrow, and decreases the deficit level. Therefore, water application efficiency may increase in the blocked end furrow system. The length of furrow L was obtained according to the new model for the above value of $d_t = 1.031 * D_{net}$ by running Eq. 18.

The symbol q in Eq. 18 represents the inflow to the furrow in L/sec. T_a is the length of the irrigation period in min. The optimum value of this variable is the value of t from model solution



17 devised in this investigation. w is the distance between the two furrows in m. L represents the optimum length of the blocked end furrow in m, which minimizes the amount of deep percolation, and this provides the uniform distribution of moisture at maximum level in the soil profile. These calculation processes are given in the solution of the sample applications.

3. CONCLUSIONS

In this investigation, a new method was devised, which enabled optimum design of the furrow system. The analytical solution approach was carried out instead of the trial and error method in this process. The wetting pattern in soil profile was placed on the coordinate system and was described analytically. The cross-sectional area of the wetting pattern was simulated to the quarter of an ellipsoid. In this process, the deep percolation was minimized. Therefore, it was aimed to be obtained a high level of water distribution uniformity in the soil profile. In addition, the cross-sectional area of the root zone, where the net irrigation water requirement of the crop was met, was maximized. A computer program was devised by Kilic (2019) in order to run the model. In conclusion, a methodology was devised for providing high level of water application efficiency in furrow irrigation method.

Meanings of the Symbols Used in the “Method” and “Application” Parts of the Investigation

$A(DP)$: Function of the cross-sectional area of deep percolation depending on time (m^2).

a, b, c : Coefficients for the soil type according to the USDA-SCS infiltration groups.

b_{min} : The minimum width of a furrow set (m).

d : The length of the line [$D_s D_{net}$] in Figure 4. ($d=D_s-D_{net}$).

d_n or D_{net} : Net irrigation water requirement of the crop in any irrigation period (mm).

d_s : Amount of deep percolation (mm).

D_s : The total amount of water in mm infiltrating to the soil at any moment t from the beginning of the irrigation application.

d_t : Total amount of irrigation water to be applied in each irrigation (mm).

E_a : Water application efficiency (%).

f, g : Coefficients for the advance features of water in furrow according to the USDA-SCS infiltration groups.

$f_1(t)$: The horizontal movement function of water depending on time.

$f_2(t)$: The amount of water (mm) which infiltrates the soil during the elapsed time t (min) from the beginning of the irrigation application. In other words, the infiltration equation depending on time in the furrow system.

L : Length of furrow (m).

M : The coefficient obtained from equation (12).

n : Manning roughness coefficient ($n=0.04$ for furrow irrigation).

N_{max} : The maximum number of furrow sets which can be placed across the width of the plot.

n_{min} : The minimum number of furrows in one furrow set.

P : Wetted perimeter of the furrow (m).

Q : Discharge of water source (system discharge) (L/sec).

q : Inflow to the furrow (L/sec).

q_{max} : The maximum inflow to the furrow (L/sec).

S_0 : The average hydraulic slope (m/m).

t : The elapsed time from the beginning of the irrigation application (min).

T_0 : Average infiltration period (min).

T_a : Irrigation period (min).



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T_i : Water advance period. Length of time necessary for water to reach the end of the furrow (min).

T_n : Net infiltration period. Length of time for infiltration of the net amount of irrigation water applied in each irrigation (min).

V_{orty} : The average velocity of horizontal advance of water on the soil surface in the blocked end furrow (m/min).

w : Distance between two furrows (m).



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A NEW METHOD FOR OPTIMUM DESIGN OF THE BLOCKED END FURROW SYSTEM: II. APPLICATION

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ABSTRACT

The model devised for determining the optimum length of furrow and optimum cut-off time in furrow irrigation was run for various soil textures, different infiltration conditions, irrigation water requirements and different inflow values. The results from the new model which was run for different sample applications were compared with the results of an existing USDA SCS method for the solution of the same problems. Results were evaluated from the points of view of optimum length of furrow, optimum cut-off time and water application efficiency. In the solution according to the USDA SCS method, the length of irrigation period (T_a), length of furrow (L) and value of water application efficiency (E_a) were found to be 150.9 min, 166.67 m and 94.18% respectively for a 1.33 L/sec inflow to the furrow for the sample application. According to the results from the new method devised in this investigation, the optimum length of irrigation period (t), optimum length of furrow (L), and water application efficiency (E_a) were found to be 143.65 min, 163.509 m and 94.44% respectively for the same amount of inflow. In addition, from the solution of another sample application according to the USDA SCS method, the length of irrigation period (T_a), length of furrow (L) and value of water application efficiency (E_a) were found to be 204 min, 175 m and 93.70% respectively for a 0.90 L/sec inflow to the furrow. When the same sample application was solved according to the new method devised in this investigation, the optimum length of irrigation period (t), optimum length of furrow (L) and value of water application efficiency (E_a) were found to be 195.48 min, 173.711 m and 94.0% respectively with the same inflow. In conclusion, the proposed method devised in this investigation can be run easily, and very sensitive results are obtained with a high level of water application efficiency, which minimizes deep percolation and provides a maximum level of uniformity in the distribution of moisture in the soil profile.

Keywords: Furrow irrigation, mathematical modeling, wetting pattern in furrow irrigation, minimization of deep percolation



1. INTRODUCTION

The blocked end level furrows have been commonly used in irrigation of vegetables in many regions worldwide. The accurate design and management of blocked end furrow irrigation can minimize water application, leaching of agrichemicals below the root zone and irrigation cost. Sanchez et al., (2009) represented management tools and guidelines for the efficient irrigation applications in the blocked end furrow system. The study was carried out in the Lower Colorado River region where the application efficiency of furrow irrigation was often low. Field experiment and modeling processes constituted the investigation. Infiltration parameters were estimated by the two point method modified for blocked end level furrows. The SRFMR model (surface irrigation hydraulic model) was used in the verification process of the model. Results showed that efficient irrigations could be performed by selecting the proper amount of flow rate and cut-off time in the blocked end level furrow system. In addition, it was determined that significant levels of increments in irrigation efficiency sometimes occurred when furrow lengths were shorter than the typical one which was used in the region.

Selle et al. (2011) carried out an investigation of the applicability of Richards' equation models to the prediction of deep percolation under surface irrigation. It was found that the use of a simple Richards' equation model appeared inadequate under such conditions. Wang et al. (2014) evaluated the soil water dynamics and crop yield under furrow irrigation. A coupled model was developed based on the CHAIN_2D and the crop growth model of EPIC. In this process, the interaction between the root water uptake and crop growth components was taken into consideration. The values from a melon field experiment were used in calibration and validation of the coupled model. Then, the yield and water productivity of melons were predicted for different furrow irrigation scenarios. Results showed that the water productivity decreased and the relative yield increased, since the relative irrigation increased through a quadratic function. Gonzalez et al. (2011, 2016) investigated a new method to improve field topography in surface irrigation. According to the results from the investigation, optimum slope depends on the infiltration, length of furrow and inflow.

In some investigations, inflow and cut-off time are the most important components for the performance of a surface irrigation system (Smith et al., 2005; Bautista et al., 2009; Morris et al., 2015). Walker and Skogerboe (1987) and Chen et al. (2012) stated that the components of slope, length and cross section are the most important geometric parameters for surface irrigation. According to Anwar et al. (2016), the common indicators are water application efficiency and moisture distribution uniformity. Deep percolation, tailwaters and flooding from some parts of the land are some of the problems in surface irrigation systems because of the inaccurate design and operation conditions. Chavez and Fuentes (2019) carried out an investigation of design and evaluation of surface irrigation systems. The data of the plot, evaluation of irrigation tests and amount of net irrigation water to be applied are some of the main components of this investigation. The root zone soil moisture deficit was met based on the water balance in model-based irrigation control by Delgoda et al. (2016). They proposed the application of system identification to water balance data to obtain a linear time series model. Irrigation return is a variable in the groundwater balance equation, and it is hard to estimate component. Naghedifar et al. (2018) investigated the irrigation return flow under sprinkler and furrow irrigation systems under arid region conditions. In order to estimate the evapotranspiration, the dual crop coefficient approach was used. It was found that 13.3% of the irrigation and precipitation inflow returned to the groundwater aquifer as irrigation return flow. Schwartz et al. (2020) carried out an investigation on a crop coefficient-based water use model



with non-uniform root distribution. Calibration of the model was performed in order to predict the evapotranspiration of maize (*Zea mays* L.). The actual evapotranspiration of maize was predicted by the calibrated model, which was optimized with crop and stress response coefficients, with the daily and seasonal periods. In this process, underestimation of runoff and overestimation of crop water use caused the largest uncertainties in predicted crop evapotranspiration. Measured and predicted soil water contents averaged over the rooting depth agreed closely, but root water extraction was overestimated in deeper profile. In conclusion, it was reported that the model would be suitable for evaluating deficit irrigation strategies. In this investigation, different sample applications were solved by both the USDA SCS method and the new method devised in this investigation. The results were analyzed comparatively in the verification process of the proposed method.

2. RUNNING OF THE SOLUTION METHODS ON SAMPLE APPLICATIONS

The new method devised in this investigation was applied in the solutions of two different problems previously published by Yıldırım (2013). Those problems were solved both by using the new method devised in this investigation and by the existing USDA SCS method used by Yıldırım (2013). Both of the solution techniques are presented in detail in the paper in order for readers to follow this specific subject easily from every point of view. Then, the values of water application efficiencies from the two different methods were compared and analyzed in detail in the verification process of the new method.

The model devised in this investigation was applied to the solution of different sample problems – which were published previously by Yıldırım (2013), and which are known by a wide range of reader groups – in order not to leave questions in the minds of readers in the verification process of the new method.

3. SAMPLE APPLICATION 1 FOR THE BLOCKED END FURROW IRRIGATION METHOD

In the problem published by Yıldırım (2013), the blocked end furrow irrigation method was applied in a farm. The plot where the blocked end furrow system was designed was in the shape of a rectangle without slope and was 225 * 500 m in size. The blocked end furrow also had no slope in the irrigation direction, and the water advanced along the furrow by means of the hydraulic slope. The water source (system) discharge was $Q=100$ L/sec, and the maximum inflow to the furrow was $q_{\max}=1.5$ L/sec. The crop type was tomatoes and the distance between rows was 100 cm. Crop evapotranspiration was 7.4 mm/day and effective root depth was 90 cm. The net irrigation water requirement of the crop was 68 mm. The infiltration test for the furrow was carried out according to the inflow-outflow method. It was determined that the soil type was in the I_f 0.60 infiltration group according to the USDA-SCS criteria.

3.1. SOLUTION PROCESS FOR THE SAMPLE APPLICATION BY THE USDA SCS METHOD

1) The soil where the blocked end furrow system was designed was in the I_f 0.60 infiltration group according to the USDA-SCS criteria. The values of the coefficients for this group were $a=1.321$, $b=0.757$, $c=7.0$, $f=8.15$ and $g=2.883 \cdot 10^{-4}$.

In this way, the additional infiltration equation was represented by the formula $D=aT^b+c$. When the coefficients were inserted in the equation, $D=1.321T^{0.757}+7$ was obtained.

2) Distance between furrows



Distance between rows was 100 cm for tomatoes. As this value was higher than 50 cm, one furrow was prepared for each crop row, and the distance between furrows was taken to be $w=1.0$ m.

3) The maximum number of furrow sets across the width of the plot

The system discharge and the maximum inflow to the furrows were $Q=100$ L/sec and $q_{max}=1.5$ L/sec respectively. In these conditions, the minimum number of furrows in a furrow set;

$$n_{min} = \frac{Q}{q_{max}} = \frac{100}{1.5} = 66$$

Under these conditions, the minimum width of one furrow set;

$$b_{min} = wn_{min} = 1 * 66 = 66 \text{ m}$$

The maximum number of furrow sets which can be placed across the width of the plot;

$$N_{max} = \frac{225}{66} = 3.41 \cong 3$$

4) Suitable furrow length and inflow

Two alternative solutions were obtained in designing this blocked end furrow system. These are given below.

Alternative I

Three furrow sets were placed across the width of the plot. Thus the inflow to a furrow was found to be $q=1.33$ L/sec according to the calculation process given in step 3. This process was carried out as shown below;

$$N_{max} = 3 = \frac{225}{b_{min}} \Rightarrow b_{min} = \frac{225}{3} \Rightarrow b_{min} = 75 \text{ m}$$

$$b_{min} = wn_{min} \Rightarrow 75 = 1.0 * n_{min} \Rightarrow n_{min} = 75$$

$$n_{min} = \frac{Q}{q} \Rightarrow 75 = \frac{100}{q} \Rightarrow q = \frac{100}{75} \Rightarrow q = 1.33 \text{ L/sec}$$

For a furrow length of $L=500$ m.

a) The average hydraulic slope

$$S_0 = \frac{0.0875q^{0.342}}{L} = \frac{0.0875 * (1.33)^{0.342}}{500} = 0.00019 \text{ m/m}$$

b) The wetted perimeter

The value of the Manning Roughness Coefficient (n) was taken as 0.04 for the furrow irrigation method.

$$P = 0.265 \left(\frac{qn}{S_0^{0.5}} \right)^{0.425} + 0.227 = 0.265 * \left(\frac{1.33 * 0.04}{0.00019^{0.5}} \right)^{0.425} + 0.227 = 0.697 \text{ m}$$

This was acceptable because $P=0.697 \text{ m} < w=1 \text{ m}$.

c) The net infiltration period

$$T_n = \left(\frac{d_n \frac{w}{P} - c}{a} \right)^{1/b} = \left(\frac{68 * \frac{1}{0.697} - 7}{1.321} \right)^{1/0.757} = 266.33 \text{ min}$$

d) The water advance period

$$\beta = \frac{gL}{qS_0^{0.5}} = \frac{2.883 * 10^{-4} * 500}{1.33 * (0.00019)^{0.5}} = 7.86$$

$$T_i = \frac{L}{f} e^{\beta} = \frac{500}{8.15} * (2.7182)^{7.86} = 158951.37 \text{ min}$$



According to these results, as the values were $T_i=158951.37 \text{ min} > 0.60 \cdot T_n=159.8 \text{ min}$, a furrow length of $L=500 \text{ m}$ was not suitable.

In this way, three sets of furrows were placed across the width of the plot, and the solution process was carried out again for a furrow length of $L=250 \text{ m}$ ($=500/2$) and inflow to the furrow $q=1.33 \text{ L/sec}$. The results obtained are given below.

As the values were $T_i=475.02 \text{ min} > 0.60 \cdot T_n=184 \text{ min}$, a furrow length of $L=250 \text{ m}$ was not suitable.

Three sets of furrows were placed across the width of the plot, and the solution process was carried out again for a furrow length of $L=166.67 \text{ m}$ ($=500/3$) and inflow to the furrow $q=1.33 \text{ L/sec}$. The results obtained are given below.

As the values were $T_i=91.65 \text{ min} < 0.60 \cdot T_n=198.48 \text{ min}$, a furrow length of $L=166.67 \text{ m}$ was suitable.

The data for the two alternative solutions are given in Table 1.

Table 1. The data for the two alternative solutions.

Alternatives	I	II
Number of furrow sets in the width of the plot	3	2
Length of furrow (L) (m)	166.67	166.67
Inflow to the furrow (q) (L/sec)	1.33	0.89
Water advance period (T_i) (min)	91.65	227.68
Net infiltration period (T_n) (min)	330.80	372.03
$0.60 \cdot T_n$	198.48	223.22
Comparison of the T_i and $0.60 \cdot T_n$	$T_i < 0.60 \cdot T_n$	$T_i > 0.60 \cdot T_n$

In these solutions, a furrow length of $L=166.67 \text{ m}$ was found to be suitable according to alternative I. However in alternative II, as the values were $T_i=227.68 \text{ min} > 0.60 \cdot T_n=223.22 \text{ min}$, a furrow length of $L=166.67 \text{ m}$ was found not to be suitable. According to these solutions, alternative I was taken into consideration in planning the system.

Solution process for Alternative I

The solution process was carried out for three sets of furrows, placed across the width of the plot, length of furrow $L=166.67 \text{ m}$ and inflow to the furrow $q=1.33 \text{ L/sec}$. The calculations for alternative I are given below.

- The maximum number of furrow sets which could be placed across the width of the plot:

The system discharge and the inflow to the furrow were $Q=100 \text{ L/sec}$ and $q=1.33 \text{ L/sec}$ respectively. In these conditions, the minimum number of furrows in one furrow set;

$$n_{min} = \frac{Q}{q_{max}} = \frac{100}{1.33} = 75$$

Thus, the minimum width of one furrow set;

$$b_{min} = wn_{min} = 1.0 \cdot 75 = 75 \text{ m}$$

The maximum number of furrow sets which can be placed across the width of the plot;



$$N_{max} = \frac{225}{75} = 3$$

The total number of furrow sets in the whole plot (225*500 m) was 3*3=9

a) The average hydraulic slope

$$S_0 = \frac{0.0875q^{0.342}}{L} = \frac{0.0875 * (1.33)^{0.342}}{166.67} = 0.00058 \text{ m/m}$$

b) The wetted perimeter

The value of the Manning Roughness Coefficient (n) was taken as 0.04 for the furrow irrigation method.

$$P = 0.265 \left(\frac{qn}{S_0^{0.5}} \right)^{0.425} + 0.227 = 0.265 * \left(\frac{1.33 * 0.04}{0.00058^{0.5}} \right)^{0.425} + 0.227 = 0.598 \text{ m}$$

This was suitable because the values were $P=0.598 \text{ m} < w=1 \text{ m}$.

c) The net infiltration period

$$T_n = \left(\frac{d_n \frac{w}{P} - c}{a} \right)^{1/b} = \left(\frac{68 * \frac{1}{0.598} - 7}{1.321} \right)^{1/0.757} = 330.80 \text{ min}$$

d) The water advance period

$$\beta = \frac{gL}{qS_0^{0.5}} = \frac{2.883 * 10^{-4} * 166.67}{1.33 * (0.00058)^{0.5}} = 1.5$$

$$T_i = \frac{L}{f} e^{\beta} = \frac{166.67}{8.15} * (2.7182)^{1.5} = 91.65 \text{ min}$$

According to these results, the values were $T_i=91.65 \text{ min} < 0.60 * T_n=198.48 \text{ min}$, and so a length of furrow of $L=166.67 \text{ m}$ was found to be suitable.

e) Average infiltration period

$$T_0 = T_n + \frac{0.0929[(\beta - 1)e^{\beta} + 1]}{fL \left(\frac{0.305\beta}{L} \right)^2} = 330.80 + \frac{0.0929 * [(1.5 - 1) * (2.7182)^{1.5} + 1]}{8.15 * 166.67 * \left(\frac{0.305 * 1.5}{166.67} \right)^2}$$

$$T_0 = 360.22 \text{ min}$$

f) The length of irrigation time

$$T_a = \frac{PL}{60q} (aT_0^b + c) = \frac{0.598 * 166.67}{60 * 1.33} * (1.321 * 360.22^{0.757} + 7) = 150.90 \text{ min}$$

g) Total amount of irrigation water to be applied

$$d_t = \frac{60qT_a}{wL} = \frac{60 * 1.33 * 150.90}{1 * 166.67} = 72.2 \text{ mm}$$

h) Amount of deep percolation

$$d_s = d_t - d_n = 72.2 - 68 = 4.2 \text{ mm}$$

i) Water application efficiency

$$E_a = 100 \frac{d_n}{d_t} = 100 * \frac{68}{72.2} = 94.18$$

The same problem was also solved by the method which was newly devised in this investigation.

3.2. RUNNING OF THE NEW METHOD FOR SOLUTION OF FURROW IRRIGATION APPLICATION

The new method devised in this investigation was run for the values of $a=1.321$, $b=0.757$, $c=7$, $w=1 \text{ m}$, $D_{net}=68 \text{ mm}$, $n=0.04$, $q=1.33 \text{ L/sec}$, and $V_{orty}=1.074 \text{ m/min}$ (Figure 1).



Figure 1. The interface form which shows the solution of the sample application by the new method (Kilic, 2019).

The parameter M in the formula 12 was determined to be 0.1271054. When formula 17 is investigated, it is seen that the right side value of this equation is the net irrigation water requirement of the crop (D_{net}). This value is used by the program with ± 0.1 mm sensitivity for confirmation and verification of the model results. The value of the net irrigation water requirement of the crop, which was calculated by the computer program for the left side value of Eq. 17 for the verification and confirmation process of the model results, was found to be 68.1 mm. The value of this verification parameter (D_{net}) is calculated by the program to a sensitivity of ± 0.1 mm by taking into consideration the parameters and the variables of equation 17. This is the reason why the value of this parameter is 0.1 mm different from the net irrigation water requirement of the crop (68 mm). These results prove the accuracy of the model solution. The calculations in the verification process of the model solution must be carried out to at least in five decimal places to obtain accurate results.

The optimum length of the irrigation period (t) was found to be 143.65 min and the optimum length of the blocked end furrow (L) was 168.33 m. In addition, when the value of d_t was rearranged as $d_t = 1.031 * D_{net}$ and the model was run again as was explained under the title “Determination of the Optimum Length of the Blocked End Furrow System” in the Method part, the optimum length of furrow (L) was found to be 163.509 m.

3.3. CONFIRMATION OF THE MODEL RESULTS AND THE COMPUTER PROGRAM FOR THE FIRST SAMPLE APPLICATION

The values of all parameters, variables and the coefficients are given below for the first sample application.

$a=1.321$, $b=0.757$, $c=7$, $w=1$ m, $D_{net}=68$ mm, $n=0.04$, $q=1.33$ L/sec, and $V_{orty}=1.074$ m/min. The optimum length of water application period (t) was found to be 143.65 min by running Eq. 17.

First of all, the value of parameter M is calculated (the calculations must be carried out to at least five decimal places for sensitivity):

$$M = 0.4447 * n^{0.425} * V_{orty}^{0.2125} * q^{0.3523} \quad (12)$$

When the values of the variables are inserted in Eq. 12, the following result is obtained for parameter M .

$$M = 0.4447 * 0.04^{0.425} * 1.074^{0.2125} * 1.33^{0.3523} \Rightarrow M = 0.1271054$$

The value of parameter M can be seen in the interface form of the computer program in Figure 1.



In the second step, Eq. 17 must be run. All the values of the parameters, variables and coefficients are inserted in Eq. 17 (The calculations must be carried out to at least five decimal places for sensitivity).

$$\frac{a * M}{w} * t^{b+0.2125} + a * t^b * \frac{0.227}{w} + \frac{c * M}{w} * t^{0.2125} + \frac{c * 0.227}{w} + \frac{a * b * M}{w} * t^{b+0.2125} + \frac{a * b * t^b * 0.227}{w} + \frac{M * a}{w} * 0.2125 * t^{b+0.2125} + \frac{M * c}{w} * 0.2125 * t^{0.2125} = D_{net} \quad (17)$$

When the values of the parameters, variables and coefficients are inserted in Eq. 17, the verification process can be carried out and the following result is obtained:

$a=1.321$, $b=0.757$, $c=7$, $w=1$ m, $D_{net}=68$ mm, $n=0.04$, $q=1.33$ L/sec, and $V_{orty}=1.074$ m/min $M=0.1271054$ and $t=143.65$ min.

$$\frac{1.321 * 0.1271054}{1} * 143.65^{0.757+0.2125} + 1.321 * 143.65^{0.757} * \frac{0.227}{1} + \frac{7 * 0.1271054}{1} * 143.65^{0.2125} + \frac{7 * 0.227}{1} + \frac{1.321 * 0.757 * 0.1271054}{1} * 143.65^{0.757+0.2125} + \frac{1.321 * 0.757 * 143.65^{0.757} * 0.227}{1} + \frac{0.1271054 * 1.321}{1} * 0.2125 * 143.65^{0.757+0.2125} + \frac{0.1271054 * 7}{1} * 0.2125 * 143.65^{0.2125} = 68$$

When the calculation process is carried out for the left side of Eq. 17, the following results are obtained:

$$20.72882 + 12.88276 + 2.55676 + 1.589 + 15.69172 + 9.75225 + 4.40487 + 0.54331 = 68$$

68.1 \cong 68

As the sensitivity of the computer program is ± 0.1 mm, the left side result of the equation was found as 68.1 mm. This calculation process verifies the validity of the model solution and the accuracy of the computer program.

The optimum length of the furrow is determined by Eq. 18. (Please see the explanations about the running of this formula in the Method part).

$$d_t = \frac{60 * q * T_a}{w * L} \quad (18)$$

$$68 = \frac{60 * 1.33 * 143.65}{1 * L} \Rightarrow L = 168.58 \text{ m.}$$

These results can be seen in the interface form of the computer program in Figure 1. The decimal difference between the results from the calculator and the computer program is caused by the 14 decimal place sensitivity of the software. On the other hand, the calculations were carried out to 5 decimal places by calculator. The same condition is valid for the other sample application.



3.4. VERIFICATION OF THE MODEL RESULTS FOR THE FIRST SAMPLE APPLICATION

The results from the new model were inserted into the USDA SCS method to determine the water application efficiency of the new method. This was the confirmation and verification process of the new method.

The model results for the given crop, soil, and inflow conditions indicated that the optimum length of furrow was $L=168.33$ m, when the inflow to the furrow was $q=1.33$ L/sec, the net irrigation water requirement of the crop (D_{net}) was 68 mm, and the number of furrow sets across the width of the plot was three. This length of furrow (168.33 m) was found to be 1% longer (1.66 m) than the furrow length of 166.67 m in the existing solution method (USDA SCS, 2012; Yıldırım, 2013). The calculation process for the comparative checking and verification of the new model results are given below.

1) The soil where the blocked end furrow system was designed was in the I_f 0.60 infiltration group according to the USDA-SCS criteria. The values of the coefficients for this group were $a=1.321$, $b=0.757$, $c=7.0$, $f=8.15$ and $g=2.883 \cdot 10^{-4}$.

In this way, the additional infiltration equation was represented by the formula $D=aT^b+c$. When the coefficients were inserted in the equation, $D=1.321T^{0.757}+7$ was obtained.

2) Distance between furrows

Distance between rows was 100 cm for tomatoes. As this value was higher than 50 cm, one furrow was prepared for each crop row, and the distance between furrows was taken to be $w=1.0$ m.

3) The maximum number of furrow sets across the width of the plot

The system discharge and the maximum inflow to the furrows were $Q=100$ L/sec and $q_{max}=1.5$ L/sec respectively. In these conditions, the minimum number of furrows in a furrow set:

$$n_{min} = \frac{Q}{q_{max}} = \frac{100}{1.5} = 66$$

Under these conditions, the minimum width of one furrow set:

$$b_{min} = wn_{min} = 1 * 66 = 66 \text{ m}$$

The maximum number of furrow sets which can be placed across the width of the plot:

$$N_{max} = \frac{225}{66} = 3.41 \cong 3$$

Total number of furrow sets in the whole plot (225*500 m) was $3*3=9$

4) The calculation process of the other components for a furrow length of $L=168.33$ m and inflow to the furrow of $q=1.33$ L/sec.

a) The average hydraulic slope

$$S_0 = \frac{0.0875q^{0.342}}{L} = \frac{0.0875 * (1.33)^{0.342}}{168.33} = 0.00057 \text{ m/m}$$

b) The wetted perimeter

The value of the Manning Roughness Coefficient (n) was taken as 0.04 for the furrow irrigation method.

$$P = 0.265 \left(\frac{qn}{S_0^{0.5}} \right)^{0.425} + 0.227 = 0.265 * \left(\frac{1.33 * 0.04}{0.00057^{0.5}} \right)^{0.425} + 0.227 = 0.599 \text{ m}$$

This was suitable because the values were $P=0.599 \text{ m} < w=1 \text{ m}$.

c) The net infiltration period



$$T_n = \left(\frac{d_n \frac{w}{P} - c}{a} \right)^{1/b} = \left(\frac{68 * \frac{1}{0.599} - 7}{1.321} \right)^{1/0.757} = 330.02 \text{ min}$$

d) The water advance period

$$\beta = \frac{gL}{qS_0^{0.5}} = \frac{2.883 * 10^{-4} * 168.33}{1.33 * (0.00057)^{0.5}} = 1.5$$

$$T_i = \frac{L}{f} e^\beta = \frac{168.33}{8.15} * (2.7182)^{1.5} = 92.56 \text{ min}$$

According to these results, the values were $T_i=92.56 \text{ min} < 0.60 * T_n=198.01 \text{ min}$, and so a length of furrow of $L=168.33 \text{ m}$ was found to be suitable.

e) Average infiltration period

$$T_0 = T_n + \frac{0.0929[(\beta - 1)e^\beta + 1]}{fL \left(\frac{0.305\beta}{L} \right)^2} = 330.02 + \frac{0.0929 * [(1.5 - 1) * (2.7182)^{1.5} + 1]}{8.15 * 168.33 * \left(\frac{0.305 * 1.5}{168.33} \right)^2}$$

$$T_0 = 359.73 \text{ min}$$

f) The length of irrigation time

$$T_a = \frac{PL}{60q} (aT_0^b + c) = \frac{0.599 * 168.33}{60 * 1.33} * (1.321 * 359.73^{0.757} + 7) = 152.51 \text{ min}$$

g) Total amount of irrigation water to be applied

$$d_t = \frac{60qT_a}{wL} = \frac{60 * 1.33 * 152.51}{1 * 168.33} = 72.3 \text{ mm}$$

h) Amount of deep percolation

$$d_s = d_t - d_n = 72.3 - 68 = 4.3 \text{ mm}$$

i) Water application efficiency

$$E_a = 100 \frac{d_n}{d_t} = 100 * \frac{68}{72.3} = 94.05$$

The model results indicated for the solution of $d_t=D_{net}$ condition that the most suitable length of furrow was $L=168.33 \text{ m}$ for a 68 mm net irrigation water requirement of the crop and a $q=1.33 \text{ L/sec}$ inflow to the furrows for the given crop and soil conditions. While the water application efficiency was found to be 94.18% for a 166.67 m length of furrow according to the USDA SCS method, it was 94.05% for a 168.33 m furrow length according to the new method. Consequently, the length of the furrow increased by 1% (1.66 m) when the optimum length of irrigation period was determined by the new method. This means that a larger area is irrigated with a high level of water application efficiency (94.05%).

In addition, when the verification process of the new model is carried out for the condition of $d_t=1.031 * D_{net}$, and for the optimum length of the furrow ($L=163.509 \text{ m}$), the water application efficiency was found to be 94.44% according to the USDA SCS method. The values of the variables, parameters and the coefficients obtained from the verification process are: $S_0=5.9 * 10^{-4} \text{ m/m}$, $P=0.597 \text{ m}$, $T_n=331.58 \text{ min}$, $\beta=1.46$, $T_i=86.38 \text{ min}$, $T_0=359.60 \text{ min}$, $T_a=147.61 \text{ min}$, $d_t=72 \text{ mm}$, $d_s=4 \text{ mm}$ and $E_a=94.44\%$ according to the USDA SCS method.

As a result, the new method devised in this investigation can easily be used with a high rate of water application efficiency in designing a blocked end furrow system.



4. SAMPLE APPLICATION 2 FOR THE BLOCKED END FURROW IRRIGATION METHOD

In the problem published by Yıldırım (2013), the blocked end furrow irrigation method was applied in a farm. The plot where the blocked end furrow system was designed was in the shape of a rectangle without slope and was 250 * 350 m in size. Also, the blocked end furrow had no slope in the irrigation direction, and the water advanced along the furrow by means of the hydraulic slope. The water source (system) discharge was $Q=80$ L/sec, and the maximum inflow the furrow was $q_{max}=1.4$ L/sec. The crop type was maize, and the distance between rows was 70 cm. The net irrigation water requirement of the crop was 84.2 mm. The infiltration test for the furrow was carried out according to the inflow-outflow method. It was determined that the soil type was in the I_f 0.40 infiltration group according to the USDA-SCS criteria.

4.1. SOLUTION PROCESS FOR THE SAMPLE APPLICATION ACCORDING TO THE USDA SCS METHOD

The blocked end furrow system design was carried out in line with these data as explained below by Yıldırım (2013);

- 1) The soil where the blocked end furrow system was designed was in the I_f 0.40 infiltration group according to the USDA-SCS criteria. The values of the coefficients for this group were $a=1.064$, $b=0.736$, $c=7.0$, $f=7.79$ and $g=2.23*10^{-4}$.

In this way, the additional infiltration equation was represented by the formula $D=aT^b+c$. When the coefficients were inserted in the equation, $D=1.064T^{0.736}+7$ was obtained.

- 2) Distance between furrows

Distance between rows was 70 cm for maize. As this value was higher than 50 cm, one furrow was prepared for each crop row, and the distance between furrows was taken to be $w=0.70$ m.

- 3) The maximum number of furrow sets across the width of the plot

The system discharge and the maximum inflow to the furrows were $Q=80$ L/sec and $q_{max}=1.4$ L/sec respectively. In these conditions, the minimum number of furrows in a furrow set;

$$n_{min} = \frac{Q}{q_{max}} = \frac{80}{1.4} = 57$$

Under these conditions, the minimum width of one furrow set;

$$b_{min} = wn_{min} = 0.70 * 57 = 40 \text{ m}$$

The maximum number of furrow sets which can be placed across the width of the plot;

$$N_{max} = \frac{250}{40} = 6$$

- 4) Suitable furrow length and inflow

Four alternative solutions were obtained by Yıldırım (2013) in designing this blocked end furrow system. These are given below.

Alternative I

Six furrow sets were placed across the width of the plot. Thus the inflow to the furrow was found to be $q=1.33$ L/sec according to the calculation process given in step 3.

For a furrow length of $L=350$ m.

$$S_0 = \frac{0.0875q^{0.342}}{L} = \frac{0.0875 * (1.33)^{0.342}}{350} = 0.00028 \text{ m/m}$$

- b) The wetted perimeter

The value of the Manning Roughness Coefficient (n) was taken as 0.04 for the furrow irrigation method.



$$P = 0.265 \left(\frac{qn}{S_0^{0.5}} \right)^{0.425} + 0.227 = 0.265 * \left(\frac{1.33 * 0.04}{0.00028^{0.5}} \right)^{0.425} + 0.227 = 0.66 \text{ m}$$

This was acceptable because $P=0.66 \text{ m} < w=0.70 \text{ m}$.

c) The net infiltration period

$$T_n = \left(\frac{d_n \frac{w}{P} - c}{a} \right)^{1/b} = \left(\frac{84.2 * \frac{0.70}{0.66} - 7.0}{1.064} \right)^{1/0.736} = 368 \text{ min}$$

d) The water advance period

$$\beta = \frac{gL}{qS_0^{0.5}} = \frac{2.23 * 10^{-4} * 350}{1.33 * (0.00028)^{0.5}} = 3.54$$

$$T_i = \frac{L}{f} e^{\beta} = \frac{350}{7.79} * (2.7182)^{3.54} = 1549 \text{ min}$$

According to these results, as the values were $T_i=1549 \text{ min} > 0.60 * T_n=221 \text{ min}$, a furrow length of $L=350 \text{ m}$ was not suitable.

In this way, six sets of furrows were placed across the width of the plot, and the solution process was carried out again for a furrow length of $L=175 \text{ m}$ ($=350/2$) and inflow to the furrow $q=1.33 \text{ L/sec}$. The results obtained are given below.

As the values were $T_i=78 \text{ min} < 0.60 * T_n=254 \text{ min}$, a furrow length of $L=175 \text{ m}$ was suitable. The data for the four alternative solutions are given in Table 2.

Table 2. The data for the four alternative solutions.

Alternatives	I	II	III	IV
Number of furrow sets in the width of the plot	6	5	4	3
Length of furrow (L) (m)	175	175	175	175
Inflow to the furrow (q) (L/sec)	1.33	1.13	0.90	0.67
Water advance period (T_i) (min)	78	102	163	362
Net infiltration period (T_n) (min)	423	445	481	521
$0.60 * T_n$	254	267	289	313
Comparison of the T_i and $0.60 * T_n$	$T_i < 0.60 * T_n$	$T_i < 0.60 * T_n$	$T_i < 0.60 * T_n$	$T_i > 0.60 * T_n$

In these solutions, a furrow length of $L=175 \text{ m}$ was found to be suitable according to alternatives I, II and III. However, in alternative IV, as the values were $T_i=362 \text{ min} > 0.60 * T_n=313 \text{ min}$, a furrow length of $L=175 \text{ m}$ was found not to be suitable. As the lowest inflow to the furrow was found in alternative III, this choice was taken into consideration in planning the system.

Solution Process for Alternative III

The solution process was carried out for four sets of furrows, placed across the width of the plot, length of furrow $L=175 \text{ m}$ and inflow to the furrow $q=0.90 \text{ L/sec}$. The calculations for alternative III are given below (Yıldırım, 2013).

- The maximum number of furrow sets which could be placed across the width of the plot:



The system discharge and the inflow to the furrow were $Q=80$ L/sec and $q= 0.90$ L/sec respectively. In these conditions, the minimum number of furrows in one furrow set;

$$n_{min} = \frac{Q}{q_{max}} = \frac{80}{0.90} = 88$$

Thus, the minimum width of one furrow set;

$$b_{min} = wn_{min} = 0.70 * 88 = 61.6 \text{ m}$$

The maximum number of furrow sets which can be placed across the width of the plot;

$$N_{max} = \frac{250}{61.6} = 4$$

The total number of furrow sets in the whole plot (250*350 m) was $4*2=8$

a) The average hydraulic slope

$$S_0 = \frac{0.0875q^{0.342}}{L} = \frac{0.0875 * (0.90)^{0.342}}{175} = 0.00048 \text{ m/m}$$

b) The wetted perimeter

The value of the Manning Roughness Coefficient (n) was taken as 0.04 for the furrow irrigation method.

$$P = 0.265 \left(\frac{qn}{S_0^{0.5}} \right)^{0.425} + 0.227 = 0.265 * \left(\frac{0.90 * 0.04}{0.00048^{0.5}} \right)^{0.425} + 0.227 = 0.55 \text{ m}$$

This was suitable because the values were $P=0.55 \text{ m} < w=0.70 \text{ m}$.

c) The net infiltration period

$$T_n = \left(\frac{d_n \frac{w}{P} - c}{a} \right)^{1/b} = \left(\frac{84.2 * \frac{0.70}{0.55} - 7.0}{1.064} \right)^{1/0.736} = 481 \text{ min}$$

d) The water advance period

$$\beta = \frac{gL}{qS_0^{0.5}} = \frac{2.23 * 10^{-4} * 175}{0.90 * (0.00048)^{0.5}} = 1.98$$

$$T_i = \frac{L}{f} e^{\beta} = \frac{175}{7.79} * (2.7182)^{1.98} = 163 \text{ min}$$

According to these results, the values were $T_i=163 \text{ min} < 0.60*T_n=289 \text{ min}$, and so a length of furrow of $L=175 \text{ m}$ was found to be suitable.

e) Average infiltration period

$$T_0 = T_n + \frac{0.0929[(\beta - 1)e^{\beta} + 1]}{fL \left(\frac{0.305\beta}{L} \right)^2} = 481 + \frac{0.0929 * [(1.98 - 1) * (2.7182)^{1.98} + 1]}{7.79 * 175 * \left(\frac{0.305 * 1.98}{175} \right)^2}$$

$$T_0 = 527 \text{ min}$$

f) The length of irrigation time

$$T_a = \frac{PL}{60q} (aT_0^b + c) = \frac{0.55 * 175}{60 * 0.90} * (1.064 * 527^{0.736} + 7.0) = 204 \text{ min}$$

g) Total amount of irrigation water to be applied

$$d_t = \frac{60qT_a}{wL} = \frac{60 * 0.90 * 204}{0.70 * 175} = 89.9 \text{ mm}$$

h) Amount of deep percolation

$$d_s = d_t - d_n = 89.9 - 84.2 = 5.7 \text{ mm}$$

i) Water application efficiency



$$E_a = 100 \frac{d_n}{d_t} = 100 * \frac{84.2}{89.9} = 93.7$$

The same problem was also solved by the method which was newly devised in this investigation. Features of flow occurring in the blocked end furrow system and movement of water in the soil were described by separating them into stages, and results were obtained.

4.2. RUNNING THE NEW METHOD FOR SOLUTION OF THE FURROW IRRIGATION APPLICATION

The new method devised in this investigation is applied to the solution of the sample problem given above. The computer program (Kilic, 2019) was run for the values of; $a=1.064$, $b=0.736$, $c=7$, $w=0.7$ m, $D_{net}=84.2$ mm, $n=0.04$, $q=0.9$ L/sec, and $V_{orty}=1.074$ m/min.

Parameter	Value
a	1.064
b	0.736
c	7
w (m)	0.7
Dnet (mm)	84.2
n	0.04
q (L/sec)	0.9
Vorty (m/min)	1.074
t (lower border) (min)	1
t (upper border) (min)	400
M	0.1107671
t (optimum irrigation time) (min)	195.48
Dnet (verification of the solution) (mm)	84.3
L (optimum length of furrow) (m)	178.884

Figure 2. The interface form which shows the solution of the sample application by the new method.

When the new model was run for the solution of the sample problem, the value of M was obtained as 0.1107671. The variable D_{net} was obtained from the left side calculation of Eq. (17) for verification of the model solution as 84.3 mm, with a sensitivity of ± 0.1 mm. This value was used for the confirmation and verification process of the program solution as explained in the Description of the Methodology part of the paper. The optimum length of the irrigation period (t) was found to be 195.48 min., and the optimum length of the furrow (L) was determined as 178.88 m.

The confirmation and verification process of the model results can be carried out by inserting the calculated value of t , which is equal to 195.48 min for this sample application, together with the values of the other parameters, coefficients and the variables in equation (17) given in the paper. The left side value of equation (17) will be obtained as $D_{net}+0.1$ mm because of the sensitivity of the computer program, and will be equal to 84.3 mm as seen in the solution window of the computer program (Figure 2). The calculations in the verification process of the model solution must be carried out to at least in five decimal places to obtain accurate results.

In addition, when the new model was run for the condition $d_t=1.031 * D_{net}$ as was explained under the title “Determination of the Optimum Length of the Blocked End Furrow System” in the Method Part, the optimum length of furrow (L) was found to be 173.711 m.

The new solution method is valid under different soil infiltration characteristics which are suitable for furrow irrigation applications and different irrigation water requirements of crops and flow rates of the water source. These are the important advantages of this new method devised in this investigation.



4.3. CONFIRMATION OF THE MODEL RESULTS AND THE COMPUTER PROGRAM FOR THE SECOND SAMPLE APPLICATION

The values of the parameters, variables and the coefficients are given below for the second sample application.

$a=1.064$, $b=0.736$, $c=7$, $w=0.7$ m, $D_{net}=84.2$ mm, $n=0.04$, $q=0.9$ L/sec, and $V_{orty}=1.074$ m/min. The optimum length of water application period (t) was found to be 195.48 min by running Eq. 17 (Figure 2).

In the first stage, value M is calculated (the calculations must be carried out to at least five decimal places for sensitivity):

$$M = 0.4447 * n^{0.425} * V_{orty}^{0.2125} * q^{0.3523} \quad (12)$$

When the values of the variables are inserted in Eq. 12, the following result is obtained for parameter M .

$$M = 0.4447 * 0.04^{0.425} * 1.074^{0.2125} * 0.9^{0.3523} \Rightarrow M = 0.1107671$$

The calculated value of M can be seen in the interface form of the computer program in Figure 2.

In the second step, Eq. 17 is run. All the values of the parameters, variables and coefficients are inserted in Eq. 17 (The calculations must be carried out to at least five decimal places for sensitivity).

$$\begin{aligned} & \frac{a * M}{w} * t^{b+0.2125} + a * t^b * \frac{0.227}{w} + \frac{c * M}{w} * t^{0.2125} + \frac{c * 0.227}{w} + \\ & \frac{a * b * M}{w} * t^{b+0.2125} + \frac{a * b * t^b * 0.227}{w} + \frac{M * a}{w} * 0.2125 * t^{b+0.2125} + \\ & \frac{M * c}{w} * 0.2125 * t^{0.2125} = D_{net} \quad (17) \end{aligned}$$

When the values of the parameters, variables and coefficients are inserted in Eq. 17, the verification process can be carried out and the following result is obtained:

$a=1.064$, $b=0.736$, $c=7$, $w=0.7$ m, $D_{net}=84.2$ mm, $n=0.04$, $q=0.9$ L/sec, and $V_{orty}=1.074$ m/min, $M=0.1107671$ and $t=195.48$ min.

$$\begin{aligned} & \frac{1.064 * 0.1107671}{0.7} * 195.48^{0.736+0.2125} + 1.064 * 195.48^{0.736} * \frac{0.227}{0.7} + \\ & \frac{7 * 0.1107671}{0.7} * 195.48^{0.2125} + \frac{7 * 0.227}{0.7} + \\ & \frac{1.064 * 0.736 * 0.1107671}{0.7} * 195.48^{0.736+0.2125} + \frac{1.064 * 0.736 * 195.48^{0.736} * 0.227}{0.7} \\ & + \frac{0.1107671 * 1.064}{0.7} * 0.2125 * 195.48^{0.736+0.2125} + \\ & \frac{0.1107671 * 7}{0.7} * 0.2125 * 195.48^{0.2125} = 84.2 \end{aligned}$$

When the calculation process is carried out for the left side of Eq. 17, the following results are obtained:

$$25.08216 + 16.75409 + 3.39837 + 2.27 + 18.46047 + 12.33101 + 5.32996 + 0.72215 = 84.2$$

$$84.3 \cong 84.2$$



As the sensitivity of the computer program is ± 0.1 mm, the left side result of the equation was found to be 84.3 mm (Figure 2). This process verifies the validity of the model solution and the accuracy of the computer program.

The optimum length of the furrow is determined by running Eq. 18. (Please see the explanations about the running of this formula in the Method part).

$$d_t = \frac{60 * q * T_a}{w * L} \quad (18)$$

$$84.2 = \frac{60 * 0.9 * 195.48}{0.7 * L} \Rightarrow L = 179.09 \text{ m.}$$

All of the results for the second sample application can also be seen in the interface form of the computer program in Figure 2. The decimal difference between the results from the calculator and the computer program is caused by the 14 decimal place sensitivity of the software. On the other hand, the calculations were carried out with 5 decimal places by calculator. In conclusion, both the results from the computer program and from the calculator are very similar to each other. All these processes verify the validity of the new method and the accuracy of the computer program.

4.4. VERIFICATION OF THE MODEL RESULTS FOR THE SECOND SAMPLE APPLICATION

The model results for the given crop and soil conditions indicated that the optimum length of furrow is $L=178.88$ m, when the inflow to the furrow is $q=0.90$ L/sec, the net irrigation water requirement of the crop (D_{net}) is 84.2 mm, and the number of furrow sets across the width of the plot is four. This length of furrow (178.88 m) was found to be 2.22% longer than the furrow length of 175 m obtained from the USDA SCS method. The calculation process for the comparative checking and verification of the new model results are given below.

- 1) The soil type was in the $I_f 0.40$ infiltration group according to the USDA-SCS criteria. The values of the coefficients for this group were $a=1.064$, $b=0.736$, $c=7.0$, $f=7.79$ and $g=2.23*10^{-4}$.

Thus, the additional infiltration equation was represented by the formula $D=aT^b+c$. When the coefficients were inserted in the equation, $D=1.064T^{0.736}+7$ was obtained.

- 2) Distance between furrows

Distance between rows is 70 cm for maize. As this value is higher than 50 cm, one furrow was prepared for each crop row, and the distance between furrows was taken as $w=0.70$ m.

- 3) The maximum number of furrow sets which could be placed across the width of the plot
- The system discharge and the inflow to the furrow were $Q=80$ L/sec and $q=0.90$ L/sec respectively. In these conditions, the minimum number of furrows in one furrow set;

$$n_{min} = \frac{Q}{q_{max}} = \frac{80}{0.90} = 88$$

Thus, the minimum width of one furrow set;

$$b_{min} = wn_{min} = 0.70 * 88 = 61.6 \text{ m}$$

The maximum number of furrow sets which could be placed across the width of the plot;

$$N_{max} = \frac{250}{61.6} = 4$$

Total number of furrow sets in the whole plot (250*350 m) was $4*2=8$

- 4) The calculation process of the other components for a furrow length of $L=178.88$ m and an inflow to the furrow of $q=0.90$ L/sec.
 - a) The average hydraulic slope



$$S_0 = \frac{0.0875q^{0.342}}{L} = \frac{0.0875 * (0.90)^{0.342}}{178.88} = 0.000472 \text{ m/m}$$

b) The wetted perimeter

The value of the Manning Roughness Coefficient (n) was taken as 0.04 for the furrow irrigation method.

$$P = 0.265 \left(\frac{qn}{S_0^{0.5}} \right)^{0.425} + 0.227 = 0.265 * \left(\frac{0.90 * 0.04}{0.000472^{0.5}} \right)^{0.425} + 0.227 = 0.555 \text{ m}$$

As the values were $P=0.555 \text{ m} < w=0.70 \text{ m}$, this was suitable.

c) The net infiltration period

$$T_n = \left(\frac{d_n \frac{w}{P} - c}{a} \right)^{1/b} = \left(\frac{84.2 * \frac{0.70}{0.555} - 7.0}{1.064} \right)^{1/0.736} = 474.28 \text{ min}$$

d) The water advance period

$$\beta = \frac{gL}{qS_0^{0.5}} = \frac{2.23 * 10^{-4} * 178.88}{0.90 * (0.000472)^{0.5}} = 2.04$$

$$T_i = \frac{L}{f} e^\beta = \frac{178.88}{7.79} * (2.7182)^{2.04} = 176.59 \text{ min}$$

According to these results, because the values were $T_i=176.59 \text{ min} < 0.60 * T_n=284.57 \text{ min}$, a length of furrow of $L=178.88 \text{ m}$ was found to be suitable.

e) The average infiltration period

$$T_0 = T_n + \frac{0.0929[(\beta - 1)e^\beta + 1]}{fL \left(\frac{0.305\beta}{L} \right)^2} = 474.28 + \frac{0.0929 * [(2.04 - 1) * (2.7182)^{2.04} + 1]}{7.79 * 178.88 * \left(\frac{0.305 * 2.04}{178.88} \right)^2}$$

$$T_0 = 523.86 \text{ min}$$

f) The length of irrigation time

$$T_a = \frac{PL}{60q} (aT_0^b + c) = \frac{0.555 * 178.88}{60 * 0.90} * (1.064 * (523.86)^{0.736} + 7.0) = 209.09 \text{ min}$$

g) Total amount of irrigation water to be applied

$$d_t = \frac{60qT_a}{wL} = \frac{60 * 0.90 * 209.09}{0.70 * 178.88} = 90.2 \text{ mm}$$

h) The amount of deep percolation

$$d_s = d_t - d_n = 90.2 - 84.2 = 6 \text{ mm}$$

i) The water application efficiency

$$E_a = 100 \frac{d_n}{d_t} = 100 * \frac{84.2}{90.2} = 93.4$$

The model results indicated that the most suitable length of furrow was $L=178.88 \text{ m}$ for the 84.2 mm net irrigation water requirement of the crop and the $q=0.90 \text{ L/sec}$ inflow to the furrows for the given crop and soil conditions (for $d_i=D_{net}$ condition). While the water application efficiency was found to be 93.7% for the 175 m length of furrow according to the existing USDA SCS method, it was 93.4% for the 178.88 m furrow length according to the new method. Consequently, the length of the furrow is increased 2.22% (3.88 m) by determining the optimum length of irrigation period according to the new method. This means that a larger area is irrigated with a high level of water application efficiency (93.4%).



In addition, when the verification process of the new model was carried out for the condition of $d_t=1.031*D_{net}$, and for the optimum length of the furrow ($L=173.711$ m), the water application efficiency was found as 94.0% according to the USDA SCS method. All the calculations were carried out as explained above. The values of the variables, parameters and the coefficients obtained from the verification process are $S_0=4.859*10^{-4}$ m/m, $P=0.553$ m, $T_n=476.78$ min, $\beta=1.95$, $T_i=156.73$ min, $T_0=521.74$ min, $T_a=201.75$ min, $d_t=89.6$ mm, $d_s=5.4$ mm and $E_a=94.0\%$ according to the USDA SCS method.

As a result, the new method devised in this investigation can be used easily with a high rate of water application efficiency in designing a blocked end furrow system.

5. CONCLUSIONS

The new model devised in this investigation was run for the solution of two different sample applications. Those problems were also solved by the USDA SCS method, and verification of the new model was analyzed comparatively. In the solution according to the existing USDA SCS method, the length of irrigation period (T_a), length of furrow (L) and value of water application efficiency (E_a) were found to be 150.9 min, 166.67 m and 94.18% respectively for a 1.33 L/sec inflow to the furrow for the sample application represented in the paper. According to the results from the new method devised in this investigation, the optimum length of irrigation period (t), optimum length of furrow (L), and water application efficiency (E_a) were found to be 143.65 min, 168.33 m and 94.05% respectively for the same amount of inflow for $d_t=D_{net}$ condition (Figure 1). According to these results, a 1% (1.66 m) larger area was irrigated with a high level of water application efficiency (94.05%) with the same inflow in the solution of the new method.

In addition, from the solution of another sample application according to the USDA SCS method, the length of irrigation period (T_a), length of furrow (L) and value of water application efficiency (E_a) were found to be 204 min, 175 m and 93.70% respectively for a 0.90 L/sec inflow to the furrow. When the same sample application was solved according to the new method devised in this investigation, the optimum length of irrigation period (t), optimum length of furrow (L) and value of water application efficiency (E_a) were found to be 195.48 min, 178.88 m and 93.40% respectively with the same inflow for $d_t=D_{net}$ condition. According to these results, a 2.22% (3.88 m) increment occurred in the optimum length of the furrow as determined from the solution of the new method. That is, a 2.22% larger area was irrigated with the same inflow with a high level of water application efficiency (93.4%).

All the results from the existing USDA SCS method and from the new model solutions are given below.

Table 3. Results from the USDA SCS method and the new model.

	USDA SCS method	The new method devised in this investigation	
		Solution for $d_t=D_{net}$	Solution for $d_t=1.031*D_{net}$
1. Sample application	$t = T_a = 150.90$ min $L = 166.67$ m Application efficiency = 94.18%	$t = 143.65$ min $L = 168.33$ m Application efficiency = 94.05%	$t = 143.65$ min $L = 163.509$ m Application efficiency = 94.44%
2. Sample application	$t = T_a = 204$ min $L = 175$ m Application efficiency = 93.70%	$t = 195.48$ min $L = 178.88$ m Application efficiency = 93.40%	$t = 195.48$ min $L = 173.711$ m Application efficiency = 94.0%

These results indicate that the values of water application efficiencies do not show significant levels of increment depending on the increment in amount of d_t . Consequently, the values of



water application efficiencies (94.05% and 93.40% for $d_t=D_{net}$ and 94.44% and 94.0% for $d_t=1.031*D_{net}$) from the new model are completely acceptable in designing a blocked end furrow system (Table 3).

The results of the new method devised in this investigation were obtained without necessitating very complicated data sets. The new model decreased the calculation density by significant extent. Most importantly, the new method devised in this investigation has a general validity for various infiltration characteristics of soils, different amount of irrigation water requirements of crops and inflow. Thus, maximum uniformity is obtained in the distribution of moisture in the soil profile. These properties are the main and most important advantages of the new method.

In conclusion, the new method devised in this investigation can be run easily, and very sensitive results are obtained with a high level of water application efficiency, which minimize deep percolation and provide a maximum level of uniformity in the distribution of moisture in the soil profile.

Meanings of the Symbols Used in the “Method” and “Application” Parts of the Investigation

$A(DP)$: Function of the cross sectional area of deep percolation depending on time (m^2).

a, b, c : Coefficients for the soil type according to the USDA-SCS infiltration groups.

b_{min} : The minimum width of a furrow set (m).

d : The length of the line [$D_S D_{net}$] in Figure 4. ($d=D_S-D_{net}$).

d_n or D_{net} : Net irrigation water requirement of the crop in any irrigation period (mm).

d_S : Amount of deep percolation (mm).

D_S : The total amount of water in mm infiltrating to the soil at any moment t from the beginning of the irrigation application.

d_t : Total amount of irrigation water to be applied in each irrigation (mm).

E_a : Water application efficiency (%).

f, g : Coefficients for the advance features of water in furrow according to the USDA-SCS infiltration groups.

$f_1(t)$: The horizontal movement function of water depending on time.

$f_2(t)$: The amount of water (mm) which infiltrates the soil during the elapsed time t (min) from the beginning of the irrigation application. In other words, the infiltration equation depending on time in the furrow system.

L : Length of furrow (m).

M : The coefficient obtained from equation (12).

n : Manning roughness coefficient ($n=0.04$ for furrow irrigation).

N_{max} : The maximum number of furrow sets which can be placed across the width of the plot.

n_{min} : The minimum number of furrows in one furrow set.

P : Wetted perimeter of the furrow (m).

Q : Discharge of water source (system discharge) (L/sec).

q : Inflow to the furrow (L/sec).

q_{max} : The maximum inflow to the furrow (L/sec).

S_0 : The average hydraulic slope (m/m).

t : The elapsed time from the beginning of the irrigation application (min).

T_0 : Average infiltration period (min).

T_a : Irrigation period (min).

T_i : Water advance period. Length of time necessary for water to reach the end of the furrow (min).



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T_n : Net infiltration period. Length of time for infiltration of the net amount of irrigation water applied in each irrigation (min).

V_{orty} : The average velocity of horizontal advance of water on the soil surface in the blocked end furrow (m/min).

w : Distance between two furrows (m).



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WATER BARRIER PROPERTIES OF SUGAR PALM FIBER-REINFORCED POLYMER COMPOSITES – A REVIEW

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ABSTRACT

The current review has been aimed to discuss the water barrier properties of Sugar palm fiber-based composites and their effects on bio packaging applications. Sugar palm or scientifically named *Arenga pinnata* ((*Wurmb.*) *Merr*) is a multipurpose tree mostly cultivated in South Asia and Southeast Asia. Hydrophobicity is one of the most significant criteria to consider when selecting materials for food packaging applications, since it can impact the performance of the finished product regardless of whether it is water-sensitive or not. Hence, films with low water vapor permeability are appropriate for food packaging applications, such as decreasing and inhibiting moisture transfer between the surrounding environment and the food. Therefore, reducing the water vapor permeability of SPF based composites is critical for their wide potential applicability. This review reveals that the addition of sugar palm fiber into sugar palm starch (SPF/SPS) composites resulted in decrease the water vapor permeability of composites. Hence, the addition of natural fiber would be better way to improve the water barrier properties of polymer-based food packaging. To the best of our knowledge, no review paper was published on the water barrier properties of sugar palm fiber-based composites.

Keywords: Sugar palm fiber, composites, water barrier property, bio packaging



INTRODUCTION

It can be seen in the current development of composites that their use in various fields, particularly in the engineering industry, has led to the search for materials that can provide maximum optimization in applications. The development of natural fiber-reinforced polymer composite matrices as a great potential in terms of environmental conservation because they are eco-friendly, biodegradable, and exhibit superior mechanical properties is the main focus of material engineering innovations nowadays. [1]. By the using biodegradable material, the effect of environmental pollution can also be reduced.

Natural fibre properties vary depending on species, growing conditions, geographical location, fibre preparation method, and a variety of other factors [2],[3]. Natural fibres extracted from plants are known as lignocellulosic fibres because they are primarily composed of cellulose fibrils embedded in a lignin matrix. The structural parameter's characteristic value varies from plant to plant [4]. Natural fibres typically have complex layered structures that include a primary cell wall and three different secondary cell walls. Each cell wall is made up of three essential components: cellulose, hemicellulose, and lignin [5].

Arenga pinnata also known as sugar palm is a natural forest tree which came from the *Palmae* family. It is known with various names by the local in Malaysia and Indonesia (e.g., enau, kabung, irok, aren, gomuti palm) [6]. The natural habitat for this plant is in forest area along stream and river located close to human residence. Sugar palm is a deep root tree capable of growing in slope area and holding together soil structure preventing erosion. It strives well at sea level elevation up to 1400 m in tropical climate. It is known to have natural resistant against pest and able to mature without any fertilizers. Among all the palm species, sugar palm is one of the most resourceful because practically all parts of the tree can be utilized. Figure. 1, represented the sugar palm tree with plantation plan.

This review demonstrates a decrease in water vapour permeability for composites due to the addition of sugar palm fibre into the sugar palm starch (SPF/SPS). Therefore, it would be best to add natural fibres to improve the water barrier properties of food packaging based on polymer. As far as we know, no review paper on the properties of sugar palm fibre composites in water barriers was published.



Figure 1: Sugar palm plantation planted by Kebun Rimau Sdn.Bhd.

Natural fibres

Over the last few decades, synthetic fibres have been associated with adverse environmental and health effects in the composite industry. Man-made fibres are connected to waste products that are not biodegradable, to human or animal health hazards and to higher costs than natural fibres. Natural fibre was generally produced on the basis of animals and plants. Their properties vary by species, method of fibre treatment, geographical location, growing environment and many others. [7]. The natural extraction of fibre usually took several methods from the simplest to the most complex steps. The fibre extracted is known as long-chain lignin matrix lignocellulosic fibres. Natural fibres are used as reinforcement in biocomposites, mostly based on plants, as synthetic fibres. Furthermore, plant fibres are sub fixed in a group of fibres which contain the leaf, bast, fruit, twig, seed, and grass fibres extracted from a part of the plant [7]. The use of timber for wood plastic composite can replace by natural fibres. Furthermore, it is cheaper, more abundant and helps to prevent further deforestations in the material sector for the massive consumption of wood. It is safe, biodegradable and easily accessible in comparison with fibre glass. Different experiments were performed to reduce waste through product creation. Waste products can be turned into useful products, from fibres or fruits. According to Ilyas et al. [8] Bio composites using natural fibre as a basis can replace fibre glass and carbon fibre. Since ancient civilizations, natural fibre has been used every day. Kenaf, coir, cotton, flax, silk and wool are common natural fibres. [8].



Sugar palm fibre (SPF)

Sugar palm fibres, known for its strength and resistance to sea-water, is extracted from the outside part of the trunk as shown in figure.1. The fibre is extracted by an uncomplicated process because the fibres are naturally wrapped around the palm trunk in the form of the twisted fibre from below to the top of the tree. The production of fibre extending to 1.19 m, diameter varies between 94 and 370 μm and the density of 1.26 kg/m^3 , takes five years from the plantation of the tree [6]. Sugar tree ageing and height are factors that affect the strength of the fibre in the upper part near the live palm thickness and have higher module characteristics, tensile resistance and rupture elongation than fibre in the lower part. Due to an ageing process which greatly decreases the polymer chains in micro fibrils, the chemical construction between the ground and upper part of the trees differs. In the beginning of the 1800s, fibre based products can be tracked. It can be used to make products for the breeding of fish such as brooms, clothes, brushers, filters, covers, mat and refuges. The use of sugar palm fibre has reached an entirely new level in today's engineering industry. For example, geo-textile fibreglass reinforcement is used to replace soil stabilisation, underground and underwater cable building and reinforcement of composites in materials engineering by polymer matrix. Now, SPS and SPF had developed a fully biodegradable and renewable bio composite. Since the two materials have the same botanical source, the mechanical characteristics and water resistance for the SPF/SPS bio composites have improved considerably as a good adhesive bonding [9].

Downsides of sugar palm fibres as reinforcement for polymer composites

Inconsistent fibre properties

In addition to the many advantages of sugar palm fibres, they also have drawbacks, which continue to limit its applications in the composites industry. SPFs cannot supply consistent and resistant physical properties patterns. Their properties vary mainly from season to season or from plant to plant [10]. The variation in SPFs depends on (a) the growing environments of the plant (i.e. rain and soil), (b) the plant maturity, (c) the fiber-extracting plant part and (4) the collection and processing of the fibre process. These physical characteristics variations reflect the lack of uniformity of mechanical properties with respect to synthetic fibres. The solution to this problem is to mix batches or parts of one plant of fibres from different collections [10].

Hydrophilicity of natural fibers

The high sensitivity to moisture of natural fibres has greatly reduced their success in manufacturing sustainable composites for external applications (i.e. external auto motive parts) and SPF is no exception. SPFs' hydrophilic nature leads to low microbial resistance and rotational susceptibility [11]. This particular disadvantage is particularly important during shipment and long-term storage and composite processing. Cellulose's hygroscopy in SPFs makes it possible to absorb and swell water from the surrounding environment. The swelling not only alters the mechanical and physical properties but also reduces the composite's dimensional stability [12]. However, an approach to surface modification can help reduce the sensitivity of SPFs to water.

Low thermal stability

Their low thermal strength is another obstacle to the widespread use of natural fibres in composites [10]. Natural fibres are able to withstand temperatures below 200°C and start to degrade and decrease above. Exposure to fibres at high temperatures will change their physical and/or chemical structures by depolymerisation, hydrolysis, oxidation, dehydration,



decarboxylation and recrystallization [3]. The prevention of such processing defects necessitate limiting the range of processing temperature, pressure and time [10].

Water barrier properties and its mitigations

Table.1, shows the water barrier properties of various natural biomass such as sugar palm, cassava and corn. Moisture content range of sugar palm based composite were about 15.29-12.45 %, which were relatively greater than moisture content of cassava bagasse (10.97-11.7%). This was due to the hydrophilic behavior of SPS which contain multi-hydroxyl polymer with three hydroxyl groups per monomer. Moreover, when the concentrations of SPNCCs were increased from 0.1 to 1.0 % (w/w), this significant decrease in moisture content of sugar palm starch biological movies was also found [13]. Because of the strengthening of SPNCCs, the hydrophilic content decreased. The strong linkage of hydrogen from nanofiller / matrix could be attributed to this, which prohibits water to link with molecules of starch. While, water absorption of sugar palm and corn husk composites show significantly low compared cassava bagasse composites. From the table it can be absorbed that, with increasing cassava bagasse, water absorption tends to decrease. The dry cassava bagasse is well known to be rehydrated in water like a sponge, meaning it was absorbed by water in a short period of time, by about 160% of its weight, hence a larger weight. Water absorption is based on the cassava bagasse particle size. It should be noted. The resulting moisture in the material could be up to three times or more after absorption by cassava bagasse. Water absorption tests revealed a higher water absorption capacity by stabilizing cassava bagasse mixtures. The results of this study are very similar to our earlier works [14].

Table 1. Comparable study of sugar palm fiber with other lignocellulosic materials.

Material	Moisture content (%)	Water absorption (%)	Water vapor permeability (10⁻¹⁰ ×g.s⁻¹.1.m⁻¹.Pa⁻¹)	References
SPS/SPNCCs	15.29-12.45	119.79-98.1	8.91-7.81	[13]
Cassava starch/Cassava bagasse	10.96-11.7	316.45-291.99	-	[15]
Corn starch/Corn husk	11.64-10.95	92.45-96.37	-	[16]

CONCLUSIONS

SPF has a lot of potential for use as reinforcement in SPS biopolymer composites. This fibre had previously been modified (delignification, mercerization, hydrolysis, defilation, and high pressurize homogenization processes, among others) to improve its interfacial properties in polymer composites. These modifications not only changed the properties of the sugar palm, but also reduced the size of the sugar palm from macro to nano. Because of its high surface area, high crystallinity, high aspect ratio, abundant hydroxyl groups, large specific surface area, low weight, high strength, biodegradability, and stiffness, as well as great thermal resistance and good mechanical properties, shrinking the SPF was known to be a good reinforcing agent. Numerous successful SPF reinforced SPS biocomposite products have been developed to date. Because sugar palm is little known and there is little information available about it, more research is needed to demonstrate its importance and promote its use for the benefit of the public.



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RECORD KEEPING IN LIVESTOCK

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ABSTRACT

In this study, examples of charts are prepared for recording information on bovine and ovine animals. These are records like birth, mating, milk yield, fleece / mohair yield, body weight and body condition score. Records to be kept in farming should be written initially in a record notebook or cards on daily. Then, these records should be transferred to the computer systematically. Various records are arranged according to the purpose and level of breeding in livestock farms. However, the point that should be emphasized is that the records kept must meet the needs of the farms. Record keeping, regarded as an unnecessary endeavour by many producers, is actually must for any breeder who wants to keep a close eye on his herd. The most important thing when editing records is that the column and row layout of the tables in the notebook or cards should be exactly the same as the format arranged on the computer. The basic condition for regularly animal breeding is to keep regular records in the farms. Breeding studies to determine high-yielding and quality animals are based on yield inspections. Today, the productivity of animals is recorded by measuring and weighing at certain times. Yield inspections allow healthy breeding selection and determination of the profitability of the farms. Yield inspections enable to determination of the profitability of the farm and to make healthy of the breeding selection. It also enables herd management and feeding programs to be arranged according to the needs of the animals and farming economics. With the charts prepared for these purposes, all kinds of information that has an important place in animal husbandry can be recorded.

Keywords: Record keeping, herd management, cattle, small ruminant



1. INTRODUCTION

The basic condition for regularly animal breeding is to keep regular records in the farms. Breeding studies to determine high-yielding and quality animals are based on yield inspections. Today, the productivity of animals is recorded by measuring and weighing at certain times. Yield inspections allow healthy breeding selection and determination of the profitability of the farms. It also enables herd management and feeding programs to be arranged according to the needs of the animals and farming economics.

Various records are arranged according to the purpose and level of breeding in livestock farms. However, the point that should be emphasized is that the records kept must meet the needs of the farms. Record keeping, regarded as an unnecessary endeavour by many producers, is actually must for any breeder who wants to keep a close eye on his herd. Because a good breeder wants to know when animals was born, how many months pregnant, how much milk give, whether it has a disease and their parent records.

Records to be kept in farming should be written initially in a record notebook or cards on daily. Then, these records should be transferred to the computer systematically. It should be avoided possible confusion by ensuring that the records are transferred to the computer environment on a weekly or monthly basis. Also, the records transferred to the computer should be backed up in an external disk or mail environment. Thus, the desired data can be accessed quickly when needed. In order to the records to be made properly, the animals must be registered in the national registration system of the state.

The most important thing when editing records is that the column and row layout of the tables in the notebook or cards should be exactly the same as the format arranged on the computer. With this one-sample editing, the transfer and usage of the tables becomes more easy. The registrations should be simple and cover a certain period. For example, recording the rams used during the mating season. Some of the records kept in cattle and small farms are shown below.

2. RECORD KEEPING IN CATTLE FARMINGS

a. Birth / Identify (ID) Records: The records here are the pedigree information used in the identification of the animal in general. Below is an example of the table where records are made. This record table should not be seen as a record used only during the birth period. With these records, the age period / age of the animal can be followed from here. This can be achieved by opening a new column to the far right in the computer environment.

Table 1. Cattle Birth / Identify (ID) Records Table

• This part must be compatible with the registry/card.							Added on the computer	
Order	ID No	Breed	Birth Date	Gender	Maternal No	Paternal No	Period	Note
1								
2								
3								
4								

b. Out of Herd Records: Records of animals leaving the herd can also be followed from this section. This process can be achieved by opening a new page next to the page studied in the computer environment and transferring the non-herd animal there.



Table 2. Out of Herd Records Table

Order	ID No	Breed	Birth Date	Gender	Maternal No	Paternal No	Period	Leaving Date From the Herd	Reason for Leaving the Herd
1									
2									
3									
4									

c. Mating (Progeny Yield) Records: The profitability and efficiency of a dairy business primarily depends on the cows giving birth to one calf per year. The shorter the period between two pregnancies in cows, the more calf the cow can produce per year. Mating records of all female animals in the holding can be kept here. Here, only one insemination record of an animal can be entered per line.

Table 3. Mating (Progeny Yield) Records Table

Order	ID No	Breed	Birth Date	Insemination Date	Bull Name/No	Insemination Result	Time Since Last Birth	Dry Exit to Date	Probable Birth Date	Date of Birth	Pregnancy Time
1											
2											
3											
4											

The next insemination information of the same animal should be entered on a lower line and the information of the same animal should be listed one below the other. In addition, the information about the animals leaving the herd should not be deleted, but should be kept on another page in the same format. If cows are conceived by natural breeding method, inbreeding should be avoided. In order to prevent this, the pedigree records table of which sampling is given for sheep breeding enterprises should be prepared.

d. Calves Records of Cows: In the records to be made in this section, information about the calves that cows give throughout their lives and information about the age at which the cow gave birth can be found. By entering the next offspring information of the same animal on a lower line, information about all the offspring of the same cow can be followed easily.

Table 4. Calves Records of Cows Table

Order	ID No	Breed	Birth Date	Birth Sequence	Calf ID No	Calf Gender	Calf Birth Date	Mother's Age at Birth
1								
2								
3								
4								

e. Milk Yield Records: In this section, milk yields of the cows are taken in certain periods on a fifteen-day or monthly basis starting from the birth. Record samples should be taken as many times a day as cows are milked, for example morning and evening records should be recorded separately. With these records, milk yields can be calculated during the lactation period of the cows and monthly or yearly for the herd. In addition to milk yield records, dry matter ratios such as fat, protein, lactose in milk and somatic cell scores in milk can be determined and recorded at each sampling or desired period. While these records are being made, information about only one sampling record of an animal can be entered on each line.



Table 5. Milk Yield Records Table

Order	ID No	Breed	Birth Date	Last Birth Date	Time Since Last Birth	Milk Sampling Date	Sample Period	Milk Yield	Fat Percentage	Protein Percentage	Lactose Percentage	Somatic Cell Count
1												
2												
3												
4												

f. Body Weight and Body Measurement Records: The records in this section should include body weight and body measurements of animals measured periodically (either three or six months) from birth to adult body weight or up to a certain age (eg 24 months). Thus, the growth and development of animals can be easily followed, and activities such as breeding selection, fattening start period and determination of insemination to the first can be carried out successfully. In addition, live weights of the animals can be recorded during the periods such as weaning, insemination, calving period, milking periods and slaughter.

Table 6. Cattle Body Weight and Body Measurement Records Table

Order	ID No	Breed	Birth Date	Gender	Maternal No	Maternal Weight at Birth	Birth Weight	Chest Girth at Birth	3 Month Weight	3 Month Chest Girth
1										
2										
3										
4										

g. Body Condition Records: Body condition information, that is, external characteristics, helps in directing the genetic structure of the cow. Today, not only yields such as meat and milk, but also external characteristics have gained importance. In case of any decrease in productivity in the herd, the first thing to do is to correct the structure of the herd by using suitable insemination sperm or bulls. Records that can be taken from these features;

- Body Condition Scores in various physiological periods,
- Linear Identification (morphology) scores (features such as breast, leg, foot, nail),
- Periodic locomotion (transfer/transfer from one compartment to another) scores,

3. RECORD KEEPING IN SMALL RUMINANT FARMINGS

a. Birth (ID) Records: These records are the basic pedigree information used to identify the animal. The identity registration table and the examples of the tables of the herd animals are shown above in the section of record keeping in cattle, here a new column can be added in which only the birth type of the lambs is recorded.

Table 7. Sheep Birth (ID) Records Table

This part must be compatible with the registry/card.								Added on the computer	
Order	ID No	Breed	Birth Date	Gender	Birth Type	Maternal No	Paternal No	Period	Note
1									
2									
3									
4									



b. Mating Records: Small cattle should generally be planned to give one brood per year or three puppies in two years. Questions such as when the sheep in the herd will be bred for the first time, when they gave birth last, and whether they are infertile can be provided by knowing their reproductive status. In order to ensure these, records must be made regularly in the enterprise. In sheep and goat farms, mating is generally done in the form of free breeding, hand breeding or group breeding. The ancestral yields of ewes and rams, if any, are found collectively, until at least three generations ago. By looking at these records, inbreeding is prevented in the selection of animals to be used in breeding. An example of pedigree records used in businesses is presented below.

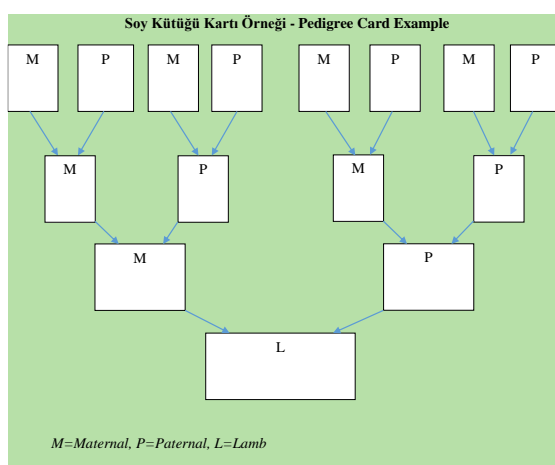


Figure 1. Pedigree Recording Form

In the farms, mating should be programmed to prevent inbreeding according to the pedigree information mentioned above. In this direction, which females the ram used in breeding crossed, how many times it crossed, lambing dates of the sheep and the number of offspring should be recorded. By using this information, fertility levels of sheep are determined. An example of the excess record used in small cattle enterprises is presented below.

Table 8. Mating Records Table

Ram Registration No:							
Ram's Breed and Date of Birth:							
Ram's Body Weight and Body Condition Score:							
Mating Year and Mating Type:							
Mating Start and End Date (in free mating):							
Mating Sheep No	Sheep Age or Date of Birth	Sheep Live Weight	Sheep Body Condition Score	Mating Date	Number of Mating	Lamb Birth Date	Number of Lambs

c. Wool - Mohair Yield Records: Shearing time for sheep and goats is determined according to the weather conditions of the region. The determination of this time is based on the period when there is sufficient warmth to allow the oil on the fleece shirt to soften and emerge. Shearing should generally be done after lambing, as shearing done before lambing season may



cause abortion. In general, sheep and goats are slaughtered once a year. An example of the table in which the fleece / mohair yields used in small cattle farms are recorded is shown below.

Table 9. Wool - Mohair Yield Records Table

Order	ID No	Breed	Shear Year	Shear Live Weight (kg)	Fleece / Mohair Yield (kg)
1					
2					
3					
4					

d. Milk Yield Records: Records of sampling milking and milk yield in sheep and goats are determined. By using these records, lactation milk yield or lactation periods are determined. Milk yield measurements should be made at regular intervals. This interval should be arranged once a month or twice a month. For the records to be filled here, the milk yield and characteristics table shown above for cattle enterprises can be used in the same way.

e. Body Weight and Body Measurement Records: Records in this section should include body weight and body measurements at certain periods (either three or six months) from birth to the age when the animals will be used for mating for the first time. In this way, the growth and development of animals can be easily followed and activities such as lambs that will be separated for breeding and the beginning of fattening can be successfully determined. In addition, live weights of animals can be recorded in this section during the periods such as weaning, insemination, calving and milking periods. Below is an example of a table of animals.

Table 10. Sheep Body Weight and Body Measurement Records Table

Order	ID No	Breed	Birth Date	Gender	Birth Type	Maternal No	Maternal Weight at Birth	Maternal Body Condition Score at Birth	Birth Weight	3. Month Weight	6. Month Weight
1											
2											
3											
4											

f. Other Records: In addition to the above-mentioned records, some information must be recorded in cattle and small ruminant breeding businesses. These records are health records and accounting information records. Diseases of animals, treatments and surgeries, medicines and vaccines used should be recorded regularly. The health records of animals are extremely important in terms of precautions to be taken beforehand in the enterprise. This information is especially important in terms of being a guide for treating sick animals.

No matter how successfully a business operates, it can be known by determining the profit-loss status of businesses in monthly, annual periods, and by recording the products that are put into operation and sold. The prices of the materials and products purchased from outside the business and the sales quantities and prices of the products produced should be determined. Thus, it should be calculated how much profit the enterprises make from which products and production planning should be done accordingly. In line with this information; quantity and value of feed and feed materials purchased, medicine, vaccination etc. Records such as expenses, amount of milk produced and income from milk, prices of animals sold, tools, equipment, repair and maintenance expenses and, if any, labor expenses should be recorded.



4. CONCLUSION

As a result, ensuring a sustainable profitability in animal production depends on keeping an effective, accurate and regular record. Record keeping programs to be prepared in this direction are extremely important in terms of healthy and regular breeding and breeding activities such as breeding, selection of animals that will be separated for fattening, phenotypically or due to old age. In this respect, the records to be arranged should be a solution to the operation of the enterprise, they should be arranged easily and simply and be updated.



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**THE EFFECT OF BACTERIA APPLICATIONS SHOWING ACCD ACTIVITY ON
THE SEEDLING OF *SESBANIA PUNICEA* (CAV.) BENTH. SEEDS
UNDER SALT STRESS**

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ABSTRACT

In this study, the effects of the bacteria on the initial development period of *Sesbania* plant in salty conditions were investigated by coding the seeds of *Sesbania puniceae* to encourage plant growth. Bacteria have been isolated from Siirt ecological conditions. 5 bacterial strains, which were found to have ACCD (1-aminocyclopropane-1-carboxylate deaminase) activity, which were proven to be superior in laboratory tests and tests that determined their effects on plant growth and which are effective in terms of resistance to stress conditions, were used. Salt stress in the study was created by using NaCl. Salt concentrations (50 and 100 mM NaCl) were given at 5 ml and only once during seed sowing. As a result of the research, the effect of bacteria showing ACCD activity on salt stress in *Sesbania* plant was determined. The study was conducted in Siirt University Faculty of Agriculture, Department of Field Crops, Tissue Culture Laboratory under sterile conditions with 3 replications according to randomized lots test pattern. In each recurrence, the seeds were sown in glass petri dishes, 10 seeds each, on coarse filter paper, and watered with sterile distilled water as needed. All steps of the treatments were carried out under sterile conditions and the petri dishes with the seeds were kept in darkness in a climate chamber set at 24±2 °C. Daily observations were made and recorded. The obtained data were analyzed by JMP statistical software and the average germination percentage (%), germination rate, root length (cm), lateral root number, stalk thickness (cm), fresh and dry weight (g) values were calculated.

Keywords: Bacteria, NaCl, Salt Stress, Seedling, *Sesbania punicea*



INTRODUCTION

Two stress factors, biotic and abiotic, are effective in the stress occurring in plants. One of the biggest problems brought about by the global warming problem that threatens the whole world today is salinity, which is an abiotic stress factor. Salinity affects both the agricultural lands negatively and causes many negativities in the plants grown in the soils under the threat of salinity (Yılmaz et al., 2011). The most important abiotic stress in the agricultural world is soil salinity (Zhu, 2003). Salinity can occur naturally as well as human-induced as a result of incorrect irrigation practices (Seçkin, 2010). It is estimated that salt accumulation in arable lands will reach even more devastating dimensions in the global context. This situation will also cause great economic losses due to the decrease in product yield and quality (Mahajan and Tuteja, 2005).

Salinity in the soil causes short and long term effects on photosynthesis. It causes drought stress by preventing the water intake of plants. Plants close their stomata to reduce water loss due to sweating. Photosynthesis is also hindered due to low CO₂ assimilation (Yavaş and İlker, 2020). The salt resistance of plants is closely related to the development and growth period of the plant. Almost all of the plants growing on the earth are very resistant to salt during the germination and first development period. The fact that the plants in the germination development period are affected by the salinity negatively affects the development of the plant in the later periods (Türkoğlu et al., 2013). It has been reported that the salt tolerance feature during the germination and seedling emergence period is also an advantage for the adaptation of the plant to saline conditions in the later growth periods (Rains, 1991).

It has been observed that PGPRs effectively promote growth when the plant is in the young seedling stage, providing protection against stress factors, especially during the development period, when the plant is sensitive to environmental stresses. Thanks to PGPRs, it was determined that the plant showed high growth and survived the stress conditions in a healthy way (Shantharam and Mattoo, 1997). Salinity reduces plant growth. However, bacteria show the ability to reduce the negative effects of salinity.

Increasing saline soils and decreasing water resources necessitate the selection of ornamental plants that are more resistant to salt (Türkoğlu et al., 2013). The selection of ornamental plant species resistant to salt due to excessive use of fertilizers and limited water use will provide success especially in landscaping studies. Therefore, studies to minimize the negative effects of salinity are important.

Sesbania punicea (Cav.) Benth. It is a plant belonging to the Fabaceae family and originating from South America and is distributed in the Atlantic Forest, Pampa and Pantanal regions (Bergmann, 2014; Anonymous, 2021a). It has been used as an ornamental plant in North America, Europe, South Africa and Australia and is considered as an invasive exotic species because it spreads rapidly (Woodward and Quinn, 2011; WIDEpac, 2012). In addition to being grown as an ornamental plant (Figure 1, Figure 2), this species is also used in landscape restoration, as it is successfully used in cases such as fire and storm, changes in land use, and priority forest areas (Ulibarri et al., 2002). It tolerates poor soils well and adapts easily to different climates. Therefore, it can also be used in damp or flooded areas (Kissmann and Groth, 1992).

The aim of this study is *Sesbania punicea* (Cav.) Benth. To determine the salt tolerance of the species in order to increase its use in the landscape by encoding some plant growth promoting bacteria in the seeds of the species.



Figure 1. *Sesbania punicea*
(Anonymous, 2021b)



Figure 2. *Sesbania punicea* in Landscape
(Anonymous, 2021c)

MATERIAL and METHODS

Surface Sterilization of Seeds

Sesbania punicea (Cav.) Benth. seeds were collected from plants in a recreation area in Güre district of Balıkesir province in Turkey in August 2019.

Surface sterilization of the seeds was done by keeping them in H₂SO₄ for 25 minutes. Seeds rinsed 3 times with distilled water were kept in 5% commercial bleach for 5 minutes and rinsed 3 times with distilled water.

Preparation of Salt (NaCl) Solution

The salt solution was prepared at concentrations of 50 mM and 100 mM. Preparation of bacterial isolates.

Preparation of Bacterial Isolates

The bacteria used in the experiment were obtained from Siirt University, Faculty of Agriculture, and Department of Field Crops. Bacterial isolates were isolated from the Siirt ecological condition and their PGPB activity was detected. KF3B, KF31B, KF58B and KF63C bacteria used were diagnosed with the microbial identification system (MIS) and identified as Plant Growth Promoting Bacteria (PGPB) activity under laboratory conditions.

20 g of nutrient agar was added to one liter of distilled water, adjusted to pH 7.0, and the mixture was sterilized by autoclave for 15 minutes at 121°C. After sterilization, the feed-lots were cooled to 50°C, then transferred to petri plates and allowed to solidify. The stock cultures of the bacteria were planted in nutrient agar medium with the help of the needle and incubated at 26 ± 2°C for 24 hours (Clark, 1965).

The nutrient broth (Merck-VM775843711) was used as the liquid feed-lot. 8 g of nutrient broth feed-lot was added to one liter of distilled water and pH was adjusted to 7.0. The mixture was sterilized by autoclave for 15 minutes at 121°C and then allowed to cool. A single colony was taken from the bacteria developed in nutrient agar feed-lot and was transferred to nutrient broth feed-lot in aseptic conditions. The bacteria transferred to the liquid feed-lot were incubated at 26 ± 2°C for 24 hours and at 120 rpm in the horizontal shaker. After incubation, the bacteria concentrations were turbidimetrically adjusted to ~ 108cfu / ml. The isolates were transferred to *Sesbania* seeds for 90 minutes.



Sowing Seeds

Seeds contaminated with bacteria were placed on filter papers in pre-sterilized glass petri dishes. All experiments were done in 3 replications and 10 seeds were placed in petri dishes per experiment. Control group seeds were irrigated with distilled water. For the seeds to be treated with salt, 5 ml of 50 mM and 100 mM salt solutions were given to each petri dish. Salt application was made only once. Seeds were stored in a completely dark incubator at a temperature of $24\pm 2^{\circ}\text{C}$. The number of germinated seeds was observed for 30 days, every day, based on the emergence of the radicle from the testa, starting from the day after wetting the seeds.

Examined Properties

As germination parameters: Germination percentage (%) and germination time were determined.

$$\text{GP} = \text{GSN} / \text{TSN} \times 100$$

GP= Germination percentage (%)

GSN = Number of germinated seeds

TSN = Total number of seeds placed in petri dishes (Gosh et al., 2014)

Average germination rate (AGR):

$\text{AGR} = \sum D_n / \sum n$ In the formula, D= days counted from the beginning of the test, n = number of seeds germinated on day D (Ellis and Roberts, 1981; Sivritepe, 2012)

Calculations within 30 days; Based on 5-10-15-20-25 and 30th days.

As vegetative measurements: Root samples and seedlings were scanned in colored scale at 600 dpi resolution using a portable scanner (ISCAN, handheld scanner) according to Ceritoglu et al. (2020). Sample images were analyzed using ImageJ image analysis software (Schneider et al., 2012). All traits were measured manually for high precision.

These parameters are determined as germination percentage (%), germination rate, root length (cm), lateral root number, stalk thickness (cm), fresh and dry weight (g).

RESULTS and DISCUSSION

The data obtained in the study, which investigated the effect of bacteria on the germination and some vegetative properties of *Sesbania punicea* seeds in saline conditions, are shown in Table 1.

Against the salinity problem in increasing arid and semiarid regions, it is necessary to determine the possibilities of growing ornamental plants in salty conditions and the effect of salinity on growth (Türkoğlu et al., 2013). These mineral substances accumulate in the leaves where transpiration is the most. It is known that plant root length increases when the salt level is high, which is a response to drought stress. The direct effect of salinity on plants is that it inhibits growth by affecting water absorption, thus causing a decrease in plant height, fresh and dry weight, and inhibition of plant organ differentiation (Yavaş and İlker, 2020). In addition, the increase in pH caused by high salt levels negatively affects plant growth through changes in metabolism, nutrient absorption and ion balance (Zhang et al., 2019).

In a study where 0, 20, 40, 60 and 80 mM salt doses were applied, the growth of *Gazania splendens*, *Petunia hybrida* and *Tagetes erecta* plants, which are ornamental plants over 40 mM, were adversely affected with increasing salinity, resulting in death at 80 mM (Türkoğlu et al., 2013). For plant growth parameters such as stem diameter, root length, stem length, plant height, root fresh weight, stem fresh weight, irrigation with salt water at a dose higher than 40 mM showed negative effects.



Table 1. Effect of bacteria on germination and some vegetative properties of *Sesbania punicea* seeds under saline conditions

Applications		Root Length (cm)	Shoot Length (cm)	Lateral Root Number	Shoot Thickness (cm)	Fresh Weight (g)	Dry Weight (g)	Germination Percent (%)	Germination Rate
Bacteria	B1 (KF58B)	6,881 A	9,263	6,166 A	0,272 A	0,330	0,012	47,77	7,962
	B2 (KF58C)	6,216 A	9,155	5,194 AB	0,214 BC	0,351	0,043	52,22	8,703
	B3 (KF3B)	5,358 AB	8,876	4,416 AB	0,171 CD	0,312	0,018	51,11	8,518
	B4 (KF63C)	4,911 AB	8,568	5,416 AB	0,233 AB	0,354	0,025	47,77	7,962
	B5 (KF3A)	3,929 B	8,155	3,527 B	0,141 D	0,295	0,011	46,66	7,777
P value		p<0,01	NS	p<0,01	p<0,01	NS	NS	NS	NS
Salt	Salt0	6,328	8,675 AB	3,213 B	0,222	0,308	0,027	47,33	7,888
	Salt1	5,143	9,642 A	5,936 A	0,186	0,343	0,023	44,00	7,333
	Salt2	4,906	8,093 B	5,683 A	0,210	0,334	0,015	56,00	9,333
P value		NS	p<0,01	p<0,01	NS	NS	NS	NS	NS
Bacteria x Salt	B1 x Salt0	7,653 ABC	10,705 A	5,066 AB	0,301 A	0,319 AB	0,004 B	46,66	7,777
	B1 x Salt1	4,965 B-E	9,328 AB	6,016 AB	0,245 AB	0,308 AB	0,012 B	53,33	8,888
	B1 x Salt2	8,025 AB	7,755 AB	7,416 A	0,270 AB	0,365 AB	0,019 AB	43,33	7,222
	B2 x Salt0	8,667 A	9,932 A	4,75 ABC	0,239 AB	0,357 AB	0,09 A	43,33	7,222
	B2 x Salt1	5,799 A-E	9,949 A	5,416 AB	0,206 BCD	0,381 A	0,019 AB	53,33	8,888
	B2 x Salt2	4,182 DE	7,585 AB	5,416 AB	0,198 B-E	0,315 AB	0,022 AB	60,00	10,000
	B3 x Salt0	7,209 ABCD	8,945 AB	1,75 BC	0,195 B-E	0,255 B	0,002 B	60,00	10,000
	B3 x Salt1	4,999 BCDE	9,635 A	6,75 A	0,126 DE	0,335 AB	0,012 B	40,00	6,666
	B3 x Salt2	3,865 DE	8,048 AB	4,75 ABC	0,190 B-E	0,348 AB	0,039 AB	53,33	8,888
	B4 x Salt0	4,747 B-E	7,765 AB	3,75 ABC	0,226 BCD	0,352 AB	0,035 AB	43,33	7,222
	B4 x Salt1	5,855 A-E	9,205 AB	5,75 AB	0,236 ABC	0,381 A	0,019 AB	36,66	6,111
	B4 x Salt2	4,129 DE	8,734 AB	6,75 A	0,239 AB	0,328 AB	0,022 AB	63,33	10,555
	B5 x Salt0	3,362 E	6,028 B	0,75 C	0,151 CDE	0,258 B	0,005 B	43,33	7,222
	B5 x Salt1	4,095 DE	10,092 A	5,75 AB	0,120 E	0,311 AB	0,012 B	36,66	6,111
	B5 x Salt2	4,329 CDE	8,345 AB	4,083 ABC	0,152 CDE	0,315 AB	0,015 B	60,00	10,000
P value		p<0,01	p<0,01	p<0,01	p<0,01	p<0,01	p<0,01	NS	NS

NS: Not Significant



In a study conducted in Israel, Mayak et al., (2004) used *Achromobacter piechaudii* bacteria isolated from the plant root rhizosphere and carrying the ACC deaminase enzyme to eliminate the possible regressions in the development of plants grown in saline soils. In the study, it was observed that in the presence of NaCl over 172 mM, this bacterium caused an increase in fresh and dry weight in tomato seedlings. It has been observed that the *A. piechaudii* bacterial strain significantly reduces the ethylene level, which will increase due to salt stress, and reduces the negative effects that may occur due to this stress in the development of tomatoes.

Saravanakumar and Samiyappan (2006), in their study, determined the ACC deaminase activities of *Pseudomonas* species in peanut plant under salt stress and observed the effect of ACC deaminase enzyme on peanut under stress in vitro and in field conditions, and they achieved high performance in peanut crop yield.

Nadeem et al. (2006) in their study to reveal the potential of microbial bacterial strains with ACC deaminase activity in order not to adversely affect the development of corn plant grown under salt stress. It has been observed to provide good performance at all salinity levels. Yang et al. (2009), in a study conducted in North Korea, reported that PGPR bacteria provide resistance to salt and drought stress of plants, and thus, with the more effective use of nitrogen and phosphorus in the soil, less need for artificial fertilizers will result, and accordingly, a decrease in water pollution. reported to be effective. Jalili et al. (2009) observed an increase in the germination rate of canola seeds inoculated with PGPR bacteria containing ACC deaminase under salt stress to determine their effects on canola seeds germination.

According to Söğüt and Çiğ (2019), TV14B *S. maltophilia* strain can be an alternative to fertilization in the soil without salinity stress and reduce the problems encountered. On the other hand, TV119E *Bacillus*-GC group strain is thought to alleviate the challenges faced in wheat farming especially in the saline soils. Furthermore, TV113C *K. cryocrescens*, TV83D *B. atrophaeus*, TV54A *C. turbata* and TV83D *B. atrophaeus* + TV119E *Bacillus*-GC group bacterial treatments are thought to reduce the adverse effects of salinity stress and increase the nitrogen and phosphorus amounts in the soil.

In addition to various factors, 0.5, 10 and 15 gL⁻¹ NaCl doses were used in the germination study conducted with the *Sesbania punicea* (Cav.) Benth. (Barreto et al., 2018). Mean germination time decreased at 10 gL⁻¹ NaCl salinity. In the study, the harmful effects of salinity on the germination of *S. punicea* seeds were determined. As the salt concentration increased, there were significant reductions in the size of the seedlings and the number of leaves after 60 days.

In the study conducted on *Sesbania sesban* seeds, 0, 25, 50, 75, 100, 200 and 250 mM NaCl doses were used. At 200 mM and 250 mM salt concentration, germination was 29% and 17%, respectively. Germination started on day 1 at 100 mM salinity, and on day 3 at 200 and 250 mM salinity (Dan and Brix, 2007).

According to the results of the research, when only bacteria were evaluated, the difference between root length, lateral root number, and shoot thickness values was found to be statistically significant, while the difference between the data obtained from other parameters was statistically insignificant. While the highest average values in root length, shoot length, lateral root number and shoot thickness parameters were obtained from the application of KF58B bacteria; The highest values in fresh weight, dry weight germination percent and germination rate parameters were obtained from KF58C bacteria. Considering the effect of salt levels on the parameters examined, the difference between the average values of shoot length and lateral root number was statistically significant. The highest values among the examined parameters; while root length, shoot thickness and dry weight parameters were obtained from Salt0 bacteria



control application; shoot length, lateral root number and fresh weight parameters were obtained from Salt1 application, and germination percent and germination rate were obtained from Salt2 application.

When the effect of the interaction of bacteria and salt applications on the investigated parameters is examined; root length, shoot length, lateral root number, shoot thickness, fresh weight and dry weight parameters were statistically significant. When the average values obtained as a result of the bilateral interaction are examined; root length, shoot length, in dry weight, KF58B x Salt1 in lateral root number parameter, KF58B x Salt0 in shoot thickness, KF58C x Salt0 and KF63C x Salt1 in dry weight, and germination percent and germination if the rate parameters are in the mean value, they were obtained from the KF63C x Salt2 interaction. In general, the highest values were obtained from Salt0 and Salt2 x bacteria applications.

CONCLUSION

When the effects of 50 and 100 mM salt concentrations on the vegetative development of germinating seeds were examined, it was determined that root length, stem thickness and dry weight decreased with increasing salt dose. Among the bacteria, KF58B strain was the most effective strain on root length, stem length, root number and stem thickness. KF58C is effective in germination rate and germination rate. When all parameters were examined in reducing the effect of salt, it was determined that the most effective bacterium was KF58B application. When the germination rate and germination percentage were examined, it was determined that the most effective applications were the applications of KF58C and KF3A bacteria.

In Southeast Asia, pre-treatments such as hot water soaking, physical or acid scarification and nicking are used to increase germination in many legume species. *Sesbania* spp. knowing its needs in order for the seeds to germinate is important in terms of understanding its role in nature (Dan and Brix, 2007).

The stage in which plants are most sensitive to salt is the germination and seedling development stage, and salt tolerance increases as growth and development progress (Rains, 1991; Ashraf, 1994). In ornamental plants, this effect emerges as the plant's height, width, branching, appearance, flower quality and its vitality in the area where it is used. The purpose of using ornamental plants is on functionality (functionality) and aesthetics (visuality). The loss of these characteristics of the species that are grown and preferred especially for their color, scent, form, flower-fruit-leaf beauty reduces their use value.



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**THE EFFECT OF ACCD BACTERIAL STRAINS ON SEEDLING OF *SESBANIA PUNICEA*
(CAV.) BENTH. UNDER DROUGHT STRESS**

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ABSTRACT

The study was conducted in Siirt University Faculty of Agriculture, Department of Field Crops Tissue Culture Laboratory under sterile conditions with 3 replications according to randomized lots test pattern. In each recurrence, the seeds were sown in glass petri dishes, 10 seeds each, on coarse filter paper, and watered with sterile distilled water as needed. All steps of the treatments were carried out under sterile conditions and the petri dishes with the seeds were kept in darkness in a climate chamber set at 24 ± 2 °C. Daily observations were made and recorded. The obtained data were analyzed by JMP statistical software and the average germination percentage (%), germination rate, root length (cm), lateral root number, stalk thickness (cm), fresh and dry weight (g) values were calculated. The effects of the bacteria on the initial development period of *Sesbania* plant in drought conditions were investigated by coding the seeds of *Sesbania* spp. plant to encourage plant growth. Bacteria have been isolated from Siirt ecological conditions. 4 bacterial strains, which were found to have ACCD (1-aminocyclopropane-1-carboxylate deaminase) activity, which were proven to be superior in laboratory tests and tests that determined their effects on plant growth and which are effective in terms of resistance to stress conditions, were used. In the study, PEG 6000 was applied as 3 ml for once, with drought and drought levels of 10% and 20%. As a result of the research, the effect of bacteria showing ACCD activity on drought stress in *Sesbania* plant was determined.

Keywords: Bacteria, drought stress, PEG 6000, Seedling, *Sesbania punicea*



INTRODUCTION

Drought stress poses an important threat to agriculture, especially in areas with low rainfall and in areas where an effective irrigation system is not available. It has become a necessity to take some measures for sustainable agriculture, especially in the coming years when global climate change is predicted to increase even more (Ashraf, 2010; Arzani and Ashraf, 2016; Noman et al., 2018). Plants exposed to drought stress close their stomata to minimize the level of transpiration. Therefore, with a decrease in carbon dioxide uptake, there is a decrease in the amount of photosynthesis. Since carbohydrate molecules and energy used in plant development are produced by photosynthesis, these decreases negatively affect plant development and growth. In addition, the closure of plant stomata causes an increase in leaf surface temperature and thus cell death occurs as a result of damage to the membrane system (Farooq et al. 2009; Dolferus, 2014).

Polyethylene glycol (PEG) is a metabolically inactive compound. PEG is frequently used to induce uniform drought stress at early germination and seedling growth stages to examine the effects of water stress on different plant groups (Kausar et al., 2006; Khodarahmpour, 2011; Shamim et al., 2014).

It is known that crop yields of leguminous crops are limited by several abiotic threats and drought threats (Micheletto et al., 2007; Farooq et al., 2016). Leguminous crops are often grown in rainy regions and in different patterns (Global Climate Model) which have predicted increases in the frequency and intensity of drought, indicating the threat of water scarcity (Mittal et al., 2014).

Sesbania (*Sesbania sesban* L. Merrill.) is an ecologically important legume plant in arid and semi-arid areas due to its limited water requirements and enhanced nitrogen fixation capacity. It is also a multi-purpose plant with food and feed use due to its nutritive properties (Sultan et al., 2012). These plants are also used as green manure and organic fertilizer (Mahmood et al., 2008; Nigussie and Alemayehu, 2013). *Sesbania punicea*, which belongs to the Fabaceae family, is used as an ornamental plant due to its compound leaves, bright red flowers and winged fruits. Like many invasive ornamental plants, this plant finds its way out of its growing area and into natural areas. It prefers moist, wet environments and is often found along river banks and wetlands. *Sesbania punicea* is native to South America. All parts of *Sesbania*, especially the seeds, are poisonous (Anonymous, 2021). It is used in landscape repair and is an ornamental plant (Ulibarri et al., 2002). It tolerates poor soils well and adapts easily to different climates. Therefore, it can also be used in damp or flooded areas (Kissmann and Groth, 1992). In this study, plant growth promoting bacteria showing ACC deaminase and siderophore properties were isolated from *Sesbania punicea* (Cav.) Benth. It was carried out to determine the effects on the plant.

MATERIALS AND METHOD

Surface sterilization of seeds

Sesbania punicea (Cav.) Benth. seeds were collected from plants in a recreation area in Güre district of Balıkesir province in Turkey in August 2019. Surface sterilization of the seeds was done by keeping them in H₂SO₄ for 25 minutes. Seeds rinsed 3 times with distilled water were kept in 5% commercial bleach for 5 minutes and rinsed 3 times with distilled water.

Preparation of PEG 6000 (Polyethyleneglycol) Solution

PEG 6000 solution was prepared at 10% and 20% concentrations.



Preparation of Bacterial Isolates

The bacteria used in the experiment were obtained from Siirt University, Faculty of Agriculture, Department of Field Crops. Bacterial isolates were isolated from the Siirt ecological condition and their PGPB activity was detected. KF3B, KF31B, KF58B and KF63C bacteria used were diagnosed with the microbial identification system (MIS) and identified as Plant Growth Promoting Bacteria (PGPB) activity under laboratory conditions.

Bacterial properties

Bacterial code	Nitrogen fixation	Phosphate solubilizing	ACC Deaminaz	Siderofor production
3B <i>Paenarthrobacter nitroguajacolicus</i>	+	-	+++	+
31B <i>Pseudomonas fluorescens</i>	+	++	-	+
58B <i>Brevibacterium frigoritolerans</i>	+	Weak ⁺	+++	++
63C <i>Paenibacillus xylanilyticus</i>	+	++	++	+

20 g of nutrient agar was added to one liter of distilled water, adjusted to pH 7.0, and the mixture was sterilized by autoclave for 15 minutes at 121°C. After sterilization, the feed-lots were cooled to 50°C, then transferred to petri plates and allowed to solidify. The stock cultures of the bacteria were planted in nutrient agar medium with the help of the needle and incubated at 26 ± 2°C for 24 hours (Clark, 1965). The nutrient broth (Merck-VM775843711) was used as the liquid feed-lot. 8 g of nutrient broth feed-lot was added to one liter of distilled water and pH was adjusted to 7.0. The mixture was sterilized by autoclave for 15 minutes at 121°C and then allowed to cool. A single colony was taken from the bacteria developed in nutrient agar feed-lot and was transferred to nutrient broth feed-lot in aseptic conditions. The bacteria transferred to the liquid feed-lot were incubated at 26 ± 2°C for 24 hours and at 120 rpm in the horizontal shaker. After incubation, the bacteria concentrations were turbidimetrically adjusted to ~ 108cfu / ml. The isolates were transferred to *Sesbania* seeds for 90 minutes.

Sowing seeds

Seeds contaminated with bacteria were placed on filter papers in pre-sterilized glass petri dishes. All experiments were done in 3 replications and 10 seeds were placed in petri dishes per experiment. Control group seeds were irrigated with distilled water. For the seeds to be treated with PEG 6000, 3 ml of 10% and 20% solution was given to each petri dish. PEG 6000 application was made only once. Seeds were stored in a completely dark incubator at a temperature of 24±2°C. The number of germinated seeds was observed for 30 days, every day, based on the emergence of the radicle from the testa, starting from the day after wetting the seeds.

Examined Features

As germination parameters: Germination percentage (%) and germination time were determined.

$$GP = \frac{GSN}{TSN} \times 100$$

GP= Germination percentage (%)

GSN = Number of germinated seeds

TSN = Total number of seeds placed in petri dishes (Gosh et al., 2014)

Average germination rate (AGR):

AGR = $\frac{\sum Dn}{\sum n}$ In the formula, D= days counted from the beginning of the test, n = number of seeds germinated on day D (Ellis and Roberts, 1981; Sivritepe, 2012)

Calculations within 30 days; Based on 5-10-15-20-25 and 30th days.



As vegetative measurements: Root samples and seedlings were scanned in colored scale at 600 dpi resolution using a portable scanner (ISCAN, handheld scanner) according to Ceritoglu et al. (2020). Sample images were analyzed using ImageJ image analysis software (Schneider et al., 2012). All traits were measured manually for high precision.

These parameters are determined as germination percentage (%), germination rate, root length (cm), lateral root number, stalk thickness (cm), fresh and dry weight (g).

RESULTS AND DISCUSSION

The findings of the germination and vegetative development of the bacterial strains KF31B, KF3B, KF63C and KF58B and the seeds of *Sesbania* treated with PEG 6000 are given in Table 1.

Water stress causes many morphological, physiological and biochemical changes in plants. Drought stress reduces plant height, root length, leaf area, fresh and dry biomass. In addition, water stress causes a decrease in relative moisture content, closure of stomata, decrease in photosynthesis and chlorophyll content. The application of rhizobacteria (PGPR), which promotes plant growth from the outside, promotes plant growth by colonizing with the plant root system and increases the resistance of plants to water stress (Yavaş et al., 2016).

Table 1. Effect of PEG6000 and bacterial applications on germination and some vegetative properties of *Sesbania punicea* seeds

Applications	Root Length (cm)	Shoot Length (cm)	Lateral Root Number	Shoot Thickness (cm)	Fresh Weight (g)	Dry Weight (g)	Germination Percent (%)	Germination Rate	
Bacteria	KF58B	4,587	3,743 B	1,888 B	0,145	0,172	0,015	25,55	4,12
	KF31B	3,163	6,922 A	4,555 A	0,508	0,277	0,041	22,22	3,43
	KF3B	5,216	5,539 AB	1,777 B	0,117	0,221	0,021	28,88	4,21
	KF63C	4,157	3,756 B	3,555 AB	0,120	0,198	0,021	22,22	3,61
P value	NS	P<0,01	P<0,05	NS	NS	NS	NS	NS	
PEG 6000	PEG0	7,560 A	8,366 A	4,083 A	0,209	0,374 A	0,035 A	45,83 A	7,36 A
	PEG1	4,923 B	6,342 B	4,416 A	0,136	0,250 B	0,030 A	20,00 B	3,06 B
	PEG2	0,359 C	0,262 C	0,333 B	0,322	0,027 C	0,007 B	8,333 B	1,11 B
P value	P<0,001	P<0,001	P<0,01	NS	P<0,001	P<0,01	P<0,001	P<0,01	
Bacteria x PEG 6000	KF58B x PEG0	9,890	6,033 B	2,666 ABC	0,289	0,340	0,020	46,66	7,92 A
	KF58B x PEG1	3,872	5,195 BC	3,000 ABC	0,146	0,177	0,027	20,00	3,06 CD
	KF58B x PEG2	-	-	0,000 C	-	-	-	10,00	1,39 CD
	KF31B x PEG0	3,800	15,120 A	8,666 A	0,138	0,533	0,070	33,33	5,28 ABC
	KF31B x PEG1	4,473	4,985 BCD	4,000 ABC	0,148	0,227	0,033	23,33	3,61 BCD
	KF31B x PEG2	1,217	0,662 CDE	1,000 C	1,239	0,073	0,020	10,00	1,39 CD
	KF3B x PEG0	9,073	7,250 B	1,666 BC	0,187	0,277	0,017	60,00	8,75 A
	KF3B x PEG1	6,354	8,980 B	3,333 ABC	0,116	0,350	0,037	20,00	3,06 CD
	KF3B x PEG2	0,223	0,388 DE	0,333 C	0,050	0,037	0,010	6,66	0,83 D
	KF63C x PEG0	7,480	5,063 BCD	3,333 ABC	0,224	0,347	0,037	43,33	7,50 AB
	KF63C x PEG1	4,993	6,206 B	7,333 AB	0,137	0,250	0,027	16,66	2,50 CD
	KF63C x PEG2	-	-	0,000 C	-	-	-	6,66	0,83 D
	P value	NS	P<0,001	P<0,05	NS	NS	NS	NS	P<0,01

NS: Not Significant

Application of plant growth regulator rhizobacteria can counteract the detrimental effects of drought stress by increasing yield. The beneficial effects of rhizobiums are explained as the



positive effects of ACC-deaminase-containing rhizobiums on root growth due to external nutritional supplementation (Belimov et al., 2002). Identifying drought-resistant legume cover crops and cultivars is an effective approach to ensure food security, reduce soil erosion, and increase soil fertility in semi-arid and arid areas (Ali et al., 2020).

In a study with *Sesbania virgata* seeds, seeds treated with PEG+ABA performed better than those treated with PEG alone (Masetto et al., 2015).

Nasırcılar et al. (2020) applied PEG6000 at concentrations of 5-10-15% and 20% in four different radish cultivars and detected the highest decrease in vegetative growth parameters in 15% and 20% PEG6000 applications. Depending on the increase in the PEG6000 concentration added to the medium, a decrease was observed in the germination percentages of all cultivars, and germination could not be obtained especially in the red hazelnut radish variety in the medium containing 20% PEG. The same is true for germination times, and as drought increases, germination times also increase and the average is 6 days for all cultivars. In the study, salicylic acid was added to the medium to reduce the effect of drought stress and it was determined that it had a positive effect.

According to the results of the research, when only bacteria were evaluated, the difference between the shoot length and lateral root number values was found to be statistically significant, and the difference between the data obtained from other parameters was statistically insignificant. While the highest average values in shoot length, lateral root number, shoot thickness, fresh weight and dry weight parameters were obtained from KF31B bacteria application; The highest values in root length, germination percent and germination rate parameters were obtained from KF3B bacteria. Considering the effect of drought levels on the investigated parameters, the difference between the average values of root length, shoot length, lateral root number, fresh weight, dry weight, germination percent and germination rate was statistically significant. The highest values among the examined parameters; root length, shoot length, fresh weight, dry weight, germination percent and germination rate parameters were obtained from the control application with PEG0 bacteria; lateral root number parameter was obtained from PEG1 application and shoot thickness, and in application PEG2 application.

When the effect of the bilateral interaction of bacteria and PEG applications on the investigated parameters is examined; the effect on the average values obtained from the shoot length, lateral root number and germination rate parameters was statistically significant. When the average values obtained as a result of the bilateral interaction are examined; KF63C x PEG0 in root length, KF31B x PEG0 in shoot length, lateral root number, fresh weight and dry weight, KF31B x PEG2 in shoot thickness, and KF3B x PEG0 in average value of germination percent and germination rate parameters were obtained from binary interaction. In general, the highest values are obtained from PEG0 and bacteria applications; Only in shoot thickness, the highest value was obtained in bacterial application with PEG2.

It has been observed that *Echinacea purpurea* L. which is also used as an ornamental plant, plays an effective role in increasing plant tolerance by eliminating the negative situation resulting from drought stress with seaweed applications in the stress environment created by PEG applications (Bat et al., 2020). As a result of the research; It was determined that drought stress decreased the leaf area of the plant, the relative water content in the leaf tissues and the membrane durability index, while it caused an increase in the MDA level and the amount of ion leakage in the leaf tissues.



CONCLUSION

The germination percentage and rate of *Sesbania* seeds were mostly seen in KF3B bacterial strain. Considering the PEG 6000 application, the highest germination rate and speed were seen in the control group seeds with bacteria that were not given PEG 6000. This shows that the increasing PEG 6000 concentration, without the inoculated bacteria, negatively affects the germination parameters. Seeds with KF63C and KF58B bacteria germinated in PEG2 dose applications, but their vegetative characteristics were not determined because they did not develop in accordance with the measurement criteria. The lowest germination values were observed in all bacterial inoculations of 20% PEG 6000 concentration. Germination rate in KF63CxPEG2 and KF3B xPEG2 media had the lowest values. The highest germination rate was obtained in control group seeds with KF3B bacteria. Here, it was the PEG 6000 application, not the bacterial strains, that determined the germination. Fresh and dry weights of germinated seeds were similarly lower in 20% PEG 6000 applications. The reason for this is the water loss in the plant by creating an obstacle to water uptake by PEG application. This water loss is clearly seen in both fresh and dry weights. This negative effect, which is also seen in the interaction of KF63C and KF58B bacterial strains with the PEG2 dose, occurs even when only bacterial strains are considered. The highest fresh and dry weight were determined in seeds with KF3B and KF58B inoculation. However, it was determined that bacteria did not make a statistically significant difference. The highest root length value in KF3B bacteria applications; the lowest was obtained in KF31B applications. The lateral root number values were the opposite in these two bacterial strains. The lowest number of lateral roots was obtained in the application of KF3B bacteria with the highest root length. In PEG applications, the highest values in control group plants with bacteria; The lowest values were obtained in the PEG2 application. The highest stem length and stem thickness in germinated seeds were determined in KF31B bacteria. PEG 6000 applications, where the highest values were obtained in the bacterial control group, decreased with increasing doses from PEG1 to PEG2.

According to the data obtained from this study, it was observed that *Sesbania* seeds were sensitive to drought stress at the dose of PEG2, even some did not germinate despite the inoculated bacteria, and the germinated seeds lagged behind the others in terms of vegetative development. The most effective bacteria for the germination and development of *Sesbania* seeds under drought stress are KF31B, KF3B and KF58B bacterial strains; it can be said that the least effective one is the KF63C bacteria.



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RELATIONSHIPS BETWEEN POTASSIUM NUTRITION AND FLOWER QUALITY IN ORNAMENTAL PLANTS

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ABSTRACT

Potassium is one of the sixteen essential nutrients required for plant growth and reproduction. It regulates 60 different enzyme systems in plants. Potassium plays a important role in enhancing the crop quality. It increases tolerance of plants to diseases and insects. Potassium plays role in proper root growth and aids plants in the production of starches. Potassium supports the plant to resist drought and extreme effects of excessive temperature. Important function of potassium is also the regulation of water use in plants. This osmoregulation process of potassium affects water transport in the xylem, supports sustainability of daily cell turgor pressure, affects cell elongation for plant growth and most importantly it regulates the opening and closing of stomata which affects transpiration cooling and uptake of carbon dioxide for photosynthesis and food function. It aids roses and other flowering plants by encouraging strong stems and well-developed flowers. For most ornamental plants, potassium is the nutrient required in higher quantity. The leaves often become dark green and necrotic tissues occur in general at the margin of the leaves under the condition of potassium deficiency. Potassium is a mobile element, translocated through phloem along with sucrose and which has great importance in the creation of the osmotic gradient between the source and the drain water in the plant, especially in the flowering stage. the flowers tend to be a strong drain water, which can lead to a deficit of potassium, and consequently cause a decrease in sucrose levels with a possible adverse affect on flowering. Several studies related the effects of potassium fertilization on growth, flowering and flower quality were done in various ornamental plants such as *Zinnia elegans*, *Tagetes erecta*, *Dianthus* spp., *Chrysanthemum*, *Lilium* spp., *Gladiolus* spp., *Gerbera* spp., *Dahlia* spp., *Lavandula* spp., *Catharethus roseus*, ornamental sun flower. These studies confirmed the significant positive effects of potassium sources on growth, flowering, flower quality of ornamental plants.

Keywords: Flowering, nutrient, ornamental plants, potassium



PLANT NUTRIENTS

The visual quality of ornamental plants is undoubtedly related to an appropriate balance of nutrients. Qualitative criteria of ornamental species such as plant height, shape and coloration are directly influenced by nutrition, among other environmental features (Neto et al., 2015). Seventeen chemical elements are classified as essential plant nutrients classified into macronutrients: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulfur (S) and micronutrients: Boron (B), Chlorine (Cl), Copper (Cu), Iron (Fe), Manganese (Mn), Molybdenum (Mo), Nickel (Ni), and Zinc (Zn). Additionally Carbon (C), Oxygen (O) and Hydrogen (H) are essential for metabolism and the plant life cycle. Some elements such as Cobalt (Co) Selenium (Se) and silicon (Si) may be directly related to plant metabolism, although without meeting the essentiality criterion (Marschner, 2012). Essentiality criterion is related following three factors: 1- in the absence of the element, the plant does not complete its life cycle; 2- the element can not be replaced by any other; 3- the effect of the element should not be related to environmental conditions, but should have a direct effect on the life of the plant (Arnon and Stout, 1939).

Among the essential plant nutrients, potassium is an essential element which plays crucial vital roles in plant life. It increases root growth and improves drought resistance. Potassium in elemental form is generally required to activate more than 50 different enzymes (Atwell, 1999). It reduces lodging, controls plant turgidity, and sustains the selectivity and integrity of the cell membranes. Potassium plays role in translocation of sugars and starch and reduces water loss, wilting as well as reduces respiration, prevents energy losses, supports protein synthesis and increases the protein content of plants (Alam and Naqvi 2003).

Potassium is a major nutrient in the development of new root growth (McAfee, 2008). Roots of potassium deficient plants are poorly developed (Bajwa and Rehman, 2005) and decreases root elongation (Alam and Naqvi, 2003). Optimum level of potassium helps in maximum root length (Khan, 2007). It was reported that application of potassium increases crop quality and yield, and improves nutrition for host plants, which increases defense against fungal pathogens or show inhibition of fungal growth (Imas, 2003; Anonymous, 2004; Gülser et al., 2014).

THE EFFECTS OF POTASSIUM ON FLOWERING AND CUT FLOWER QUALITY

For most ornamental plants, potassium is the nutrient required in higher quantity. It was reported that potassium is directly related to the continuity of the osmotic balance in plant cells, the process of the regulation of gas exchange and transpiration, enzyme activation, protein synthesis, photosynthesis, and stress resistance (Benites et al., 2010; Marschner, 2012). Potassium is a mobile element, translocated through phloem along with sucrose and which has great importance in the creation of the osmotic gradient between the source and the drain water in the plant, especially in the flowering stage. The leaves often become dark green and necrotic tissues occur in general at the margin of the leaves under the condition of potassium deficiency (Figure 1a, 1b, 1c, 1d, 1e, 1f).

Plant quality is related with physical properties that determine the appearance of plants, and chemicals, including the adequate balance of nutrients, in order to achieve the standards of commercialization and consumption (Marschner, 2012). Veatch-Blohm et al. (2012) declared that the visual quality of plants and productivity are particularly important for the ornamental species and in general, determine the price of their commercialization. Barbosa et al. (2009) reported that the flowers tend to be a strong drain water, which can lead to a deficit of potassium, and consequently cause a decrease in sucrose levels with a possible adverse affect on flowering. The potassium deficiency in plant will produce stunted growth and this stress may limit flowering because the plant cells can't divide to allow the growth and reduce the quality of



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(1a)



(1b)



(1c)



(1d)



(1e)

(1f)

Figure1. Potassium Deficiency Symptoms in a) *Dianthus caryophyllus*, b) *Euphorbia pulcherrima*, c) *Rosa* spp., d) *Anthurium scherzerianum*, e) *Chrysanthemum indicum*, f) *Primula obconica* (Aktaş and Ateş, 1998)

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commercialization. Barbosa et al. (2009) reported that the flowers tend to be a strong drain water, which can lead to a deficit of potassium, and consequently cause a decrease in sucrose levels with a possible adverse affect on flowering. The potassium deficiency in plant will produce stunted growth and this stress may limit flowering because the plant cells can't divide to allow the growth and reduce the quality of flower.

Several studies on the effect of potassium applications on growth, flowering and quality of plants were done. Hend (2002) in *Zinnia elegans*, Pal and Ghosh (2010) in *Tagetes erecta*, determined the significant positive effects of potassium sources on growth and quality of flower. Matlabi et al. (2002) reported that KCl and K₂SO₄ treatments increased the flower yield significantly in carnation. Additionally, the application of potassium sulphate had a great impact on growth and flower production of tuberose plants (Khan et al., 2012). Badawy et al. (2015) reported that potassium sources had positive effects in improving the growth characters and increasing the flower yield in *Helichrysum bracteatum*.

Ravi Teja et al. (2017) found that application of potassium at the rate of 150 kg ha⁻¹ has given significantly highest flower yield per plant, per plot and per hectare as 22.31 g, 0.64 kg and 13.59 q respectively in annual *Chrysanthemum* (Table 1). In this study, application of nitrogen at the rate of 200 kg ha⁻¹ in combination with the potassium at the rate of 150 kg ha⁻¹ has given significantly highest flower yield per plant (30.00 g), per plot (1.08 kg) and per hectare (25.25 q) when compared with all other combinations of nitrogen and potassium. Additionally, the highest plant height, number of primary branches, number of secondary branches, plant spread, number of leaves and dry weight of the plant were found significantly maximum with the application of nitrogen and potassium each at the rate of 200 and 150 kg ha⁻¹.

Table1. Flower Yield Parameters of Garland *Chrysanthemum* As Influenced by Nitrogen and Potassium Levels During Rabi Season (Ravi Teja et al., 2017)

Treatment	90 DAT														
	Plant height (cm)					Number of primary branches					Number of secondary branches				
	K ₅₀	K ₁₀₀	K ₁₅₀	K ₂₀₀	Mean	K ₅₀	K ₁₀₀	K ₁₅₀	K ₂₀₀	Mean	K ₅₀	K ₁₀₀	K ₁₅₀	K ₂₀₀	Mean
N ₅₀	74.00	77.02	78.50	79.17	77.17	16.44	17.83	18.59	19.27	18.03	38.33	42.00	43.26	41.46	41.26
N ₁₀₀	81.00	81.98	82.53	83.84	82.34	20.40	21.13	21.70	21.92	21.29	42.98	43.29	43.61	43.69	43.39
N ₁₅₀	84.50	84.55	86.75	86.60	85.60	22.47	23.03	23.67	24.04	23.30	44.83	45.19	45.64	46.00	45.42
N ₂₀₀	86.50	87.88	91.50	89.50	88.85	25.00	26.17	30.50	26.80	27.12	46.70	49.00	53.67	51.49	50.22
Mean	81.50	82.85	84.82	84.78	83.49	21.08	22.04	23.61	23.01	22.44	43.21	44.87	46.55	45.66	45.07
Factors	SEm±		CD at 5%			SEm±		CD at 5%			SEm±		CD at 5%		
N	0.45		1.32			0.24		0.63			0.38		1.11		
K	0.45		1.32			0.24		0.63			0.38		1.11		
N × K	0.86		2.50			0.48		1.26			0.66		2.11		

In the another study, it was reported that increasing potassium doses showed encouraging effect particularly on number of days to flowering, flowering and flower quality criteria in *Zinnia* (Table 2, Table 3) (Shah et al., 2014)



Table 2. Influence of Potassium Levels on Days to Flowering, Number of Flowers Plant⁻¹, Flower Diameter, Fresh and Dry Flower Weight and Plant Height of *Zinnia* (Shah et al., 2014)

Treatments K (g m ⁻²)	Days to flowering	No. of flowers plant ⁻¹	Flower diameter (cm)	Fresh flower weight (g)	Dry flower weight (g)	Plant height (cm)
0	52.27	21.60 ab	7.35 c	7.63 c	0.71 c	29.87 c
10	49.73	20.33 b	8.76 b	9.27 b	1.66 b	35.93 ab
20	49.27	28.47 a	10.13 a	12.90 a	2.13 a	41.17 a
30	51.27	20.80 ab	8.73 b	8.20 bc	1.63 b	33.40 bc
LSD (P≤0.05)	NS	7.7964	0.2664	1.1871	0.1585	5.7355

Table 3. Influence of Potassium Levels on Number of Primary and Secondary Shoots, Number of Leaves, Leaf Area, Number of Roots and Root Length of *Zinnia* (Shah et al., 2014)

Treatments K (g m ⁻²)	No. of primary shoots plant ⁻¹	No. of secondary shoots plant ⁻¹	No. of leaves plant ⁻¹	Leaf area (cm ²)	No. of roots plant ⁻¹	Root length (cm)
0	6.60 c	14.87 b	228.67 b	10.69 b	36.67 b	13.33 c
10	7.87 bc	17.73 b	276.67 b	13.3 ab	43.33 b	18.17 b
20	12.23 a	24.77 a	369.10 a	16.57 a	69.43 a	21.73 a
30	8.67 b	18.67 b	281.47 b	14.97 a	45.70 b	13.27 c
LSD (P≤0.05)	1.6289	5.5484	76.225	3.4084	13.661	1.8223

Shyala et. al. (2019) determined that foliar application of ZnSO₄ in ratio of 0.5% +FeSO₄ in ratio of 0.5% +MgSO₄ in ratio of 0.5 % + Potassium humate in ratio of 1% on 25 DAT and 50 DAT was found to have beneficial effect on growth, yield and quality parameters of marigold.



Figure 2. Appearance of Calla Lily Leaves Grown Under Potassium Omission (Left) and With Application of 420 mg dm⁻³ Potassium (Right) on The Substrate (Furtini, 2012)

Plants exhibit chlorosis followed by necrosis on the tips and edges of leaves, initially occurring in older leaves under potassium deficiency conditions (Faquin, 2005). Figure 2 illustrates the potassium deficiency in calla lily plants (Furtini, 2012). Similar results were observed for ornamental ginger and ornamental banana (Pinho, 2007; Coelho et al., 2012).

Pal and Ghosh (2010) found that yield of flowers in African marigold (*Tagetes erecta* Linn.) cv. Siracole increased with increased potassium fertilization from 0 to 200 kg. Potassium supports in water economy, energy metabolism and enzymes activity (Mengel and Kirby, 1980), which have positive effect on flower weight. Potassium increases carbon exchange and enhances carbohydrate movement (Collins and Duke, 1981), also increases meristematic



activity (Verma and Verma, 2007) and consequently stimulates vegetative growth and plant height.

Potassium is a major nutrient in the development of new root growth (McAfee, 2008). Roots of potassium deficient plants are poorly developed (Bajwa and Rehman, 2005) and decreases root elongation (Alam and Naqvi, 2003). Optimum level of potassium helps in maximum root length (Khan, 2007).

SUGGESTIONS ON POTASSIUM FERTILIZATIONS IN ORNAMENTAL PLANTS

The management of mineral nutrition through fertilization is a key factor determining the ornamental value and marketability of potted plants. When taking into account referred literature knowledges, it can be suggested that applying potassium sulphate as a foliar spray combined with potassium soil dressing, it has a potential positive effect on growth parameters. Also, potassium foliar spray can be applied as a partial substitution of the recommended soil amended potassium for increasing nutrients uptake and thus stimulating growth and flowering characteristics of ornamental plants.



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ÇEVRESEL FAKTÖRLERİN ARPA YETİŞTİRİCİLİĞİ ÜZERİNDEKİ ETKİLERİ

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ÖZET

Bu araştırma, 3 adet iki sıralı ve 2 adet altı sıralı başak yapısına sahip arpa çeşidi ile Güneydoğu Anadolu Bölgesinin her üç alt bölgesini temsilen üç lokasyonda yürütülmüş ve bu çeşitlere ait çevre genotip interaksiyonu ve stabilitesi ana etkiler ve çarpımsal interaksiyonlar (AMMI) analizi ile incelenmiştir. Denemeler tesadüf blokları deneme desenine göre dört tekrarlamalı olarak 2010-2011 yetiştirme sezonunda yürütülmüştür. Ana etkiler ve çarpımsal interaksiyonlar analiz sonuçlarına göre, Çevre ve genotip istatiki anlamda % 1, çevre genotip interaksiyonu ise % 5' e göre önemli bulunmuş ve karaler ortalaması sırasıyla % 20.5'i çeşitten, %70.6'sı çevre ve %8.9'u interaksiyondan etkilendiğini göstermiştir. Çeşitlerin tane verimi daha çok çevrelerin oldukça farklı özelliklerinden etkilendiği tespit edilmiştir. AMMI analizi sonuçlarına göre Akhisar çeşidi diğer çeşitlere göre daha yüksek verimli(555.4 kg/da), Şahin 91 çeşidi ise daha stabil($b=0.57734$) oldukları tespit edilmiştir. Ayrıca çalışmanın yürütüldüğü çevrelerden Diyarbakır yüksek ortalama verim (584.6 kg/da), Hani lokasyonu ise düşük ortalama verime (477.5 kg/da) sahip oldukları görülmüştür. Çalışmanın yürütüldüğü lokasyonlar oldukça farklı özelliklere sahip oldukları için, AMMI analizi sonuçlarına göre her bir lokasyon için önerilen çeşitler farklılık göstermiştir.Çalışmaların yürütüldüğü Diyarbakır lokasyonu için birinci dereceden Tokak 157 çeşidi, Hani lokasyonu için Akhisar çeşidi ve Kızıltepe lokasyonu için ise Vamıkhoça çeşidi ön plana çıkmıştır. Her bir lokasyon için 2. 3. ve 4. sırada önerilecek çeşitler farklılık göstermiştir. Kısacası çok dar bir coğrafya da bile yetiştirilecek çeşitler farklılık gösterebilmektedir. Bu nedenle herhangi bir bölge veya alt bölgeye uygun çeşitleri tavsiye edebilmek için stabilize çalışmalarının yapılması oldukça önemlidir. Ana etkiler ve çarpımsal interaksiyonlar analizi hem görsel olarak çeşit ve çevre durumlarını tespit etmek hem de her bir lokasyon için ilk dört sırada önerilecek çeşitlerin belirlenmesi açısından faydalı bilgiler sunmaktadır.

Anahtar Kelimeler: Interaksiyon, çevre, yazlık, biplot



THE EFFECTS OF ENVIRONMENTAL FACTORS ON BARLEY CULTIVATION

ABSTRACT

This research was carried out with 3 double-row and 2 six-row barley cultivars in three locations representing all three sub-regions of the Southeastern Anatolia Region, and the environmental genotype interaction and stability of these cultivars were investigated by main effects and multiplicative interactions (AMMI) analysis. Experiments were carried out in randomized blocks design with four replications during the 2010-2011 growing season. According to the results of the main effects and multiplicative interactions analysis, it was found that the environment and genotype statistically 1%, the environment genotype interaction was significant compared to 5%, and the average caracal average was 20.5% affected by the variety, 70.6% by the environment and 8.9% by the interaction. has shown. It has been determined that the grain yield of the cultivars is mostly affected by quite different characteristics of the environment. According to the results of AMMI analysis, Akhisar variety was found to be more productive (5554 kg/ha) than other varieties, and Şahin 91 variety was more stable ($b=0.57734$). In addition, Diyarbakir has a high average yield (5846 kg/ha), and Hani location has a low average yield (4775 kg/ha), among the environments where the study was carried out. Since the locations where the study was carried out had quite different characteristics, the varieties recommended for each location differed according to the results of the AMMI analysis. First-order Tokak 157 cultivar for the Diyarbakır location, Akhisar cultivar for the Hani location, and Vamikhoca cultivar for the Kızıltepe location came to the fore. The varieties to be recommended in the 2nd, 3rd and 4th rows for each location differed. In short, even in a very narrow geography, the varieties to be grown may differ. For this reason, it is very important to carry out stability studies in order to recommend suitable varieties for any region or sub-region. The main effects and multiplicative interactions analysis provides useful information both in terms of visually determining the variety and environmental conditions and determining the varieties to be recommended in the first four rows for each location.

Keywords: Interaction, Environment, Spring, Bi-plot.



GİRİŞ

Arpa (*Hordeum vulgare* L.) buğdaydan sonra ülkemizde en fazla yetiştiriciliği yapılan bir tahıl bitkisi olup, her yıl tahıl üretiminin yaklaşık % 20' sini oluşturmaktadır. Güneydoğu Anadolu Bölgesinde tahılın yetiştirildiği alanlar iki kısımda incelenir. Birincisi kurak şartlarda yapılan yetiştiricilik, ikincisi sulu şartlarda yapılan yetiştiriciliktir. Arpa, bu bölgede kurak şartları en iyi değerlendiren bir tahıl bitkisi olduğundan ve sulu şartlarda da erken hasat edilmesi nedeni ile ikinci ürün için daha geniş zaman aralığı bıraktığı için buğdaydan sonra en fazla tercih edilen bir tahıl bitkisi olarak karşımıza çıkmaktadır (Kendal, 2020).

Güneydoğu Anadolu Bölgesinde çevre şartları çok değişken olup yetiştirilecek çeşitlerde stabil olma şartı aranmaktadır. Bu nedenle, özellikle kurak şartlara dayanıklı ve ikinci ürün için de erkenci olan çeşitler daha çok tercih edilmektedir (Kızılgöçü ve ark., 2016). Arpa yetiştiricilerinin bu tercihi ıslah ve demonstrasyon çalışmalarını bu yönde yapılmasını baskılamaktadır. Bu bölgede dar alanda bile çevre şartları çok değiştiği için çeşit tercihi oldukça önemlidir. Yetiştirilecek çeşitlerin üreticiler tarafından tercih edilmesi için oldukça stabil ve morfolojik olarak gösterişli olmaları gerekmektedir. Bu nedenle Güneydoğu Anadolu Bölgesine yönelik çeşitlerin belirlenmesi için çeşit, çevre ve interaksiyonun etkisinin iyi irdelenmesine ihtiyaç duyulmaktadır. Yapılan bazı araştırmalarda, Sabaghnia ve ark. (2012), verim performansında genetik kazanımların artırılması daralan genotiplerin adaptasyonunun yükseltilmesi ve özel çevrelerde verimin artırılması genotip çevre interaksiyonu ile belirlenebileceği, Mohammadi ve ark. (2013), interaksiyon test edilen çevrelerde genotiplerin performansı hakkında bilgi sunduğunu ve ıslah programlarında verim stabilitesinin ilerleyişinde önemli bir rol oynadığını, Akter ve ark. (2014), tane verimi, bir çok genetik faktörden ve özellikle diğer belirteçlerden daha karışık olduğundan dolayı çevresel dalgalanmalardan daha çok etkilendiğini bildirmektedirler. Bu anlamda çevre genotip ve interaksiyonun etkisini ortaya koyan çok farklı teknikler kullanılmaktadır. Bu yöntemlerden bir tanesi de ana etkiler ve çarpımsal interaksiyonlar analiz modeli olup hem iki yönlü veri yapısını hem de bir çeşidin genotipik potansiyeli ve üzerindeki çevresel etkilere ilişkin güçlü sonuçları elde etmemizi mümkün kılan ve son zamanlarda çevre genotip çalışmalarında sık sık kullanılan kompleks bir yapıya sahip olduğu ve oldukça pratik bilgiler sunduğu birçok araştırmacı tarafından bildirilmektedir (Kendal ve Doğan, 2018; Mirosavlievic ve ark., 2014). Bu metod ile yürütülen çalışmalar sonucunda; Kılıç (2014), bu yöntem, genotip çevre interaksiyonu farklı çevre şartları altında genotiplerin verim performansını ortaya çıkardığı için tercih edildiğini, Mukherjee ve ark. (2013), bu yöntemde genotiplerin çevreler üzerinde daha belirleyici görüntüler sergilediğini, özel ve özel olmayan çevreleri belirlediğini, çok özel çevreleri tanımladığını, Hagos and Abay (2013), bu yöntemin, farklı çevrelerde ileri kademedeki tescil adayı hatları test etmek, performansını ve stabilitesini tahmin etmek için çok önemli olduğunu, Asfaw ve ark., (2009), bu yöntemin, genotip çevre interaksiyonunda önemli etkileri ve ilişki boyutlarını sergilediğini, Tarakanovas and Ruzgas (2006), genotip çevre interaksiyon çalışmalarında bu modelin çok etkili olduğunu bildirmişlerdir. Bu nedenle, ıslah çalışmalarında son zamanlarda sıkça tercih edilen, başarılı sonuçları sergileyen ve ıslahçılara yön veren, ıslahçıların hızlı ve etkin kararları almalarında etkili olan ana etkiler ve çarpımsal interaksiyonlar analiz modeli kullanılmıştır.

Bu çalışmada, AMMI analiz modeli ile tescilli bazı iki ve altı sıralı başak yapısına sahip yazlık bazı çeşitlerde tane verimi üzerinde genotip çevre interaksiyonunun etkisini görmek, büyük çevre gruplarını tanımlamak, her bir mega veya özel çevre için en iyi çeşidi belirlemek ve bu sonuçlar ile arpa yetiştiriciliğine yön vermek temel amacımızı oluşturmuştur.



MATERYAL ve YÖNTEM

Materyal

Çalışmada yeni ve eski çeşitlerden oluşan iki ve altı sıralı başak yapısına sahip toplam 5 çeşit kullanılmıştır (Tablo 1).

Tablo 1. Denemede kullanılan çeşitlerin ıslah edildiği yer ve başak yapısı

Çeşit Adı	Islah Edildiği Kuruluş	Başak Yapısı
Akhisar	Ege Tarımsal Araştırma Enstitüsü Müdürlüğü	6 sıralı
Sur 93	GAP Uluslararası Tarımsal Araştırma ve Eğitim Merkezi Müdürlüğü	2 Sıralı
Şahin-91	GAP Uluslararası Tarımsal Araştırma ve Eğitim Merkezi Müdürlüğü	2 sıralı
Tokak 157	Tarla Bitkileri Merkez Araştırma Enstitüsü Müdürlüğü	2 sıralı
Vamıkhoca 98	Ege Tarımsal Araştırma Enstitüsü Müdürlüğü	6 Sıralı

Çalışma, 2010-2011 sezonunda Diyarbakır/Merkez, Diyarbakır/Hani, ve Mardin/Kızıltepe lokasyonlarında yürütülmüştür. Bu çalışmada kullanılan her bir lokasyon, Güneydoğu Anadolu Bölgesinin her üç alt bölgesinden birini temsilen kullanılmıştır. Çalışma ve değerlendirme toplam 3 çevre üzerinden yapılmıştır. Çevrelerin özellikleri ve uzun yıllar yağış miktarları Tablo 2’ de verilmiştir. Bilindiği gibi ortalama yağış miktarları tane verimi üzerinde çok etkilidir. Uzun yıllar ortalama yağış miktarlarına göre lokasyonlardaki verimin etkilendiği ve değiştiğini söylemek mümkündür.

Tablo 2. Araştırmanın yürütüldüğü çevrelerin kodları, koordinatları ve yağış miktarları

Çevreler	Yükseklik(m)	Enlem	Boylam	Yıllık yağış(mm)
Diyarbakır/Merkez	670	37° 55' N	40° 14' E	496
Diyarbakır/Hani	553	37° 88' N	40° 18' E	600
Mardin/Kızıltepe	366	36° 84' N	40° 04' E	396

KAYNAK:meteor.gov.tr.

Yöntem

Denemeler tesadüf blokları deneme deseninde dört tekerrürlü olarak kurulmuştur. Deneme parselleri $1.2 \times 6 = 7.2 \text{ m}^2$ olacak şekilde ekim ayında deneme mibzeri ile ekilmiştir. Ekimle birlikte, dekara 6 kg saf P_2O_5 ve 6 kg saf N, Ayrıca 6 kg saf N/da bahar gübresi olarak kardeşlemenin sonuna doğru uygulanmıştır. Ayrıca, geniş yapraklı yabancı otlara karşı kimyasal mücadele yapılmıştır. Gelişme döneminde parselin her iki kenarından 0.5 m kenar tesiri olarak bırakılmış ve parseller 6 m^2 üzerinden parsel biçerdöveri ile hasat edilmiştir.

Toplam 3 çevreden elde edilen ve 5 çeşidin tane verimini kapsayan veriler AMMI biplot analizleri ile değerlendirilmiştir (Gauch 1988). İstatistik analizleri JMP 5.0 ve Gen Stat Release 14.1 (Copyright 2011, VSN International Ltd.) paket programları kullanılarak yapılmıştır.



BULGULAR ve TARTIŞMA

Analiz Modeli

Güneydoğu Anadolu Bölgesinin üç alt bölgesindeki lokasyonlarda 5 çeşit ile yürütülen çalışmadan elde edilen veriler Ana Etkiler ve Çarpımsal İnteraksiyonlar analiz metodu ile değerlendirilmiştir. Bu değerlendirme neticesinde tane verimi bakımından, çevre ve genotip istatiki anlamda % 1, çevre genotip interaksyonu ise % 5' e göre önemli bulunmuş ve kareler ortalaması sırasıyla % 20.5'i çeşitten, %70.6'sı çevre ve %8.9'u interaksyondan etkilendiği görülmektedir (Tablo 3, Tablo 4). Çeşitlerin tane verimi daha çok çevrelerin etkisinde kaldığı tespit edilmiştir. PCA 1 and PCA 2 eksenlerinde (Temel Bileşenler Analizi) PC1 genotip çevre interaksyonun % 78.8' ini oluşturduğu ve % 0.01'e göre önemli olduğu saptanmıştır (Table 3).

Ana etkiler ve çarpımsal interaksyonlar (AMMI) analizi sonuçlarına göre tane verimi bakımından çeşitler arasında önemli farklılıkların olduğunu ve çevrenin diğer varyasyon kaynaklarına göre varyasyonu daha fazla etkilediğini göstermiştir.

Tablo 3. Tane verimi üzerinden yapılan AMMI analizine ait varyans analiz sonuçları

Varyasyon Kaynakları	Serbestlik Derecesi	Kareler toplamı	Kareler ortalaması	F Değeri	G+Ç+GÇ KO Oranı(%)	GÇ KO Oranı(%)
Çeşitler	4	78618	19654	6.34**	20.5	
Çevreler	3	135159	67580	31.72**	70.6	
Tekerrür	12	19174	2130	0.69		
İnteraksiyon	12	67771	8471	2.73*	8.9	
PCA1 İnt.	6	53743	10749	3.47**		78.8
PCA2 İnt.	4	14028	4676	1.51ÖD		12.2
Uygulama	19	281548	20111	6.49		
Hata	48	111616	3100			
Toplam	79	412337	6989			

G:Genotip, Ç:Çevre, GÇİ: Genotip Çevre İnteraksyonu, KO: Kareler Ortalaması, **;P=0.01,*;P=0.05, ÖD; Önemli Değil

AMMI analiz modeli tarafından gösterilen genotip çevre interaksyonu, özellikle interaksyonun iki temel bileşen eksen(IPCA 1 ve IPCA 2) arasında bölündüğünde etkisinin ortaya çıktığı birçok araştırmacı tarafından bildirilmiştir (Tekdal ve Kendal ve 2018; Yan and Hunt 2001). AMMI analizinin bu modeli genotip çevre etkilerini iki yönlü hesaplamaktadır. Hata kareler ortalamasının sonuçlarına göre, TBE 1(temel bileşen eksen) eksen %1.0' e göre önemli bulunmuştur (Tablo 5 ve Tablo 6).

Tablo 4. Lokasyonlara ait Varyans analiz tablosu ve kareler ortalamasına ait değerler ve çeşitlerin önemlilik durumları

Kaynaklar	Serbestlik Derecesi	Diyarbakır/Merkez	Diyarbakır/Hani	Mardin/Kızıltepe
Çeşit	4	14740.4*	15504.8*	6351.96*
Tekerrür	3	2798.2	2844.1	748.94
Hata	12	4682.6	3191.2	1427.44

**;P=0.01,*;P=0.05'e göre önemli



Tablo 5. AMMI analiz sonuçlarına göre çeşitlerin ortalamaları ve skorları

Çeşitler	Ort. Verim(kg/da)	TBEIç[1]	TBEIç[2]
Akhisar	555.4	-6.37048	2.03719
Sur 93	449.6	2.67112	5.03513
Şahin-91	518.5	3.69934	0.57734
Tokak 157	530.5	-5.22062	-3.57512
Vamıkhoca 98	535.7	5.22064	-4.07454

Ayrıca GGE biplot analiz sonuçları TBE 1 ekseninin kareler ortalamasının % 78.8' ini, TBE 2 nin ise sadece 12.2'sine sahip olduğu, tespit edilmiştir (Şekil 2).

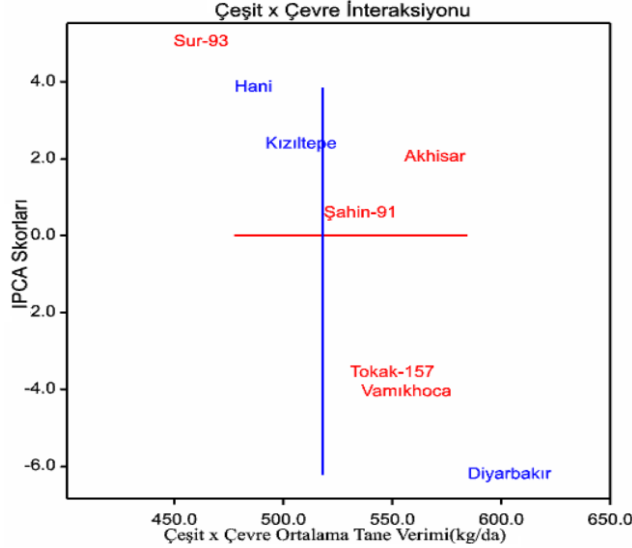
Tablo 6. AMMI analiz sonuçlarına göre çevrelerin ortalamaları ve skorları

Çevreler	Ort. Verim(kg/da)	Varyans	TBEIç[1]	TBEIç[2]
Diyarbakır (Merkez)	584.6	6503	-1.19404	-6.22504
Diyarbakır (Hani)	477.5	5729	-6.94534	3.85164
Mardin(Kızıltepe)	491.8	2357	8.13938	2.37340

AMMI modeli üç çevreden elde edilen ve beş çeşide ait tane verimi değerlerini 2 adet temel bileşen eksenini üzerinden değerlendirmiş ve her bir bileşen ekseninin interaksiyona olan etkisini ortaya çıkarmıştır. Analiz sonuçlarına göre TBE 1 kareler ortalamasının % 78.8'i, TBA2 % 12.2'si oranında toplam varyasyonda interaksiyon üzerinde etkili olduğu ve sadece TBE 1 % 1' e göre önemli iken TBE 2 ekseninin önemsiz olduğu tespit edilmiştir (Tablo 3). Gauch and Zobel (1996), AMMI modeli her iki temel bileşen ekseninin ya da daha fazlasının birlikte değerlendirebilen ve her birinin genotip çevre interaksiyonunu ne kadar etkilediğini oranlar ile ortaya koyan çok doğru bir model olduğunu bildirmektedir. Genotiplerin temel bileşen eksen değerlerinden (TBEIç[1], değeri yüksek “+”pozitif değere, TBEIç[2] düşük pozitif değere sahip ise bu genotiplerin tüm çevrelerde o derecede stabil olduğunu aynı şekilde çevrelerin (TBEIç[1], değeri yüksek “+”pozitif değere, TBEIç[2] düşük pozitif değere sahip ise o derece elverişli olduğunu göstermektedir (Tablo 5, Tablo 6). Çok yönlü analiz modeli genellikle AMMI



analiz modeli ile değerlendirilmektedir (Carbonell ve ark., 2004). AMMI analizinde görsel olarak şekil üzerindeki x-ekseni çeşitlerin ve çevrenin temel etkisini, y-ekseni ise interaksiyonu açıklamaktadır (Şekil 1).



Şekil 1. Üç çevreye ait verilerden oluşturulan AMMI biplot grafiği

Çevre ve genotipler hem temel etki hem de interaksiyon bakımından çok değişkenlik göstermişlerdir. AMMI görselinde; tüm çevrelerin ortalama tane verimleri üzerinden yapılan değerlendirmede Akhisar çeşidi ile Vamikhoca 98 çeşidinin diğer çeşitlere (Tokak, Sur 93 ve Şahin 91) göre dört çevredeki tane verimi ortalaması daha yüksek, olduğu tespit edilmiştir. Ayrıca Şahin 91 çeşidi ($TBE\check{I}\check{C}(2) = 0.57734$) tüm çevrelerin ortalamasına göre stabilite çizgisine (b değerine) yakın olduğundan dolayı ortalama verimi geçen diğer çeşitlere göre daha stabil olduğu tespit edilmiştir (Tablo 5). Sonuçlar Akhisar çeşidinin diğer çeşitlere göre daha yüksek verimli, Şahin 91 çeşidinin ise oldukça stabil ancak ortalamaya yakın bir verime sahip olduğunu göstermektedir (Şekil 1). Diğer taraftan AMMI görseline göre 2010-11 yetiştirme sezonunda Hani ve Kızıltepe lokasyonları ortalama verimin altında tane verimine, aynı yetiştirme sezonunda Diyarbakır lokasyonu ise en yüksek tane verimine sahip olmuşlardır (Şekil 1, Tablo 6, Tablo 7).

Tablo 7. Çeşitlerin 4 çevredeki ve ortalama tane verimi sonuçları(kg/da)

Çeşitler	Diyarbakır (Merkez)	Diyarbakır (Hani)	Mardin (Kızıltepe)	Ortalama
Akhisar	617.0 a	567.1 a	482.2 b	555.4 A
Sur-93	481.7 b	410.0 c	457.1 c	449.6 B
Şahin-91	577.1 ab	454.6 bc	523.8 ab	518.5 A
Tokak-157	625.6 b	512.6 ab	453.4 c	530.5 A
Vamikhoca-98	621.5 b	443.3 bc	542.3 a	535.7 A
Ortalama	584.5 A	491.8 B	477.5 B	
DK(%)	11.7	11.8	7.9	10.8
AÖF(0.5)	105.43	87.03	58.208	



Mirosavlievic ve ark., (2014), e göre düşük TBEİ 2 değerlerine sahip çeşitler daha stabil, Becker and Leon (1988), e göre stabilitenin temel istatistik konsepti tüm çevrelerde stabil çeşitlerin minimum varyasyonunu göstermektedir. Yüksek verime sahip genotipler dinamik stabiliteyi temsil etmekte ve ticari bitki ıslahında kullanılmaktadır (Flores ve ark., 1998). Hevsel çeşidi yüksek verim ve düşük TBEİ 2 değerlerine sahip olduğu tespit edilmiştir. Benzer sonuçlar; Kendal ve Doğan(2018) tarafından da tespit edilmiştir.

AMMI analizi sonuçlarına göre her çevre için sırasıyla önerilebilecek ilk dört çeşidin sıralaması Tablo 8' de verilmiştir.

Tablo 8. AMMI analizine göre her çevre için tercih edilmesi gereken ilk dört çeşit

Çevreler	Ort. Verim (kg/da)	Çevrelerin skorları	1. çeşit	2. çeşit	3. çeşit	4. çeşit
Diyarbakır/Merkez	584.6	-1.194	Tokak-157	Vamıkhoca	Akhisar	Şahin-91
Diyarbakır/Hani	477.5	-6.945	Akhisar	Tokak-157	Şahin-91	Vamıkhoca
Mardin/ Kızıltepe	491.8	8.139	Vamıkhoca	Şahin-91	Akhisar	Sur-93

Bu analiz sonucunda hemen hemen tüm çevreler için ilk ve ikinci sırada tercih edilebilecek veya seçilebilecek çeşitler Diyarbakır merkez lokasyonu için Tokak ve Vamıkhoca çeşitleri, Hani lokasyonu için Akhisar ve Tokak çeşitleri Kızıltepe Lokasyonu için ise Vamıkhoca ve Şahin 91 çeşitleri şeklinde sıralanmıştır. . Bunlara ek olarak Sur 93(eski) çeşidi lokasyonlara göre seçilecek çeşitler sıralaması bakımından oldukça gerilerde kalmıştır (Tablo 8). Ayrıca AMMI analizinin Tablo 8' deki sonuçlarına bakılarak her çevre veya birden fazla çevre için ilk veya ikinci derecede yüksek verim veren ve stabil olan çeşitleri seçmek mümkündür. Aynı zamanda tüm çevrelere önerilemeyecek çeşitlerin(Sur 93) de bilinmesi açısından son derece önemlidir. Kendal ve Doğan (2015), birden fazla çevreye en uygun ilk iki sıradaki çeşidi veya çeşit adaylarını tüm çevredeki durumlarını görmek açısından AMMI analizi son derece önemli sonuçları aktarma özelliğine sahip olduğunu bildirmiş olup çalışmamızı desteklemektedir.

SONUÇ

Mevcut çalışmada geleneksel analiz yöntemlerinden farklı bir analiz yöntemi uygulanmış ve çeşitlerin tane verimi bakımından adaptasyon kabiliyetleri ve stabilite yetenekleri mevcut çeşitlerle kıyaslanmış ve üstün yönleri ortaya konulmuştur. Yapılan analizlerin sonuçları, Akhisar çeşidinin, çalışmanın yürütüldüğü çevrelerde tane verimi bakımından 4 çeşitten üstün olduğu, ayrıca çeşitler içerisinde Şahin 91 çeşidinin en stabil olduğu dolayısıyla çalışmanın yürütüldüğü çevrelerde arpa yetiştiriciliği yapan yetiştiricilere iki sıralı başak yapısına sahip bir çeşit olarak rahatlıkla tavsiye edilebileceği sonucuna varılmıştır. Ayrıca çalışmaların çok çevrede yürütüldüğü durumlarda AMMI analiz modeli ile çeşitlerin stabilite durumları incelenebileceği ve bu çalışmanın sonuçları görsel olarak da teyit edilebileceğinden dolayı oldukça faydalı bir model olduğunu göstermiştir.



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BAZI TIBBİ BİTKİ UÇUCU YAĞLARININ FİTOKİMYASAL PROFİLLERİ VE ANTİFİTOVİRAL AKTİVİTELERİ

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ÖZET

Uçucu yağlar, çoğunlukla monoterpenoid veya seskiterpenoidlerden oluşan, bakterisidal, virüsidal, fungusidal, antiparazitik, insektisidal, tıbbi ve kozmetik amaçlı olarak tıpta, kozmetikte, ilaç endüstrisinde kullanılan, kokulu ve yağimsı karışımlardır. Ayrıca gıda endüstrisinde aroma ve koruyuculuk sağlamaktadırlar. Bitkilerde uçucu yağ bileşimi, kullanılan bitki organı, hasat zamanı, ekstraksiyon yöntemi, ekotip, iklim, edafik faktörler, yükseklik ve topoğrafya gibi çevresel faktörler, genetik faktör ve bunların etkileşimine bağlı olarak değişiklik göstermektedir. Bitkilerden elde edilen uçucu yağlar içeriğindeki etken maddelere göre birçok önemli aktiviteye sahiptir. Uçucu yağların içermiş olduğu fenolik bileşenler gerek bitki gelişim süreci, gerekse insan metabolizmasında çeşitli reaksiyonların gerçekleşmesinde aktif görev almakta veya bu reaksiyonların gerçekleşmesini sağlayacak tetikleyici rolü üstlenmektedir. Nane uçucu yağında mentol, menton, izomenton, 1,8-sineol, 1-5 limonen iken, kekik uçucu yağında karvakrol, linalol, p-simen, timol ve β -karyofillen, lavanta uçucu yağında linalool, linalil asetat, terpinen-4-ol, borneol ana bileşenleri hakimdir. Defne uçucu yağının bileşenleri 1,8-sineol, α -terpinyl asetat sabinen, α -pinen, β -pinen, terpinen-4-ol, α -terpineol, tıbbi adaçayının bileşenleri ise α - ve β - tuyon, kafur, sineol ve borneoldür. Uçucu yağ bileşenlerinin insanlarda Hepatit-A virüsü, Herpes Simpleks Virüsü tip-1(HSV-1), Herpes Simpleks Virüsü tip-2 (HSV-2), influenza A (H1N1), zarflı kabakulak virüsleri (MV), immün yetmezlik virüsü (HIV), rotavirüs (RV), sarıhumma virüsü ve kuş gribi gibi çok çeşitli virüslere karşı antiviral aktivite gösterdiği gözlenmiştir. Uçucu yağların bitkilerdeki antiviral etkilerine yönelik çoğunlukla tütün mozaik virüsü, salatalık mozaik virüsü, vesicular stomatit virüslerine karşı etkinliklerinin değerlendirildiği çalışmalar yapıldığı ortaya çıkmıştır. Yürütülen çalışmalar uçucu yağların, etki mekanizmaları ve virüs kaynaklı enfeksiyonların tedavisi üzerine olup, uçucu yağ bileşenleri ve antiviral etkileri arasındaki etkileşime yönelik güncel ve kapsamlı bilgi bulunmamaktadır. Bu nedenle uçucu yağların ve yağları oluşturan bileşenlerin antifitoviral aktivitesi ve kullanılması gereken uçucu yağ konsantrasyonları üzerinde daha fazla çalışma yapılması gerekmektedir.

Anahtar kelimeler: Antifitoviral, karvakrol, monoterpenoid, seskiterpenoid, uçucu yağ



PHYTOCHEMICAL PROFILES AND ANTIFITOVIRAL ACTIVITIES OF SOME MEDICINAL PLANT ESSENTIAL OILS

ABSTRACT

Essential oils are fragrant and oily mixtures, mostly consisting of monoterpenoids or sesquiterpenoids, used in medicine, cosmetics and pharmaceutical industry for bactericidal, virucidal, fungicidal, antiparasitic, insecticidal, medicinal ve cosmetic purposes. In addition, they provide aroma and preservation in the food industry. Essential oil composition in plants varies depending on plant organ, environmental factors such as the harvest time, extraction method, ecotype, climate, edaphic factors, altitude and topography, genetic factor and their interaction. Essential oils obtained from plants have many important activities according to their active ingredients. The phenolic components contained in essential oils take an active role in the realization of various reactions in both the plant development process and human metabolism or it acts as a trigger for these reactions to take place. In peppermint essential oil the main components are menthol, menthon, isomentone, 1,8-sineol, 1-5% limonene, while in thyme essential oil are carvacrol, linalol, p-cymene, thymol and β -caryophylde. Linalool, linalyl acetate, terpinen-4-ol, borneol are dominant in lavender essential oil. The constituents of laurel essential oil are 1,8-sineol, α -terpinyl acetate sabin, α -pinene, β -pinene, terpinen-4-ol, α -terpineol, and medicinal sage components are α - and β - tuion, camphor, sineol and borneol. Essential oil components have been observed to exhibit antiviral activity in humans against a wide variety of viruses such as Hepatitis-A virus, Herpes Simplex Virus type-1 (HSV-1), Herpes Simplex Virus type-2 (HSV-2), influenza A (H1N1), enveloped mumps viruses (MV), immunodeficiency virüs (HIV), rotavirus (RV), yellow fever virus and avian influenza. It has been revealed that studies have been conducted on the antiviral effects of essential oils on plants, mostly against tobacco mosaic virus, cucumber mosaic virus, and vesicular stomatitis viruses. The studies conducted are on the mechanisms of action of essential oils and the treatment of viral infections, and there is no up-to-date and comprehensive information on the interaction between essential oil components and antiviral effects. Therefore, further studies are required on the antiphytoviral activity of essential oils and their constituents, and the essential oil concentrations that should be used.

Key words: Antifitoviral, carvacrol, monoterpenoid, seskiterpenoid, essential oil



GİRİŞ

Tıbbi ve aromatik bitkiler, sekonder metabolitler olarak bilinen çok çeşitli organik bileşikler üretmektedirler. Bu maddeler ya sadece bir bitki türünde ya da taksonomik olarak ilişkili tür grubunda bulunmaktadır. Sekonder metabolitler, biyosentez şekillerine göre terpenler, fenolik bileşenler ve azot içeren bileşikler olmak üzere 3 gruba ayrılmaktadır. Terpenler, mevalonik asit yolu ile asetil-CoA'dan sentezlenen lipidlerdir. İçerdikleri 5-karbonlu birimlerin sayısına göre de monoterpen (2 adet C5 ünitesi), seskiterpen (3 adet C5 ünitesi) diterpen (4 adet C5 ünitesi) ve çoklu karbon ünitesine sahip politerpenoidlerden oluşmaktadır (Bezić ve ark., 2013). Uçucu yağlar, bitkilerin çiçeklerinde, yapraklarında, meyvelerinde, köklerinde, rizomlarında ve kabukta depolanan sekonder metabolitlerdir. Ayrıca alifatik, aromatik ve hidro-aromatik maddeler, hidrokarbonlar, alkoller, aldehitler, ketonlar, esterler, fenoller ve asitler gibi farklı kimyasal sınıflara ait organik bileşiklerin karışımlarıdır (Jerković-Mujkić ve ark., 2013).

Son yıllardaki araştırmalar, tıbbi bitkilerin biyolojik aktivitelerinin araştırılmasına yöneliktir. Tıbbi bitkiler, antimikrobiyal, antioksidan ve enzim inhibe edici aktivitelere sahip, biyolojik olarak aktif çok sayıda bileşik üretmektedir (Alsohaili ve ark., 2021).

Butil hidroksianisol (BHA), tert-butilhidrokinon (TBHQ) ve butillenmiş hidroksitoluen (BHT) gibi kimyasal olarak sentezlenen antioksidanlar, lipid peroksidasyonunu azaltmak için gıda üretiminde yaygın olarak kullanılmaktadır. Bu bileşikler, doğal ürünlere göre daha ekonomik olmalarına rağmen, farklı yan etkilere sahiptirler. Doğal bitki ürünleri, antimikrobiyal, antimutajenik, antioksidan ve antiinflamatuvar aktiviteler gibi geniş bir aktivite yelpazesi göstermekte ve bu nedenle ön plana çıkmaktadırlar. Uçucu yağlar ise antimikrobiyal etkileri, mikrobiyal direncin gelişmesinde azalmaya neden olan çok sayıda alanı hedef almaktadır (Alsohaili ve ark., 2021).

Uçucu yağlar, aromatik bitkilerde bulunan ikincil metabolitlerin bir alt kategorisini temsil etmektedir. Hasat sonrası zararları azaltması ve insan sağlığı üzerinde olumsuz etkilerinin olmaması, kullanımlarına ilginin artmasına neden olmuştur (Ghasemi ve ark., 2020).

Bitkilerin uçucu yağ bileşiminde değişikliğe neden olan çevresel ve fizyolojik durumlar, uçucu yağın belirli bileşiklerinin biyosentezinde, birikiminde ya da metabolizmasında değişikliklere neden olabilmektedir (Sarıkahya ve ark., 2013).

Son yıllarda tıbbi ve aromatik bitkiler ve doğal maddelerin kullanımına ilgi artmaktadır. Özellikle sentetik moleküllerin güvenliği ile ilgili bazı sorgular, doğal ürünler ve tıbbi bitkiler ile ilgili daha detaylı ve kapsamlı araştırmaları beraberinde getirmiştir (Fierascu ve ark., 2020). Bazı bitkisel terpenik metabolitler antiviral etkilere sahiptir. Bu antiviral mekanizma söz konusu maddelerin antioksidan kabiliyeti ile izah edilmektedir (Rajesh ve ark. 2008).

Bulgaristanda yapılan çalışmada lavanta (*Lavandula angustifolia* Mill.) uçucu yağı ve rezene *Foeniculum officinale* All. dulce var.) uçucu yağının domates lekeli solgunluk virüsüne karşı kullanılabileceği belirtilmiştir (Dikova ve ark. 2017)

UÇUCU YAĞLARIN FİTOKİMYASAL İÇERİĞİ

Achillea tomentosa L. uçucu yağı, 1,8-Sineol, α -pinen, linalool, α -terpineol, β -pinen ve terpinen-4-ol gibi biyolojik olarak aktif bileşiklere sahiptir. Yürütülen çalışmada, *Achillea tomentosa* L.'da tanımlanan bileşiklerin oranının % 0.1-23.7 arasında değiştiği, 3-karen (% 23.7), limonen (% 12.2) ve α -terpinil asetatın (% 10.2) uçucu yağın ana bileşenleri olduğu vurgulanmıştır (Alsohaili ve ark., 2021).

Thymus algeriensis, *Thymus capitatus* ve *Rosmarinus officinalis* bitkilerinin uçucu yağlarının, doza bağlı olarak iyi bir bir antioksidan aktivite gösterdiği gözlenmiştir. Bu nedenle geleneksel



tıpta, bu bitkilerin uçucu yağlarının bioaktivitelerinin önemi ortaya çıkmıştır (Zaïri ve ark., 2020).

Artemisia sieberi bitkisinde uçucu yağ verimi % 1.5 (w / v) olarak saptanmış ve 22 bileşen içerisinde ana bileşenler olarak kafur (% 33.64), 1,8-sineol (% 25.66) ve krizantenon (% 7.86) bildirilmiştir. Toplam polifenol ve flavonoid miktarı, askorbik asit ve karotenoid içeriği sırasıyla 666.3 mg GAE (gallic acid equivalent) / 100g kuru ağırlık, 54.8 mg QUE / 100g kuru ağırlık, 153.6 mg / 100g kuru ağırlık ve 907.2 mg / 100g olarak belirlenmiştir. En yüksek antioksidan aktivitesi de bitkiden elde edilen uçucu yağ ve ekstraktta elde edilmiştir (Ghasemi ve ark., 2020).

Barringtonia asiatica ham ekstraktında bazı biyoaktif bileşiklerin varlığından dolayı antibakteriyel ve antioksidan özellikler göstermektedir. Ayrıca hidrodistilasyondan elde edilen uçucu yağlarda kozmetik ve gıda endüstrisinde de kullanılabilen doğal ürünler elde edilmektedir. Uçucu yağlar, çoğunlukla monoterpenoid veya seskiterpenoidlerden oluşmaktadır. Analjezik, antiinflamatuvar, antispazmodik, lokal anestetik, antelmintik, antipruritik ve antiseptik olarak geleneksel ve tamamlayıcı alternatif ilaçlarda terapötik ajanlar olarak ve hastalıkların kontrolünde kullanılmaktadır (Umaru ve ark., 2019).

Muğla'nın Köyceğiz bölgesinden toplanan *Arbutus andrachne* L. odunu uçucu yağında sinnamil alkol (% 21.97), 4-tert-butilsikloheksil asetat (% 16.59) ve izoboril asetat (% 15.37) bileşenleri belirlenmiş ve önemli biyoaktiviteler olduğu saptanmıştır (Sıcak ve Erdoğan 2019). *Cephalaria* (Dipsacaceae) cinsine ait 10 endemik türe ilişkin toplam uçucu yağın % 68.9-84.6, toplam uçucu yağ veriminin ise % 38.2-64.1 arasında değiştiği belirlenmiştir. Ayrıca geraniol, α -sedren ve p-simen de ana bileşenler olarak saptanmıştır (Sarıkahya ve ark., 2013).

Konya'da *Anethum graveolens*, *Foeniculum vulgare*, *Mentha piperita*, *M. spicata*, *Lavandula officinalis*, *Ocimum basilicum*, *Origanum onites*, *O. vulgare*, *O. munitiflorum* ve *O. majorana*, *Rosmarinus officinalis*, *Salvia officinalis* ve *Satureja cuneifolia* bitkilerinden elde edilen uçucu yağlarda γ -terpinen, 4-allilanol, (-)-karvon, dihidrokarvon, D-limonen, (-)-fenkon, kuminil alkol, kuminil aldehit, kuminol, trans-anetol, kamfen, izoborneol, (-)-borneol, L-bornil asetat, 2-dekanol, 2-heptanol, metilheptan, farnesol, nerol, izopulegol, sitral, sitronellal, sitronellol, geraniol, geranil ester, linalol, linalil oksit, linalil ester, α -pinen, β -pinen, piperiton, (-)-mentol, izomenton, karvakrol, timol, vanilin ve ojenol bileşenlerinin olduğu saptanmıştır (Erdoğan Orhan ve ark., 2012).

Okaliptüs terpenoidler, tanenler, flavonoidler ve florosülinol türevleri yönünden zengin bir biyoaktif doğal ürün kaynağıdır. Bouharb ve ark. (2014) tarafından *Eucalyptus gomphocephala* yaprağı özlerinin, *Pseudomonas aeruginosa*'nın neden olduğu enfeksiyonların tedavisinde antibakteriyel bir ajan olarak takip edilebileceği vurgulanmıştır. Benayach ve ark. (2001) ise uçucu yağ bileşenlerinde α -pinen, β -pinen, limonen, mirsen, 1.8-sineol, allo-aromadendren ve globulol bulunduğunu, Elaissi ve ark. (2012) ise trans-pinokarveol, pinokarvon, borneol, α -terpineol ve globulol'un varlığından bahsetmişlerdir.

E. gomphocephala yaprakları fitokimyasal olarak incelendiğinde tanenler (gallik tanenler), flavonoidler, saponinler, steroidler/triterpen ve müsilajları içerdiği bildirilmiştir. Bu bileşiklerin de antibakteriyel aktiviteye sahip olduğu vurgulanmıştır. Bitkide antibakteriyel aktivitenin varlığı, bir veya daha fazla biyoaktif bileşiğin varlığına bağlı olabilmektedir. *E. gomphocephala*'da bulunan fitokimyasalların (gallik asit, ellagik asit, mirisetin ve kuersetin) ayrıca *P. aeruginosa*'ya karşı önemli inhibitör etki gösterdiği gözlenmiştir (Jayaraman ve ark., 2010; 2011).

Fas'ta, *Artemisia herba alba* bitkisinin yapraklarından ve toprak üstü kısımlarından elde edilen uçucu yağlar, sırasıyla % 39.9 ve % 46.2'dir. Kapitulum yağı, monoterpenler (% 22.9) ve monosiklik monoterpenler (% 21.5) içermekte ve esterler, kök yağının en büyük kısmını (%



62.8) oluşturmaktadır (Tilaoui ve ark., 2015). İspanya'da ise, *Artemisia herba alba*'dan elde edilen uçucu yağ, monoterpen hidrokarbon olup bazı populasyonlarda büyük miktarlarda seskiterpenler de bulunmaktadır (Feuerstein ve ark., 1988; Salido ve ark., 2004). Kafur, 1,8-sineol, p-simen ve davanon da uçucu yağda bulunan başlıca kimyasal bileşikler arasındadır. İsrail ve Sina'da yetiştirilen bitkiler için sineol-thujon bornan tipi ve monoterpen iskeletli pinan tipi iki yağ türü gözlenmiştir (Feuerstein ve ark., 1988). Ürdün'de, *Artemisia herba alba* bitkisinde düzenli monoterpenler baskın olup, ana bileşenler α - ve β -tujon'dur (Hudaib ve Aburjai, 2006). Fas'ta ise 16 kemotip bulunmuş ve bunlardan 12'sinde uçucu yağların ana bileşenleri olarak monoterpenler, kalan 4 kemotipte ise seskiterpenler gözlenmiştir (Lamiri ve ark., 1997). Cezayir uçucu yağında, monoterpenler temel bileşenler olup, kafur, α - ve β -tujon, 1,8-sineol ve krizantenil de türevleri olarak gözlenmiştir (Vernin ve ark., 1995; Dob ve Benabdelkader, 2006). Tunus'ta *Artemisia herba alba* uçucu yağının temel bileşeninin de monoterpenler olduğu bulunmuştur (Akrouf, 2004; Neffati ve ark., 2008). Tunus'ta *Artemisia* bitkisinden elde edilen uçucu yağın ana bileşeni tujon olarak bildirilirken (% 64) (Tilaoui ve ark., 2015), İspanya'da incelenen uçucu yağlarda saptanmamıştır (Feuerstein ve ark., 1988; Salido ve ark., 2004). Ouyahya ve ark. (1990) tarafından Fas'ta *Artemisia* bitkisine ilişkin üç türden (*Artemisia negri*, *Artemisia mesatlantica* ve *Artemisia herba alba*) elde edilen uçucu yağda α ve β tujon bileşiminin coğrafi bölge, mevsim, çevre ve iklim koşullarına göre değiştiği gözlenmiştir. *Artemisia herba alba* uçucu yağının en yaygın bileşenlerinden birisinin sineol olduğu İspanya (Feuerstein ve ark., 1988; Salido ve ark., 2004), İsrail (Feuerstein ve ark., 1988), Mısır (Soliman, 2007) ve Fas'ta da (Lamiri ve ark., 1997; Tilaoui ve ark., 2015) bildirilmiştir. Krizantenon, İsrail, İspanya, Tunus, Cezayir ve Fas'ta uçucu yağlarda yaygın olarak bulunan bir bileşiktir. *Artemisia herba alba* bitkisinin uçucu yağlarında davanon bileşeninin Fas'ın bazı bölgelerinde gözlenmediği (Tilaoui ve ark., 2015), bazı bölgelerde ana bileşen olduğu (Benjlali ve ark., 1982; Lawrence, 1982), İsrail'de (Feuerstein ve ark., 1988; Segal ve ark., 1987) ve Sina Çölü ve çevresindeki (Feuerstein ve ark., 1988; El-Sayed ve Seida, 1990) bitki örneklerinde ise düşük miktarlarda olduğu saptanmıştır. Tilaoui ve ark. (2015) *Artemisia herba alba* bitkisinden elde edilen uçucu yağın bileşeninde diğer bazı çalışmalardan farklı olarak (Boutekedjiret ve ark., 1992; Vernin ve ark., 1995) kafur, thujone ve 1.8 sineole bileşenlerinin bulunmadığını, fakat verbenol, trans α bisabolon, farnesen epoksit gibi yeni kemotiplerin belirlendiğini vurgulamışlardır.

Teucrium bitkilerinin uçucu yağları, karyofilen, karyofilen oksit, germacren D, α -humulen, α -muurolen, (E) - β -farnesen ve monoterpen karvakrol gibi seskiterpenlerin varlığı ile karakterize edilmektedir. *Teucrium arduini* türlerinde ana bileşik, seskiterpen hidrokarbonlar olarak β karyofilen ve oksijenli seskiterpenler olarak karyofilen oksittir. *Satureja* türü yağlarının ana bileşenleri, karvakrol ve timol gibi monoterpenlerdir. *Micromeria graeca*'nın ana bileşeni ise, α -bisabolol'dür (Bezić ve ark., 2013).

Karanfil (*Eugenia caryophyllata* Thunberg), kimyon (*Cuminum cyminum* L.), Kekik (*Origanum vulgare*) ve anason (*Pimpinella anisum*) uçucu yağlarının güçlü antibakteriyel ve antioksidan aktiviteler gösterdiği, bu nedenle İran'da gıda endüstrisinde doğal antioksidan ve antimikrobiyal ajan kaynakları olarak kabul edilebileceği ortaya çıkmıştır. Hindistan ve Arjantin'deki yerli karanfil uçucu yağlarında ana bileşenlerin öjenol, β -karyofilen ve α -karyofilen olduğu saptanmıştır (Nunez ve D'Aquino, 2012; Singh ve ark. 2012). Bir başka çalışmada ise kimyon uçucu yağ bileşenlerinin kuminaldehid, γ -terpinen, β -pinen, o-simen ve miritenal olduğu vurgulanmıştır (Johri, 2011). *Origanum* uçucu yağında ise timol, sitronellol, karyofilen, spathulenol ve α -terpineol gözlenmiştir (Mitchell ve ark., 2010; Teixeira ve ark., 2013).



Anason uçucu yağında ise trans-anethol, limonen, metil chavicol ve p-himachalene önemli bileşenler olarak vurgulanmıştır (Raeisi ve ark., 2016). Shojaii ve Abdollahi Fard (2012) ise, İran'dan toplanan anasonun ana bileşenleri olarak trans-anetol ve estragölü bildirmişlerdir.

İran'ın farklı lokasyonlarından toplanan *Stachys lavandulifolia* Vahl bitkisinin uçucu yağındaki ana bileşenler α -thujone, α -pinene, myrcene, β -fellandren, germakren D, Δ -cadinen ve 1,4-metano-1 H-inden olarak belirlenmiştir. Uçucu yağ bileşenleri genetik, çevre koşulları ve coğrafi kökene göre değişiklik göstermiştir (Pirbalouti ve Mohammadi, 2013). Mirza ve Baher (2003), İran'ın Tahran kentinden toplanan *Stachys lanata* Jacq bitki yağının α -thujone, α -humulen, β -karyofilen ve viridiflorol bakımından zengin olduğunu bildirmişlerdir. *Stachys lavandulifolia* Vahl uçucu yağının ana bileşenlerinin Orta İran'daki Tahran popülasyonu için germakren-D, β -fellandren, β -pinen, mirsen, α -pinen ve Z- β -osimen (Javidnia ve ark., 2004), Batı İran'daki Lorestan popülasyonu için mirsen, α -pinen, α -terpinen ve bisiklogermakren (Amiri ve ark., 2008), Kuzey İran'daki Mazandaran popülasyonu için α -pinen, 4-hidroksi-4-metil-2-pentanon ve heksadekanoik asit (Morteza-Semnani ve ark., 2006) ve Türkiye'de β -karyofilen ve 1,8-sineol (Sezik ve Başaran, 1985) olduğu vurgulanmıştır.

Suganya ve ark. (2015), *Pogostemon plectranthoides* uçucu yağının bileşiminde linalool, terpineol, cubebene, elemene, karyofilen, humulene, alloaroma dendren, kadinen, spatulenol ve kadinol bulunduğunu bildirmişlerdir.

Pulicaria crista uçucu yağında ana bileşenler olarak 1,4-ditert butilbenzen, karyofilen, karvon, ve neryl (s) -2-metilbütanoat, *Pulicaria undulata* için kafur ve timil asetat saptanmıştır (Mohamed ve ark., 2020).

Fas'ta *Laurus nobilis* uçucu yağında, yirmi sekiz bileşik tanımlanmış ve ana bileşenler olarak 1,8-sineol, 1- α -pinen ve linalool belirlenmiştir (Taroq ve ark., 2019).

Suudi Arabistan'da *Salvia officinalis* L. bitkisinden elde edilen uçucu yağ veriminin % 3.24 \pm 0.55 (g / kuru ağırlık) olduğu ve uçucu yağda, kafur (% 20.3), 1,8-sineol (% 15.0), a-tujon (% 14.9), viridiflorol (% 9.9), karvon (% 6.2) ve b-tujon (% 5.7) bileşenlerinin bulunduğu vurgulanmıştır (El Jery ve ark., 2020). Tunus'tan toplanan *Salvia officinalis* L. bitkilerinden elde edilen uçucu yağda ise, 1,8-sineol, a-tujon, b-tujon, borneol, b-elemene, kamfor ve a-pinen bileşenleri belirlenmiştir (Farhat ve ark., 2016). Sırbistan'dan toplanan *S. officinalis*'ten elde edilen yaprak uçucu yağ içeriğinin ise, a-tujon, viridiflorol, kamfor, 1,8-sineole, a-humulen, trans-b karyofilen, borneol ve a-pinenden oluştuğu gözlenmiştir (Couladis ve ark., 2002).

Agastache foeniculum bitkisinde metil chavicol, limonen, spathulenol ve karyofilen oksit dahil olmak üzere yağların % 95.4'ünü temsil eden yedi bileşen tanımlanmıştır (Hashemi ve ark., 2017). Mazza ve Kiehn (1992) ise uçucu yağda 50' den fazla bileşik tespit etmiş, bunlardan sadece 10 bileşen uçucu yağın % 0.1' den fazlasını, metil kavikol ise uçucu yağın % 95-98'ini oluşturduğunu vurgulamışlardır. Yürütülen bir başka çalışmada ise, *A. foeniculum* uçucu yağının metil kavikol, 1,8-sineol, 1-okten-3-ol ve germakren D olmak üzere dört ana bileşeni bildirilmiştir (Ebadollahi ve ark., 2010).

Tomurcuk ve erken çiçeklenme döneminde fesleğen yağının monoterpen bakımından zengin olduğu, seskiterpen ve fenilpropan türevlerinin miktarlarının sonraki dönemlerde artış gösterdiği vurgulanmıştır (Lemberkovics ve ark., 1998).

Okaliptüs, çay ve kekikten elde edilen uçucu yağlar ve bunların başlıca monoterpen bileşenleri a-terpinen, g-terpinen, a-pinen, p-simen, terpinen-4-ol, a-terpineol, timol, sitral ve 1,8-sineol olarak belirlenmiştir. Ayrıca bileşikler arasında monoterpen hidrokarbonlar, antiviral aktiviteleri açısından monoterpen alkollere göre biraz daha üstün bulunmuştur (Astani ve ark., 2010).



Mentha arvensis bitkisinde uçucu yağın % 90.1-98.6'sını oluşturan 22 bileşik tanımlanmıştır. Mentol, d-menton, menton, limonen ve p-menth-2-en ana bileşiklerdir. *Mentha spicata*'da ise karvon ve limonen ön plana çıkmıştır (Smitha ve Rana, 2015).

Pelargonium graveolens L. uçucu yağının bileşiminde 42 bileşik tanımlanmış ve linalol L, citronellol, geraniol, 6-Octen-1-ol, 3,7-dimetil, format ve selinen ana bileşenler olarak bildirilmiştir (Ben Hsouna ve Hamdi, 2012).

Ajuga laxmannii (Küçükbay ve ark, 2013) ve Erzurum bölgesi *Ajuga orientalis* L. (Başer ve Kırimer, 2018) uçucu yağ ana bileşenlerinin fitol, n-heksadekanoik asit ve dodekanoik asit olduğu bildirilmiştir.

Kütahya bölgesi *Ballota nigra* subsp. *anatolica* bitkisinin yaprak ve çiçeklerinden elde edilen uçucu yağlarda ana bileşen olarak hekzenal, germakren D ve β -karyofilen tanımlanmıştır (Sarıkaya, 2017).

Hyssopus officinalis bitkisinin uçucu yağında ana bileşenler olarak izopinokamfon, β -pinen, pinokarvon (Kızıl ve ark., 2010; Kürkçüoğlu ve ark., 2016); terpinen-4-ol, 1,8-sineol, borneol, kafur (Kızıl ve ark., 2010) ve β -fellandren, β -mirsen (Salman ve ark., 2015) bulunmuştur.

Thymus vulgaris bitkisinin uçucu yağında ise karvakrol, o-cymene, linalool, karvakrol metil eter bileşenleri bildirilmiştir (Sağdıç ve ark., 2013). *Sideritis caesarea* uçucu yağında β -karyofilen, karyofilen oksit, spathulenol ve heksadekanoik asit ana bileşenleri tanımlanmıştır (Günbatan ve ark., 2017). *Salvia officinalis* yağı için ana bileşenlerin 1,8-sineol, kafur, α -thujon olduğu belirlenmiştir (Salman ve ark., 2015). Atak ve ark. (2016) *Origanum onites* yağında karvakrol, γ -terpinen, linalool ve p-simen'nin temel bileşenler olduğunu vurgulamışlardır.

Çeşitli çalışmalar tıbbi aromatik bitkiler ve onların uçucu yağlarının antioksidan ve antimikrobiyal aktivitelerinin içerdiği oldukları fenolik bileşenlerden ve özellikle de çoğu bitkide bulunan rosmarinik asitten kaynaklandığını göstermiştir (Lamaison ve ark., 1991; Rauha ve ark., 2000). Oregano (*O. vulgare*), thyme (*T. serpyllum*), biberiye (*R. officinalis*), adaçayı (*S. officinalis*) bitkilerinde, rosmarinik asit seviyeleri 7.55-23.58 mg/g ile en yüksek fenolik bileşen konsantrasyonu göstermektedir (Ziaková ve Brandšteterová, 2003)

Akdeniz Bölgesi *Hibiscus sabdariffa*, *Lepidum sativum*, *Nigella sativa* L., *Origanum majorana*, *Petroselinum crispum*, *Corianderum sativum*, *Salvia officinalis*, *Saponaria officinalis*, *Thymus capitatus* ve *Thymus foenum-graecum* bitkilerinin yetiştiği yerdir. Bu bitkilerden elde edilen ekstraktlarda en yüksek fenolik içeriğin *H. sabdariffa* ve *O. majorana* bitkilerinde olduğu, bireysel olarak fenolikler incelendiğinde ise *C. sativum*'da epikateşinin, *H. Sabdariffa*'nın gallik asit, protocatechuic asit, benzoic asit ve caffeic asit bileşenlerinin, *L. sativum*'da kateşin ve şiringik asidin, *O. majorana*'da klorojenik asidin, *T. foenum-graecum*'da gentsik asidin en yüksek konsantrasyonlara sahip olduğu bildirilmektedir (Rababah ve ark., 2010).

Lamiaceae familyası bitkileri zengin polifenolik bileşenlere sahiptir ve bu bileşenlerin çeşitli tedavilerde kullanıldığı bilinmektedir (Ciocârlan, 2009, Amiri, 2010). Bu familyanın önemli türleri olan *Hyssopus officinalis*, *Ocimum basilicum* ve *Teucrium chamaedrys* geleneksel tedavi amaçlı etkileri göz önünde bulundurularak, fenolik içeriklerinin belirlendiği çalışmada p-kumarik asit, ferulik asit, isokuersetin, rutin, rosmarinik asit, kuercitrin, kuersetin, luteolin fenolik bileşenlerini içerdikleri bulunmuştur. *T. Chamaedrys* bitkisinde ferulik asit ve kuersetin bileşenleri tespit edilemezken, diğer bitkilerde ise bu bileşenler farklı konsantrasyonlarda ortaya çıkmıştır. En yüksek 524.8 μ g/g değeri ile izokuersetin *T. Chamaedrys*'de belirlenmiştir. Rutin bileşeninin en yüksek değeri 425.71 μ g/g ile *O. basilicum* bitkisinden elde edilmiştir. Bitki materyallerinden *H. officinalis* bitkisinin fenolik bileşenleri ise üç bitki arasında en düşük değerleri vermiştir (Vlase ve ark., 2014). Bu üç bitkinin tedavi amaçlı kullanımının veya



etkisinin farklı olma nedeni ise içermiş oldukları fenolik madde konsantrasyonlarından kaynaklanmaktadır (Naveed ve ark., 2018).

FİTOVİRAL ETKİ

Uçucu yağların aromaterapi ve fitoterapideki kullanımı çoğunlukla antiviral antibakteriyel, antifungal ve antioksidan etkilerinden kaynaklanmaktadır ve bu da “antiviral” (99.600 makale), “antibakteriyel” (746.000 makale), “antifungal” (160.000 makale), anti-koronavirüs” (11.800 makale) yapılan makalelerin sayısına yansımaktadır (Boukhatem, 2020).

Bitkilerden elde edilen uçucu yağlar, virüs kaynaklı hastalıkların tedavisinde alternatif oluşturmaktadır. Önceki çalışmalar uçucu yağların, geniş spektrumlu etki mekanizmaları ve virüs kaynaklı enfeksiyonların tedavisi üzerinedir. Fakat bileşenler ve antiviral etkileri arasındaki etkileşime yönelik güncel ve kapsamlı bilgi bulunmamaktadır. Bitkisel kaynaklı uçucu yağlar, monoterpenler, seskiterpenler ve fenilpropanoidler gibi çeşitli fitokimyasallardan oluşan kompleks uçuculardır (Ma ve Yao, 2020).

Uçucu yağlar geniş biyolojik aktivite göstermeleri nedeni ile farklı çalışmalarda kullanılmaktadır. Orta çağlardan beri kullanılmakta olan uçucu yağlar, günümüzde ilaç, kozmetik, tarım ve gıda endüstrilerinde bakterisidal, virüsidal, fungisidal, antiparaziter, insektisidal, tıbbi ve kozmetik uygulamalar için yaygın olarak kullanılmaktadır. Uçucu yağlar, büyüme ve gelişmede fizyolojik işlev göstermeleri, hastalıklara ve zararlılara karşı koruma göstermesi gibi birçok önemli rol oynamaktadır. Fitopatogenik virüslerle ilgili olarak, doğal ve sentetik kökenli çeşitli maddeler, antifitoviral aktiviteleri açısından değerlendirilmektedir. Uçucu yağların antifitoviral aktiviteleri hakkında ise sınırlı sayıda veri bulunmaktadır (Bezić ve ark., 2013).

Kimyasalların virüs kaynaklı hastalıklara karşı bitkileri koruma oluşturmaması nedeniyle, uçucu yağlardaki sekonder metabolitlerin viral enfeksiyonların yayılmasını kontrol etme ya da azaltma potansiyeli değerlendirilmektedir (Bezić ve ark., 2013).

Bitki virolojisi alanında, uçucu yağların bitki sistemlerindeki virüsler veya viral enfeksiyonlar üzerindeki etkileri hakkında sınırlı miktarda bilgi bulunmaktadır (Bezić ve ark., 2011; Bishop ve ark., 1995; Dunki’c ve ark., 2010; Dunki’c ve ark., 2013; Othman ve ark., 2004; Vuko ve ark; 2012; Vuko ve ark., 2019).

Farklı bitki türlerinin seskiterpen bakımından zengin yağlarının bitkilerde viral enfeksiyonu azaltabileceği gözlenmiştir (Vuko ve ark., 2019).

Flavonoidler, terpenler, polisakkaritler, alkaloidler, amino asitler, fenoller ve uçucu yağlar, bitkisel kaynaklı antiviral moleküller arasında yer almakta ve insanlarda da hepatit B, immün yetmezlik virüsü, herpes simpleks ve SARS gibi bazı virüslerin çoğalmasını önlediği gözlenmektedir (Boukhatem, 2020).

Fungusitler ve bakterisitlerin aksine, ticari olarak geliştirilen virüsit bulunmamaktadır. Virüsler, konukçusu hücreyi ve ortamı kullanarak çoğalma gösteren patojenlerdir. Birçok virüs, kimyasal uygulama ile kontrol edilmesi çok zor veya imkansız olan salgınlara neden olmaktadır. Viral enfeksiyonları tedavi etmek için en umut verici yaklaşımlardan birisi, bitkilerin ve bitkisel ürünlerinin kullanımınıdır. Bitkiler, aromatik madde sentezleme konusunda sınırsız bir yeteneğe sahiptir, bunların bir çoğunu fenol veya bunların oksijenle ikame edilmiş türevleri oluşturmaktadır. Bitriazolil bileşikleri, tiloforin B, fananteren bazlı tiloforin, tiyadiazol asetamid, siyanoaweyat türevleri ve rasemik fenantroindolizidin alkaloidleri veya saf alkaloidler tütün mozaik virüsünün replikasyonunu inhibe eden bileşikler olarak tanımlanmıştır (Jerković-Mujkić ve ark., 2013).

Hırvatistan’da *Micromeria croatica* bitkisinden elde edilen uçucu yağın ana bileşeninin β -karyofilen ve karyofilen oksit olduğu belirlenmiştir. Salatalık mozaik virüsüne karşı bu uçucu



yağın uygulanmasının yapraklardaki lezyonların sayısını azalttığı gözlenmiştir. Uçucu yağın antiviral aktivitesi, ana yağ bileşeninin antiviral aktivitesi ile ilişkilendirilmiş ve virüslere karşı bitki savunmasında uçucu yağın aktivitesinde β -karyofilen ve karyofilen oksidin rolü ortaya konmuştur (Vuko ve ark., 2019).

Bitki virüslerinin çoğalmasını azaltmada uçucu yağlar ya da uçucu yağdaki bileşikler kullanılmaktadır. Bitkilerin enfeksiyona karşı savunma yetenekleri, bağışıklık ile ilgili bir durumdur. Antiviral maddeler sadece onları üreten türler için değil, aynı zamanda yakın çevresindeki türler için de koruma sağlamaktadır. Bu nedenle kirlenmemiş ve izole edilmiş habitatlardan doğal olarak yetişen bitkilerin uçucu yağları izole edilmektedir (Bezić ve ark., 2013).

Geranium pratense L. bitkisinin çiçek ve yeşil kısımlarından, *G. sanguineum* L. bitkisinin çiçeklerinden izole edilen polifenol ve flavanoidler virüs ile bulaşıklık öncesi salatalık bitkisinin yapraklarına ve köklerine uygulanmış, yaprak yüzeylerinde virüs etkisinin ortaya çıkmadığı ve virüsün etkilerinin geciktiği görülmüştür (Orazov ve Nikitina, 2004)

Satureja montana L. ssp. *variegata* (Host), bitkisinden elde edilen uçucu yağ, tütün mozaik virüsü ve salatalık mozaik virüsü ile enfekte olmuş *Chenopodium amaranticolor* ve *Chenopodium quinoa* bitkilerine uygulandığında lokal lezyonların sırasıyla % 29.2 ve % 24.1 azaldığı gözlenmiştir. Lezyonların azalmasında uçucu yağın ana bileşenleri olan timol ve karvakrolün etkili olduğu saptanmıştır. Ayrıca salatalık mozaik virüsünü azaltmada timolün (%33.2), tütün mozaik virüsünü azaltmada ise karvakrolün (%34.3) daha etkili olduğu belirlenmiştir (Bezić ve ark., 2013).

Teucrium polium, *Teucrium flavum*, *Teucrium montanum*, *Teucrium chamaedrys* ve *Teucrium arduini* bitkilerinin uçucu yağlarının, salatalık mozaik virüsü ile enfekte olmuş bitkilerde lezyonları engellediği gözlenmiştir. Bu türlerin uçucu yağları ise, karyofilen, karyofilen oksit, germakren D ve a-bisabolol dahil seskiterpenler açısından oldukça zengindir (Bezić ve ark., 2013).

T. montanum, *T. polium*, *T. chamaedrys* ve *T. flavum*'dan izole edilen uçucu yağların antiviral aktivitesi, yağdaki β -karyofilen yüzdesinin, yağın antiviral aktivitesi ile ilişkili olduğunu göstermiştir. *T. montanum* esansiyel yağındaki germakren D, ardından β -pinen, β -karyofilen ve limonen bileşenlerinin ise türler arasında en güçlü antiviral aktiviteyi gösterdiği ortaya çıkmıştır. Seskiterpen yağı bileşeni karyofilen ve oksijenli seskiterpen olan karyofilen oksit, salatalık mozaik virüsü ile enfekte olmuş bitkilerde lokal semptomların sayısını azaltarak önemli bir antiviral aktivite göstermiştir. Bu nedenle, monoterpenler ve seskiterpenlerce zengin uçucu yağların tütün mozaik virüsü, salatalık mozaik virüsü enfeksiyonlarını engelleyebileceği gözlenmiştir (Bezić ve ark., 2013).

Melaleuca leucadendron L., *Myrtus communis* L. ve *Satureja montana* L. bitkilerinin uçucu yağları, tütün mozaik virüsüne karşı önemli düzeyde inhibitör etki göstermiştir. *Chenopodium quinoa* bitkilerinde *Melaleuca leucadendron* bitkisinin tüm uçucu yağ konsantrasyonlarında % 100'e yakın, *Satureja montana* L. uçucu yağında ise %100 virüs inhibisyonu gözlenmiştir. *Satureja montana* L. bitkisinden elde edilen uçucu yağ, en iyi antifitoviral etki göstermiştir. Bu uçucu yağ, lezyonlarda % 46.4-100 oranında değişen bir azalmaya neden olmuştur (Jerković-Mujkić ve ark., 2013).

Bitkilerin farklı kısımlarından elde edilen ekstraktlarda, çeşitli fitokimyasallar farklı konsantrasyonlarda bulunmaktadır. Mazı ağacının yapraklarının, zencefilin köklerinin, üzerlik otu tohumunun ve zerdeçal rizomlarının ekstraksiyonu sonucunda elde edilen fitokimyasalların Mekke Bölgesi'nde yetişen incirlerdeki incir mozaik virüsünü (FLMaV-1) engellediği gözlenmiştir (Aldhebani ve ark., 2017). Ayrıca zencefil, limon, çay, mandalin kabuğu ve yavşan otu uçucu yağlarının (100 μ g/ml) tütün mozaik virüsünü % 50 oranında



ortadan kaldırdığı saptanmıştır (Min ve ark., 2013). Lavanta ve rezeneden elde edilen uçucu yağların farklı dozlarının, biberde solgunluk virüsüne karşı uygulanması sonucu, lavanta uçucu yağının en düşük dozlar hariç virüsü engellediği, rezene uçucu yağının ise etkili olmadığı belirlenmiştir (Dikova ve ark., 2017).

Tıbbi ve aromatik bitkilerden elde edilen uçucu yağlar veya bünyelerinde yaygın bir şekilde bulunan rosmarinik asidin, biyolojik veya biyolojik olmayan farklı stres faktörlerine karşı savunma mekanizmasında önemli rol oynadığı bilinmektedir (Petersen ve Simmonds, 2003, Georgiev ve ark., 2007)

SONUÇLAR

Tıbbi ve aromatik bitkiler günümüzde modern bitkisel tıp ve alternatif tedavide kullanılmaktadır. Tıbbi bitkilerden elde edilen uçucu yağların ve kimyasal bileşenlerinin çok çeşitli virüslere karşı aktif olduğu bilinmektedir. Uçucu yağlarda bulunan oksijenli monoterpenler ve seskiterpenler antiviral etkili olmaktadır. Çiçeklenme zamanı, coğrafi faktörler ve iklim koşulları uçucu yağların içeriği ve verimi açısından önemli rol oynamaktadır. Günümüzde antibiyotikler sayesinde bakteriyel enfeksiyonların birçoğu kontrol altına alınabilirken, viral enfeksiyonlarda durum daha farklıdır. Virüslerin çoğu tarımda bitkisel ürünlerde önemli kayıplara neden olmakta ve etkin önlemlerin alınması gerekmektedir. Bu nedenle uçucu yağların ve yağları oluşturan bileşenlerin antiviral aktivitesinin daha fazla araştırılması gerekmektedir. Bu da uçucu yağların antifitoviral aktivitesinin daha iyi anlaşılmasına ve bitki virüs hastalıklarının kontrolünde kullanılmasına yardımcı olacaktır.



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ADANA İKLİMİ KOŞULLARINDA GÜNEŞ ENERJİSİYLE SERA ISITMA AMACIYLA VAKUM BORULU TOPLAÇLARIN KULLANILMASI ÜZERİNE BİR ARAŞTIRMA

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ÖZET

Bu araştırmada, Adana iklimi koşullarında 140 m² taban alanı olan plastik seranın ısıtılmasında yararlanmak üzere, güneş enerjisinin, ısı depolama materyali olarak su kullanılarak, duyulur ısı depolama yöntemi ile kısa süreli (gündüzden-geceye) depolanması amaçlanmıştır. Sistem esas olarak, vakum borulu güneş toplaçlarından oluşan ısı toplama ünitesi, toplanılan ısının depolandığı ısı depolama ünitesi, depolanan ısıyla ısıtılan plastik sera, ısı toplama-depolama üniteleri ile sera arasında ısı taşıma ve kontrol ünitesinden oluşmaktadır. Isı toplama sistemi altı ünite vakum borulu güneş toplaçlarından oluşmaktadır. Her ünite 36 adet vakum boru bulunmaktadır. Isı depolama ünitesi olarak, korozyona dayanıklı galvanize çelik metal malzemeden tasarlanmış ve hacmi 240 L olan silindirik depolama tankı kullanılmıştır. Araştırma boyutları, 10 m (uzunluk) × 14 m (genişlik) × 3 m'dir (yükseklik) olan plastik seralarda yürütülmüştür. Serada ısıtma borusu olarak, sera ısı gereksinimine bağlı olarak, 25 mm çapında toplam 180 m uzunluğunda oluklu spiral boru kullanılmıştır. Araştırmada ısı taşıma akışkanı olarak su ve % 5 oranında Al₂O₃ ve % 95 oranında su karışımından oluşan nanoakışkan kullanılmıştır. Sera ortamında hava ve toprak sıcaklıkları, depolama ünitesinde farklı yüksekliklerde su sıcaklıkları, ısıtma boruları giriş ve çıkışlarında ısı taşıma akışkanı sıcaklıkları, 5'er dakika aralıklar ile ölçülmüş ve kaydedilmiştir. Araştırma seralarında Malazgirt F1 hıyar çeşidi üretilmiştir. Su ile ısıtma yapılan dönemde sera iç ortamı ile dış ortam arasındaki sıcaklık farkı ortalama 4,6 °C, ısıtma akışkanının seraya giriş ve çıkışı arasındaki sıcaklık farkı ise ortalama 5,7 °C belirlenmiştir. Isıtma akışkanı olarak sıcak su kullanılması durumunda, ısıtma yapılan gece dönemlerindeki belirtilen sürelerde, sera ısı gereksiniminin karşılanma oranı ortalama % 38,45, sıcak nanoakışkan kullanılan dönemde ortalama % 44,36 olarak belirlenmiştir. Isıtma akışkanı olarak sıcak su kullanılması durumunda, ısıtma yapılan gece dönemlerindeki belirtilen sürelerde, ısı gücü/ekserji oranı ortalama % 9,86 iken, sıcak nanoakışkan kullanılan dönemde ortalama % 10,69 olarak belirlenmiştir. Isıtma akışkanı olarak sıcak su kullanılması durumunda, hıyar verimi ısıtılmayan seraya kıyasla, 393 kg (% 34,2 oranında) daha yüksek olarak gerçekleşmiştir. Sera ısıtmak için günlük toplam enerji, yakıt ve emisyon tasarrufu; su ile ısıtma yapılan dönemde, % 37,6 olarak belirlenirken, nanoakışkan ile ısıtma yapılan dönemde % 42 olarak belirlenmiştir. Bu durum nanoakışkan ile ısı geri kazma etkinliğinin daha yüksek olmasından kaynaklanmaktadır. Su ile ısıtma durumunda, doğal gaz tasarrufuna ilişkin geri ödeme süresi 5,84 yıl, kömür tasarrufuna ilişkin geri ödeme süresi 4,47 yıl olarak hesaplanmıştır.

Anahtar Kelimeler: Sera ısıtma, Güneş enerjisi, Isı depolama



A RESEARCH ON THE USE OF VACUUM TUBULAR COLLECTORS FOR GREENHOUSE HEATING WITH SOLAR ENERGY IN ADANA CLIMATE CONDITIONS

ABSTRACT

In this study, it is aimed to store solar energy for a short time (day-to-night) using sensible heat storage method, using water as the heat storage material in order to be used in heating the plastic greenhouse with a floor area of 140 m² under Adana climate conditions. The system mainly consists of a heat collection unit consisting of vacuum tube solar collectors, a heat storage unit where the collected heat is stored, a plastic greenhouse heated by the stored heat, heat transfer and control unit between the heat collection-storage units and the greenhouse. The heat collection system consists of six units of vacuum tube solar collectors. There are 36 vacuum pipes in each unit. As the heat storage unit, a cylindrical storage tank with a volume of 240 L, designed from corrosion resistant galvanized steel metal material, is used. Research dimensions were carried out in plastic greenhouses with 10 m (length) \square 14 m (width) \square 3 m (height). As the heating pipe in the greenhouse, corrugated spiral pipes with a diameter of 25 mm and a total length of 180 m were used, depending on the greenhouse heat requirement. In the study, water and a nanofluid consisting of a mixture of 5% Al₂O₃ and 95% water were used as heat transfer fluid. Air and soil temperatures in the greenhouse environment, water temperatures at different heights in the storage unit, heat transfer fluid temperatures at the inlet and outlet of the heating pipes were measured and recorded at intervals of 5 minutes. Malazgirt F1 cucumber variety was produced in research greenhouses. During the period of heating with water, the temperature difference between the indoor and outdoor environment of the greenhouse was an average of 4.6 C, and the temperature difference between the heating fluid entering and leaving the greenhouse was 5.7 C. In the case of using hot water as the heating fluid, the rate of meeting the greenhouse heat requirement was determined to be 38.45% on average during the specified periods during the night periods of heating, and 44.36% during the period when hot nanofluid was used. In the case of using hot water as the heating fluid, the thermal power / exergy ratio was determined to be 9,86% on average during the specified periods during the night periods of heating, while it was determined to be 10,69% in the period when hot nanofluid was used. In the case of using hot water as the heating fluid, the cucumber yield was 393 kg (34.2%) higher than the unheated greenhouse. Daily energy, fuel and emission savings for heating greenhouses; While it was determined as 37.6% in the period of heating with water, it was determined as 42% in the period of heating with nanofluidic fluid. This is due to the higher efficiency of heat recovery with nanofluidic fluid. In the case of heating with water, the payback period for saving natural gas is 5.84 years, and the payback period for coal savings is 4.47 years.

Keywords: Greenhouse heating, solar energy, heat storage



GİRİŞ

Örtü altı yetiştiriciliğinde başlıca amaç, iç ortam sıcaklığını bitki büyüme gelişmesi için en uygun düzeyde sürdürmektir. Seralarda gerçekleştirilen bitkisel üretimden beklenen en yüksek verimin elde edilmesi için, dış ortam sıcaklığının düşük olduğu dönemlerde seranın ısıtılması gerekir. Enerji fiyatlarının yüksek olduğu günümüzde, sera ısıtma giderleri yükselmekte ve yetiştirilen ürünlerin maliyeti artmaktadır. Esas olarak sezon dışı üretim amacıyla kullanılan seralarda yetiştirilen ürünlerin kalite, miktar ve gelişme süresi bakımından en uygun ortam koşullarının sağlanması için, kışın soğuk dönemlerde ısıtma gereklidir. Akdeniz ülkelerinin çoğunda ekolojik koşulların uygun olması nedeniyle, sadece soğuk kış gecelerinde gereksinim duyulan ısıtma uygulamaları yeterince yapılmamaktadır. Bu nedenle, seralarda yetiştirilen ürünlerin kalite, miktar ve hasat zamanı açısından bazı olumsuzluklarla karşılaşmaktadır. Bu nedenle, seraların ısıtılmasında, kurulduğu yerde bulunan en ucuz enerji kaynakları kullanılmalıdır. Bulunulan yöre, yetiştirilen ürün çeşidi ve yapılan üretim şekline göre, klasik fosil yakıtlarla yapılan ısıtma uygulamalarında, ısıtma giderleri toplam üretim giderlerinin % 60-70'ine ulaşmaktadır [1]. Güney Avrupa koşullarında sera ısıtma giderleri, toplam işletme giderlerinin % 30'undan daha fazladır [2]. Alışılacağı enerji kaynaklarından elde edilen enerji bedellerinin yüksek olması nedeniyle, sera ısıtma amacıyla yeni ve yenilenebilir enerji kaynaklarından yararlanmak büyük önem kazanmıştır. Sera ısıtma uygulamalarında, günümüz enerji varlığını korumak ve çevre kirlenmesini önlemek amacıyla fosil enerji kaynakları yerine, doğal enerji kaynaklarından yararlanılması öncelikli bir gereksinimdir.

Bu araştırmada, Adana iklimi koşullarında 140 m² taban alanı olan plastik seranın ısıtılmasında yararlanmak üzere, güneş enerjisinin, ısı depolama materyali olarak nanopartikül (Al₂O₃) karıştırılmış su (nanoakışkan) kullanılarak, duyulur ısı depolama yöntemi ile kısa süreli (gündüzden-geceye) depolanması amaçlanmıştır. Serada güneş enerjisi depolama uygulaması ile seranın ısıtma enerjisi gereksiniminin azalması amaçlanmıştır. Sera ısıtma için kullanılması gereken enerji miktarının azalmasına bağlı olarak, ısıtma giderleri azalacak ve enerji tasarrufu sağlanacaktır. Enerji tasarrufu sağlanmasının önemli bir sonucu olarak, sera ısıtma uygulamaları için fosil yakıt tüketimi de azalacağından, atmosferde sera etkisi yaratan başlıca gazlardan birisi olan CO₂ gazı salımı da önemli oranda azalacaktır. Böylece; sera üreticisi, ülke ekonomisi, insan sağlığı ve çevre korunumu açısından önemli katkılar sağlanacaktır.

MATERYAL ve YÖNTEM

İklim Özellikleri

Adana ili, Akdeniz ikliminin özelliklerini taşır. Yazları sıcak ve kurak, kışları ise ılık ve yağışlıdır. Adana'da yılın 195,6 günü yaz günüdür. Bu günlerin 134,4'ü tropik gün olarak belirlenmiştir. Adana ilinde uzun yıllık ortalama sıcaklık ortalaması 19,1 °C olup, ortalama en yüksek ve en düşük sıcaklık değerleri sırasıyla 25,3 °C ve 13,8 °C'dir. **Ortalama en yüksek sıcaklıkların yaz mevsimindeki (Haziran-Ağustos) ortalaması 33,3 °C'dir. Ortalama en düşük sıcaklıkların kış aylarındaki (Aralık-Şubat) ortalaması -6,6 °C'dir [3].**

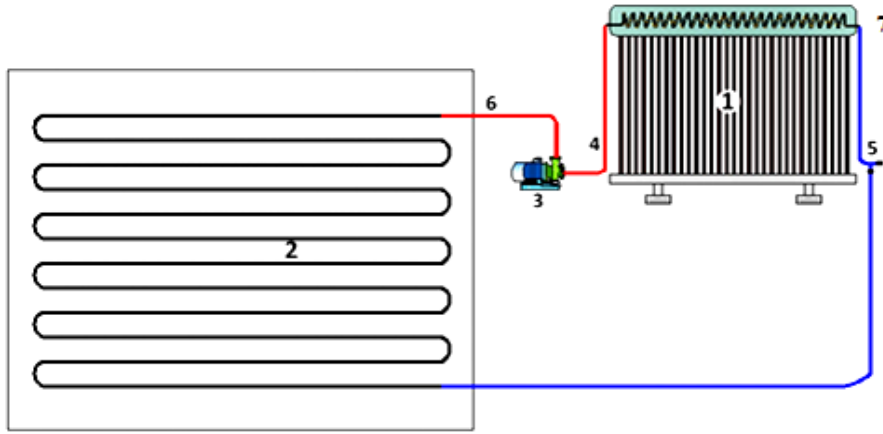
Adana ilinde toplam güneş enerjisi; 1,99-6,60 kWh/m²gün aralığında değişmekte olup, yıllık ortalama 4,21 kWh/m²gün değerindedir. Toplam güneş enerjisi yaz mevsiminde (Haziran-Ağustos) ortalama 6,23 kWh/m²gün düzeyinde iken, kış mevsiminde (Aralık-Şubat) 2,02 kWh/m²gün düzeyine azalmaktadır. Güneşlenme süresi ise; 4,58-11,46 saat aralığında değişmekte olup, yıllık ortalama 8,21 saattir. Güneşlenme



süresi yaz aylarında (Haziran–Ağustos) ortalama 11,22 saat değerinde iken, kış aylarında (Aralık–Şubat) 5,15 saat değerine azalmaktadır.

Güneş Enerjisiyle Sera Isıtma Sistemi

Sera ısıtma, güneş enerjisinin su kullanılarak duyulur ısı depolama yöntemi ile günlük olarak depolanması için tasarlanmış olan araştırma, TC Tarım ve Orman Bakanlığı Adana Tarımsal Yayım ve Hizmetiçi Eğitim Merkezi Müdürlüğü'nde yürütülmüştür. Tasarlanan sistemin şematik görünümü Şekil 1'de verilmiştir. Sistem esas olarak Vakum borulu güneş toplaçlarından oluşan ısı toplama ünitesi, toplanılan ısının depolandığı ısı depolama ünitesi, depolanan ısıyla ısıtılan plastik sera, ısı toplama-depolama üniteleri ile sera arasında ısı taşıma ve kontrol ünitesinden oluşmaktadır. Şekil 1'de gösterilen güneş enerjili sera ısıtma sisteminde; gündüz sürelerinde, vakum borulu güneş toplaçları (1) tarafından toplanılan ısı enerjisi, sistemin üst kısmında yer alan ısı depolama ünitesinde (7) depolanmıştır. Sera iç ortam sıcaklığına bağlı olarak, ısı depolama ünitesinden gece sürelerinde ısı geri kazanılması için, pompa ünitesi (3) çalıştırılmıştır.



Şekil 1. Güneş enerjisiyle sera ısıtma için tasarlanan sistemin şematik görünümü: (1) ısı vakum borulu güneş toplaçları (toplama ünitesi), (2) sera içi ısıtma boruları, (3) sirkülasyon pompası, (4-5-6) sıcak su dolaşım hattı ve (7) ısı depolama ünitesi.

Bu durumda, ısı depolama ünitesi (7) ile plastik sera içindeki ısıtma boruları (2) arasında akışkan dolaşımı sağlanmıştır. Isı geri kazanılan gece sürelerinde, plastik sera (2) ve ısı depolama (7) üniteleri arasında akışkan dolaşımı için kullanılan pompa ünitesine hareket veren elektrik motorunun çalışması termostat ile kontrol edilmiştir. Güneş enerjisiyle ısıtılan serada hava sıcaklığı 12 °C'ye azaldığında, sirkülasyon pompası çalışmaya başlamış ve ısı depolama ünitesi ile sera ortamı arasında ısı transferi gerçekleşmiştir. Sistemin kurulma aşamasını gösteren görseller Şekil 2'de verilmiştir.

Isı Toplama Ünitesi: Vakum Borulu Güneş Toplaçları

Isı depolama ünitesinde ısı enerjisi olarak depolanacak olan güneş enerjisinin toplanması için, vakum borulu güneş toplaçlarından yararlanılmıştır (Şekil 2). Vakum borulu toplaçlar, yüksek sıcaklıklı ve güneşi izlemesi gerekmeyen güneş toplaçlarıdır. Kurulumu yapılan tasarım 6 üniteden oluşmaktadır. Her ünite 36 adet vakum boru bulunmaktadır.



Şekil 2. Vakum borulu toplaçlarından oluşan ısı toplama ünitesi

Isı Depolama Ünitesi

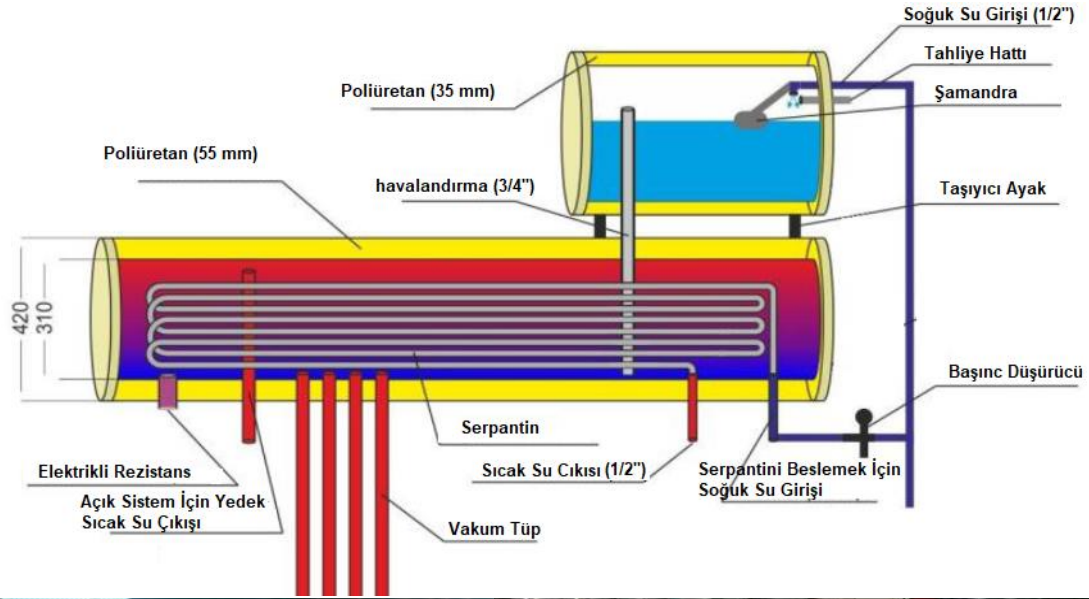
Isı depolama ünitesi olarak, korozyona dayanıklı galvanize çelik metal malzemeden tasarlanmış ve hacmi 240 L olan silindirik depolama tankı kullanılmıştır (Şekil 3). Isı depolama ünitesinin dış yüzeyleri, ısı kayıplarının önlenmesi için, etkin bir şekilde poliüretan ile ısı olarak yalıtılmıştır. Isı depolama ünitesinin alt kısmından itibaren 5 (alt), 15 (orta) ve 25 (üst) cm yüksekliklerde, ısı depolama akışkanının sıcaklıkları ölçülmüştür. Vakum borulu güneş toplaçlarından oluşan ısı toplama ünitesinden gelen sıcak su, tanktaki suyun ısınması sağlanmıştır. Tank içerisinde bulunan bakır serpantin içerisinde dolaşan akışkan depolanan ısı enerjisini üzerine alarak dolaşım sonucunda plastik sera içerisine aktarmıştır. Isı toplama ünitesinin başlıca bileşenleri ve iç görünümü Şekil 3’de verilmiştir.

Plastik Seralar

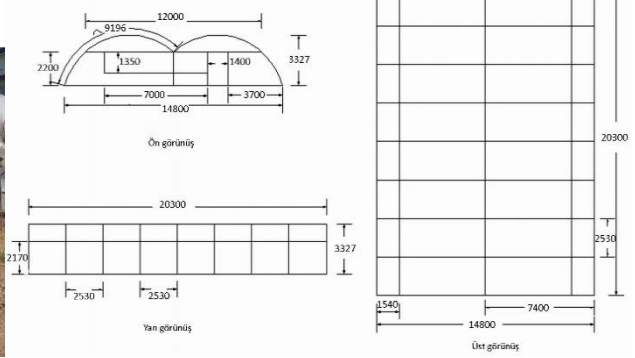
Araştırma kapsamında, Adana iklimi koşullarında 140 m² taban alanında polietilen (PE) plastik seralar için, güneş enerjisiyle sera ısıtma sisteminin tasarım değişkenleri belirlenmiştir. Aynı tasarımda mevcut olan iki adet plastik seradan birisi kontrol amacıyla kullanılmıştır. Kurulan plastik seraların boyutları şu şekildedir: 10 m (uzunluk) × 14 m (genişlik) × 3 m’dir (yükseklik). Plastik seraların görünüşü ve teknik resim çizimleri Şekil 4’de, bazı özellikleri ise Tablo 1’de verilmiştir.

Plastik Borulu Isıtma Sistemi

Deneme serasının ısıtılması, tabanına yerleştirilmiş plastik spiral boru içerisinde sıcak su dolaşımı ile sağlanmıştır (Şekil 5). Bu amaçla, sera ısı gereksinimine bağlı olarak, 25 mm çapında toplam 180 m uzunluğunda oluklu spiral boru kullanılmıştır. Isıtma borularının teknik özellikleri Tablo 2’de verilmiştir.



Şekil 3. Isı depolama ünitesinin bileşenleri ve iç görünümü



Şekil 4. Denelerin yapıldığı plastik seranın görünümü ve boyutları




Tablo 1. Plastik seranın özellikleri

Özellikler	Değerler
İ kalınlığı (mm)	0,35
İ lam uzunluk (m)	20
İ ne genişliği (m)	7
İ lam genişlik (m)	14
İ lam yükseklik (m)	3



Şekil 5. Plastik serada plastik borulu ısıtma sistemi

Tablo 2. Sera ısıtma borusunun teknik özellikleri

Dış çap	25 mm	 Isıtma borusu
Nominal çalışma basıncı (55 °C)	2,5 Atm	
Maksimum çalışma sıcaklığı	70 °C	
Kalınlık	0,90 mm	
Kütle	116,0 g/m	
Paketleme	100 m	

Plastik seradaki ısıtma sistemi, seranın uzun kenarı boyunca sera tabanındaki toprak yüzeyine belirli aralıklar ile yerleştirilmiş ısıtma borularından oluşmaktadır. Sıcak su girişi ve ılık su dönüşü gerçekleşen spiral borular, sera genişliği boyunca yerleştirilmiş olan ana dağıtım ve dönüş hattına bağlıdır (Şekil 5).

Isı geri kazanma dönemlerinde, plastik sera ve ısı depolama ünitesi arasında akışkan dolaşımı için sirkülasyon pompası kullanılmıştır. Sera iç hava sıcaklığına bağlı olarak, pompa çalışmış ve sera içerisindeki ısıtma borularından akışkan dolaşımı sağlanmıştır. Pompa 220-230V/50Hz çalışmaktadır. Limk WRS25/7-130 marka pompa, 80 W gücünde ve debisi 0,26 kg/s'dir.

Nanoakışkan

Nanoakışkanlar en genel tanımıyla; nanometrik boyuttaki (1–100 nm) katı partiküllerin bir temel akışkan içerisinde dağıtılması ile oluşturulan akışkanlardır. Böyle bir yapı oluşturmaktaki amaç, ısı iletkenliği, temel akışkanın ısı iletkenliğinden daha yüksek olan bir nano malzemeyi



(metal, metal oksit veya yüksek yüzey alanlı karbonik yapılar) akışkan içerisine karıştırarak, akışkanın ısıl iletkenliğini arttırmaktır. Araştırmada % 5 oranında Al_2O_3 ve % 95 oranında su karışımından oluşan nanoakışkan kullanılmıştır. Kullanılan nanoakışkanın özellikleri Tablo 3’de verilmiştir.

Tablo 3. Nanoakışkanın özellikleri

Alüminyum Oksit Alfa Dağılımı	Değer
Al_2O_3	% 5 wt
Boyut	30-50 Nm
Safılık	%99.9
Kristal yapı ve tipi	Alfa
Görünümü	Beyaz sıvı
Spesifik yüzey alan	190 m ² /g
pH	6-8
Yoğunluk	(20 °C) 3,9 g/cm ³
Erime noktası	2040 °C
Molekül ağırlığı	101,96
Termal iletkenlik	30 W/m K
Özgül ısı	451-955 J/kgK

Ölçme Sistemi ve Kayıt Sistemi

Araştırmada sistemin farklı birer bileşenini oluşturan; plastik sera ortamları ve ısı depolama ünitesinde farklı fiziksel büyüklükler ölçülmüştür. Sera iç ortamları ve dış ortamda sıcaklık ölçümü, sıcaklık arttıkça direnci azalan negatif ısı katsayılı (NTC) termistör ile yapılmıştır. Bağıl nem ölçümü ise, kapasitif özellikteki nem algılayıcı ile yapılmıştır. Ölçümler 5’er dakika aralıklar ile ölçülmüş ve kaydedilmiştir.

Serada Hıyar Üretimi

Araştırma seralarında Malazgirt F1 hıyar çeşidi üretilmiştir. Dikim 100 × 50 × 50 cm (300 bitki/140 m²) aralığında gerçekleştirilmiş ve ilk sulama işlemi aynı gün yapılmıştır. Fideler dikildikten sonra ilk verilen can suyundan ilk meyveler görülünceye kadar ki dönemde çok olmamak koşuluyla 3-4 günde sulama yapılmıştır. 15-15-15 gübresinden 15 kg fide dikiminden 10-15 gün önce toprağın yüzüne serilerek en az 15-20 cm derinliğinde toprak işlenmiştir.

Hesaplama Yöntemi

Sera Isı Gereksiniminin Belirlenmesi

Plastik seranın ısıtılması için, taban alanı başına gereksinim duyulan ısıl güç miktarı aşağıdaki eşitlikten belirlenmiştir [1].

$$q_s = \frac{A_{\delta}}{A_t} \times u \times (T_i - T_d) - I \times \tau \times \gamma \quad (W/m^2) \quad (1)$$

Bu eşitlikte;

- q_s = Taban alanı başına ısıl güç gereksinimi (W/m^2),
- A_{δ} = Sera örtüsü yüzey alanı (m^2),
- A_t = Sera taban alanı (m^2),
- u = Toplam ısı kaybı katsayısı ($W/m^2 \text{ } ^\circ C$),
- T_i = Sera iç ortam havasının sıcaklığı ($^\circ C$),
- T_d = Dış ortam havasının sıcaklığı ($^\circ C$),
- I = Toplam güneş ışınımı (W/m^2)
- τ = Seranın toplam ışınım geçirgenliği ve



γ = Toplam ışınımın sera iç ortam sıcaklığının artmasında etkili olan ısı ışınımına dönüşme oranıdır.

Sera toplam ısı güç gereksinimi, birim taban alanı için gerekli ısı güç miktarına bağlı olarak aşağıdaki gibi hesaplanmıştır (2).

$$Q_s = q_s \times A_s \quad (W) \quad (2)$$

Bu eşitlikte;

$$\begin{aligned} Q_s &= \text{Seranın toplam ısı güç gereksinimi (W),} \\ q_s &= \text{Taban alanı başına ısı güç gereksinimi (W/m}^2\text{) ve} \\ A_s &= \text{Sera taban alanıdır (m}^2\text{).} \end{aligned}$$

Plastik seranın ısı güç gereksinimi, güneşten ısı kazancının olmadığı gece koşulları için hesaplanmıştır. Seralarda güneş enerjili aktif ısıtma sistemleri, yıllık ısı gereksiniminin belirli bir oranını karşılamak için tasarlanırlar. Sera iç ortamında istenilen sıcaklığa bağlı olarak oluşan ısı kayıpları dikkate alınır ve seranın yıllık ısı gereksinimi hesaplanır.

Toplam Isı Kaybı Katsayısı

Toplam ısı kaybı katsayısı genellikle rüzgar hızı ile ilişkili olarak incelenir. Akdeniz Bölgesi iklimi koşullarında; UV+IR katkılı PE ile örtülü plastik seralar için toplam ısı kayıp katsayısı, rüzgar hızına (v_r , m/s) bağlı olarak aşağıdaki eşitlikten belirlenebilir [3].

$$u=2,83+0,10v_r \quad (W/m^2\text{ }^\circ\text{C}) \quad (3)$$

Sera İç Ortam Hava Sıcaklığı

Seralarda değişik tür bitkilerin yetiştirilebilmesi için, iç ortam hava sıcaklığı 10–28 °C aralığında ayarlanabilmelidir. Plastik serada hıyar üretimi için gerekli olan ısı gereksinimi, 17 °C iç ortam sıcaklığına bağlı olarak hesaplanmıştır.

Dış Ortam İklim Koşulları

Dış ortam sıcaklığının belirlenmesinde, seranın bulunduğu bölgenin iklim koşullarına bağlı olarak yılın en soğuk zamanında oluşan en düşük sıcaklıkların ortalaması dikkate alınır. Isıtma sistemi tasarımında, Adana yöresine ilişkin uzun yıllık sıcaklık değerleri dikkate alınmıştır.

Sera Ortamına Verilen Isıl Güç Miktarının Belirlenmesi

Isı depolama ünitesi ile sera arasında akışkan dolaşımı ile sera ortamına aktarılan ısı güç miktarı aşağıdaki eşitlikten hesaplanmıştır [4].

$$Q_t = m \times c_p (T_g - T_\varphi) \quad (W) \quad (4)$$

Burada:

$$\begin{aligned} Q_t &= \text{Sera ortamına taşınan ısı güç miktarı (W),} \\ m &= \text{Akışkanın kütleli debisi (kg/s),} \\ c_p &= \text{Akışkanın özgül ısısı (J/kg }^\circ\text{C),} \\ T_g &= \text{Akışkanın seradan çıkış sıcaklığı (}^\circ\text{C) ve} \\ T_\varphi &= \text{Akışkanın seraya giriş sıcaklığıdır (}^\circ\text{C).} \end{aligned}$$

Sera Ortam Hava Verilen Isıl Ekserji Miktarının Belirlenmesi

Isı depolama ünitesi ile sera arasında akışkan dolaşımı ile sera ortamına aktarılan ısı ekserji miktarı aşağıdaki eşitlikten hesaplanmıştır [5].

$$\Xi_t = m \times c_p (T_g - T_\varphi) - T_r \times m \times c_p (\ln T_g / T_\varphi) \quad (W) \quad (5)$$

Burada:

$$\Xi_t = \text{Sera ortamına taşınan ısı ekserji miktarı (W),}$$



- m = Akışkanın kütleli debisi (kg/s),
 c_p = Akışkanın özgül ısı (J/kg K),
 $T_ç$ = Seradan çıkan akışkanın mutlak sıcaklığı (K),
 T_g = Seraya giren akışkanın mutlak sıcaklığı (K) ve
 T_r = Referans sıcaklıktır (10 K).

Sera Isıtma Sisteminin Boyutlandırılması

Isıtma Borusu Uzunluğunun Belirlenmesi

Seralardaki sıcak sulu ısıtma sistemlerinde kullanılması gereken toplam ısıtma borusu uzunluğu, seranın toplam ısı gereksinimi ve kullanılması tasarımılanan ısıtma borusunun birim uzunluğundan kazanılan ısı miktarına bağlı olarak aşağıdaki gibi hesaplanır [6].

$$L_b = \frac{Q_s}{Q_b} \quad (m) \quad (6)$$

Bu eşitlikte;

- L_b = Isıtma borusunun uzunluğu (m)
 Q_s = Seranın toplam ısı güç gereksinimi (W) ve
 Q_b = Borudan kazanılan ısı güç miktarıdır (W/m).

2.5.4.2. Isıtma Borusundan Isı Transferinin Belirlenmesi

Isıtma borusundan sera ortamına geçen toplam ısı güç miktarı aşağıdaki eşitlikten hesaplanmıştır [6].

$$Q_b = \frac{4\pi L_b \Delta T_b}{\frac{1}{\alpha_i d_i} + \frac{\ln(d_d/d_i)}{\lambda_b} + \frac{1}{\alpha_d d_d}} + Q_r \quad (m) \quad (7)$$

Bu eşitlikte;

- L_b = Isıtma borusu uzunluğu (m),
 ΔT_b = Sıcaklık farkı (°C),
 α_i = İç yüzey ısı taşınım katsayısı (W/m²K),
 α_d = Dış yüzey ısı taşınım katsayısı (W/m²K),
 d_d = Boru dış çapı (m),
 d_i = Boru iç çapı (m),
 λ_b = Isı iletim katsayısı (W/m K) ve
 Q_r = Işınlama ile geçen ısı güç miktarıdır (W).

Isıtma Borusundan Sera Ortamına Işınlama ile Geçen Isıl Güç

Plastik seradaki ısıtma borularından sera ortamına ışınlama ile geçen ısı güç miktarı (Q_r , W) aşağıdaki gibi hesaplanır [6].

$$Q_r = \varepsilon \cdot \sigma \cdot A_b (T_b^4 - T_s^4) \quad (W) \quad (8)$$

Bu eşitlikte;



- ε = Işınım yayma değeri,
 σ = Stefan-Boltzmann sabiti ($5.6697 \times 10^{-8} \text{ W/m}^2\text{K}^4$),
 A_b = Boru yüzey alanı (m^2),
 T_b = Isıtma borusunun mutlak sıcaklığı (K) ve
 T_s = Sera ortam havasının mutlak sıcaklığıdır (K).

Sıcaklık Farkı

Sera iç ortamındaki hava sıcaklığı ile ısıtma borusu içerisindeki su sıcaklığı arasındaki fark (ΔT_b), logaritmik ortalama sıcaklık farkı olarak hesaplanır [6].

$$\Delta T_b = \frac{T_g - T_{\phi}}{\ln \frac{(T_g - T_s)}{(T_{\phi} - T_s)}} \text{ (}^\circ\text{C)} \quad (9)$$

Burada;

- T_g = Suyun ısıtma borusuna giriş sıcaklığı ($^\circ\text{C}$),
 T_{ϕ} = Isıtma borusundan su çıkış sıcaklığı ($^\circ\text{C}$) ve
 T_s = Sera içerisindeki hava sıcaklığıdır ($^\circ\text{C}$).

Isıtma Borusu Yüzey Alanı

Isıtma borusundan ısı geçişi gerçekleşen yüzey alanının belirlenmesinde, borunun logaritmik ortalama yüzey alanı dikkate alınır [6].

$$A_b = \frac{2\pi \times L_b \times (r_d - r_i)}{\ln \frac{r_d}{r_i}} \text{ (m}^2\text{)} \quad (10)$$

Burada;

- A_b = Isıtma borusu yüzey alanı (m^2),
 L_b = Isıtma borusunun uzunluğu (m)
 r_i = Isıtma borusunun iç yarıçapı (m) ve
 r_d = Isıtma borusunun dış yarıçapıdır (m).

Isı Depolama Materyali Miktarının Belirlenmesi

Isı depolama ünitesinde duyulur ısı depolama materyali olarak kullanılması gereken su miktarı aşağıdaki eşitlikten hesaplanmıştır [6].

$$\dot{m} = \frac{Q_s}{c_p \times \Delta T} \text{ (kg)} \quad (11)$$

Burada;

- m = Kullanılması gereken su kütlesi (kg),
 Q_s = Güneş enerjisi ile karşılanması öngörülen sera ısı gereksinimi (kJ/gün),
 c_p = Suyun özgül ısısıdır (kJ/kg $^\circ\text{C}$) ve



ΔT = Sudaki sıcaklık artışıdır ($^{\circ}\text{C}$).

Isı Toplama Ünitesi Yüzey Alanının Belirlenmesi

Sera ısıtma amacıyla yıllık ısı gereksiniminin belirli bir oranını karşılamak için gerekli ısı enerji miktarı belirlendikten sonra, bu enerjinin toplanması için gerekli toplaç alanı hesaplanır. Toplaçların güneş enerjisi toplama verimi; toplaç üzerine gelen güneş ışınımına, toplaç örtü malzemesi ve soğurucu yüzeyin optik özelliklerine bağlıdır. Isı toplama ünitesinde kullanılması gereken toplaç alanı aşağıdaki eşitlikten hesaplanmıştır[6].

$$A_t = \frac{Q_s}{I \times \eta_t} \text{ (m}^2\text{)} \quad (12)$$

Burada;

- A_t = Toplaç yüzey alanı (m^2),
- Q_s = Güneş enerjisi ile karşılanması öngörülen sera ısı gereksinimi (kJ/gün),
- I = Toplaç yüzeyine gelen güneş enerjisi miktarı (kJ/m^2 gün) ve
- η_t = Toplaç verimidir (%).

Isı Depolama Ünitesi Hacminin Belirlenmesi

Isı depolama ünitesi (ısı deposu) hacminin belirlenmesinde, günlük olarak gerekli olan depolanabilecek en fazla ısı miktarı dikkate alınır. Isı depolama ünitesinin hacmi aşağıdaki eşitlikten belirlenmiştir.

$$V = \frac{Q_s}{\rho_s \times c_{ps} \times \Delta T} \text{ (m}^3\text{)} \quad (13)$$

Burada;

- V = Isı depolama ünitesi hacmi (m^3),
- Q_s = Güneş enerjisi ile karşılanması öngörülen sera ısı gereksinimi (kJ/gün),
- ρ_s = Suyun yoğunluğu (kg/m^3),
- c_{ps} = Suyun özgül ısısı ($\text{kJ}/\text{kg K}$) ve
- ΔT = Isı depolama için ısı depolama materyalinin ortalama sıcaklık artışıdır ($^{\circ}\text{C}$).

Dolaşım Pompası Debisinin Belirlenmesi

Isıtma sisteminde kullanılacak olan dolaşım pompası, sitemde meydana gelen sürtünme kayıplarını karşılayabilecek büyüklükte seçilmelidir. Dolaşım pompasının debisi, gerekli ısı enerjisi miktarı ve akışkanın giriş-çıkış sıcaklık farkına bağlı olarak aşağıdaki gibi belirlenmiştir.

$$V_p = \frac{Q_s}{c_p \times \rho \times (T_g - T_{\check{c}})} \cdot \text{(m}^3/\text{s)} \quad (14)$$

Burada;

- V_p = Dolaşım pompasının debisi (m^3/s),
- Q_k = Gerekli ısı miktarı (kW),
- ρ = Akışkanın yoğunluğu (kg/m^3),
- c_p = Akışkanın özgül ısısı ($\text{kJ}/\text{kg } ^{\circ}\text{C}$),
- T_g = Akışkan giriş sıcaklığı ($^{\circ}\text{C}$) ve
- $T_{\check{c}}$ = Akışkan çıkış sıcaklığıdır ($^{\circ}\text{C}$).



Tasarruf Edilecek Yakıt Miktarı ve Yakıt Giderinin Belirlenmesi

Plastik seranın güneş enerjisiyle ısıtılması durumunda, tasarruf edilecek yakıt miktarı değerlerinin belirlenmesi için, Tablo 4’de verilen yakıtlara ilişkin ısıl değerler ve çevrim verimleri ile Adana (Merkez) ili Eylül 2020 tarihindeki yakıt birim fiyatları dikkate alınmıştır.

Tablo 4. Yakıt ve emisyon tasarrufunun belirlenmesinde kullanılan değerler [7]

Yakıt Çeşidi	Isıl Değeri(kWh/kg)	Çevrim Verimi (%)	LCA Emisyon Faktörü (gCO _{2-eş} /kWh)
Doğal gaz	10,6	90	237
Kömür	7,16	60	385

Tasarruf Edilecek Eşdeğer Karbondioksit Emisyonu Miktarının Belirlenmesi

Plastik seranın güneş enerjisiyle ısıtılması durumunda, tasarruf edilecek eşdeğer karbondioksit emisyonunun (CO_{2-eş}) belirlenmesi için, Tablo 4’de verilen yakıtlara ilişkin ısıl değerler ve çevrim verimleri ile yaşam döngüsü analizlerinde dikkate alınan CO_{2-eş} salım faktörleri kullanılmıştır.

$$CO_{2-eş} = m_y \times LHV_y \times EF_y \text{ (kgCO}_{2-eş}\text{)} \quad (15)$$

Burada;

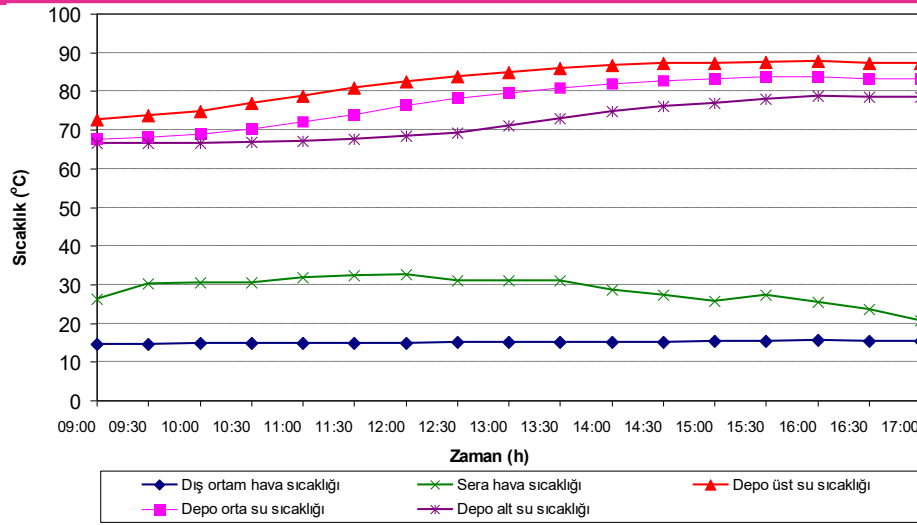
- CO_{2-eş} = CO_{2-eş} emisyonu (kgCO_{2-eş})
- m_y = Yakıt miktarı (kg),
- LHV_y = Yakıtın alt ısıl değeri (kWh/kg) ve
- EF_y = Yakıtın emisyon faktörüdür (kgCO_{2-eş}/kWh).

BULGULAR ve TARTIŞMA

Su İle Isıtma Yapılan Dönem

Gündüz Dönemi Sıcaklık Değişimi

Su ile ısıtma yapılan dönemde (1-31 Mart 2020), güneş enerjisinden vakum borulu toplaçlar aracılığı ile ısı enerjisi kazanılarak, ısı depolama ünitesinde ısı depolama yapılan gündüz sürelerinde (09:00–17:00) hava ve su sıcaklıklarının değişimi Şekil 6’de verilmiştir. Belirtilen dönemde, gündüz sürelerinde dış ortam hava sıcaklığı 14,48–15,58 °C aralığında, sera iç ortamındaki hava sıcaklığı ise 23,51–32,59 °C aralığında değişmiştir. Gündüz sürelerinde, belirtilen saatler (09:00–17:00) arasındaki süreçte hava sıcaklığı ortalaması dış ortamda 15,08 °C, sera iç ortamında ise 28,61 °C olarak belirlenmiştir. Isı depolama ünitesinin, üst, orta ve alt kısımlardaki su sıcaklıkları sırasıyla, 72,57–87,79 °C, 67,56–83,86 °C ve 66,57–78,70 °C aralıklarında değişmiştir. Gündüz sürelerinde belirtilen saatler (09:00–17:00) arasındaki süreçte, ısı depolama ünitesinin, üst, orta ve alt kısımlardaki ortalama su sıcaklıkları sırasıyla, 82,68 °C, 77,55 °C ve 72,07 °C olarak belirlenmiştir.

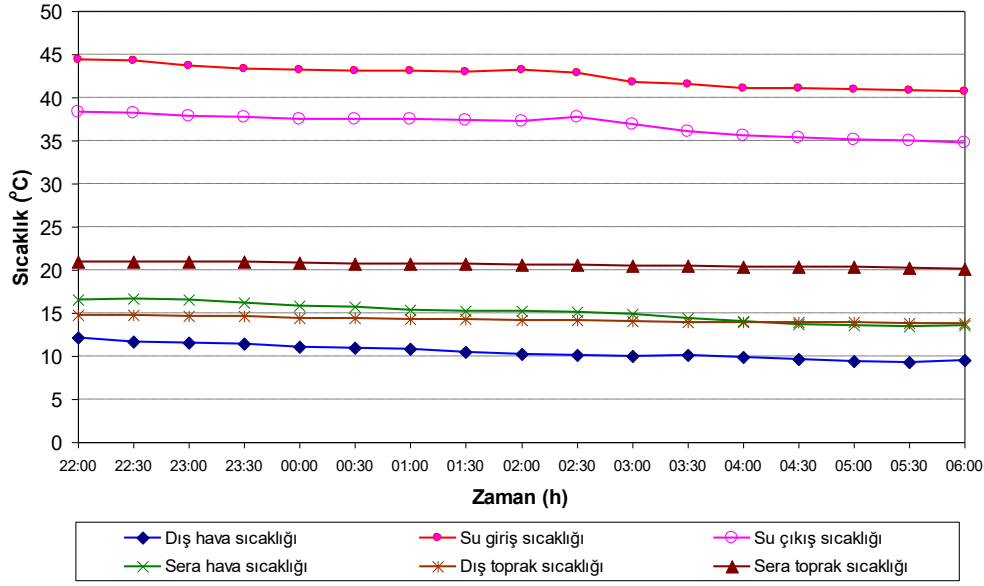


Şekil 6. Su ile ısı depolama yapılan dönemde gündüz sürelerinde sıcaklık değişimi

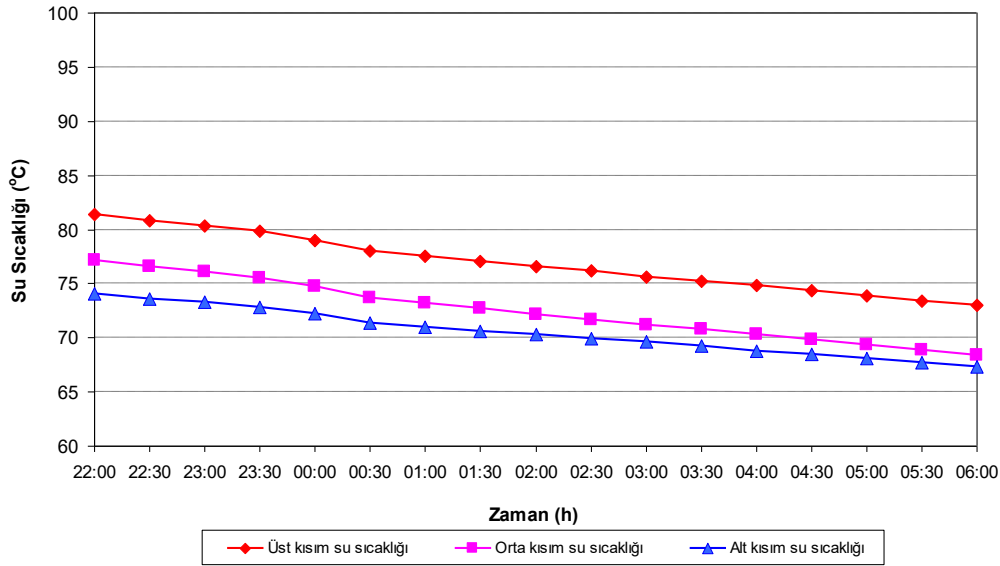
Gece Dönemi Sıcaklık Değişimi

Su ile ısıtma yapılan dönemde (1-31 Mart 2020), ısı depolama ünitesinden ısı geri kazanılarak serada sıcak su ile ısıtma yapılan gece sürelerinde (22:⁰⁰-06:⁰⁰) hava, toprak ve su sıcaklıklarının değişimi Şekil 7’de verilmiştir. Isı depolama ünitesinde depolanan ısı enerjisi ile ısınarak seraya giren suyun sıcaklığı 40,77-44,45 °C aralığında değişmiştir. Sera iç ortamındaki ısıtma borularında dolaşarak taşıdığı ısı enerjisini sera ortamındaki havaya aktararak, serada çıkan suyun sıcaklığı 34,79-38,25 °C aralığında değişmiştir. Serada sıcak su ile ısıtma yapılan gece sürelerinde (22:⁰⁰-06:⁰⁰), seraya giren ve seradan çıkan ortalama su sıcaklıkları sırasıyla, 42,49 °C ve 36,82 °C olarak belirlenmiştir. Seraya giren ve seradan çıkan su sıcaklıkları farkı, 6,1-4,89 °C aralığında değişmiş ve ortalama 5,66 °C olarak hesaplanmıştır.

Belirtilen dönemde, gece sürelerinde dış ortam hava sıcaklığı 9,28-12,13 °C aralığında, sera iç ortamındaki hava sıcaklığı ise 13,40-16,69 °C aralığında değişmiştir. Gece sürelerinde, belirtilen saatler (22:⁰⁰-06:⁰⁰) arasındaki süreçte hava sıcaklığı ortalaması dış ortamda 10,50 °C, sera iç ortamında ise 15,06 °C olarak belirlenmiştir. Su ile ısıtma yapılan sera ortamı ile dış ortam arasındaki hava sıcaklığı farkı 4,07-4,97 °C aralığında değişmiş ve ortalama 4,56 °C olarak hesaplanmıştır. Su ile ısıtma yapılan gece sürelerinde toprak sıcaklığı, dış ortamda 13,75-14,81 °C aralığında, sera iç ortamındaki ise 20,15-21,00 °C aralığında değişmiştir. Gece sürelerinde, belirtilen saatler (22:⁰⁰-06:⁰⁰) arasındaki süreçte toprak sıcaklığı ortalaması dış ortamda 14,22 °C, sera iç ortamında ise 20,60 °C olarak belirlenmiştir. Sera ısıtma yapılan gece sürelerinde belirtilen saatler (22:⁰⁰-06:⁰⁰) arasındaki süreçte, Isı depolama ünitesinin, üst, orta ve alt kısımlardaki su sıcaklıkları sırasıyla, 72,99-81,35 °C, 68,37-77,12 °C ve 67,37-74,03 °C aralıklarında değişmiştir (Şekil 8). Isı depolama ünitesinin, üst, orta ve alt kısımlardaki ortalama su sıcaklıkları sırasıyla, 76,89 °C, 72,48 °C ve 70,50 °C olarak belirlenmiştir.



Şekil 7. Su ile ısıtma yapılan dönemde gece sürelerinde sıcaklık değişimi



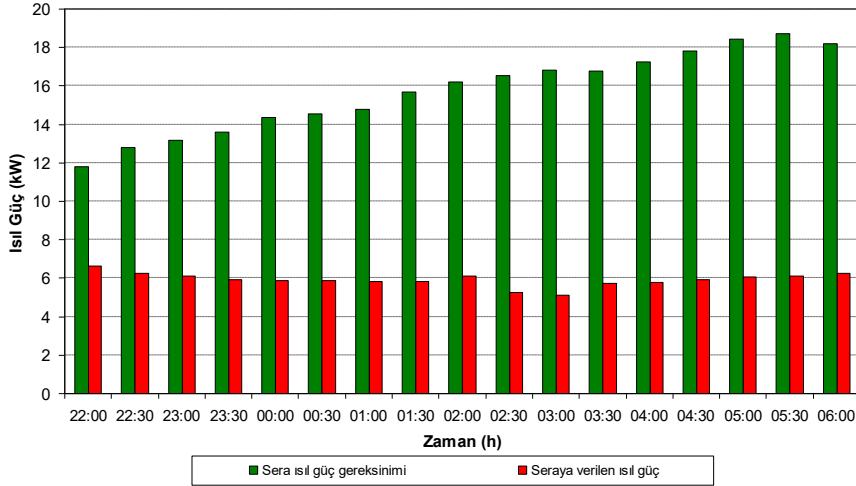
Şekil 8. Isı depolama ünitesinde gece sürelerinde su sıcaklıklarının değişimi

Gece Dönemi Isıl Güç ve Ekserji Değişimi

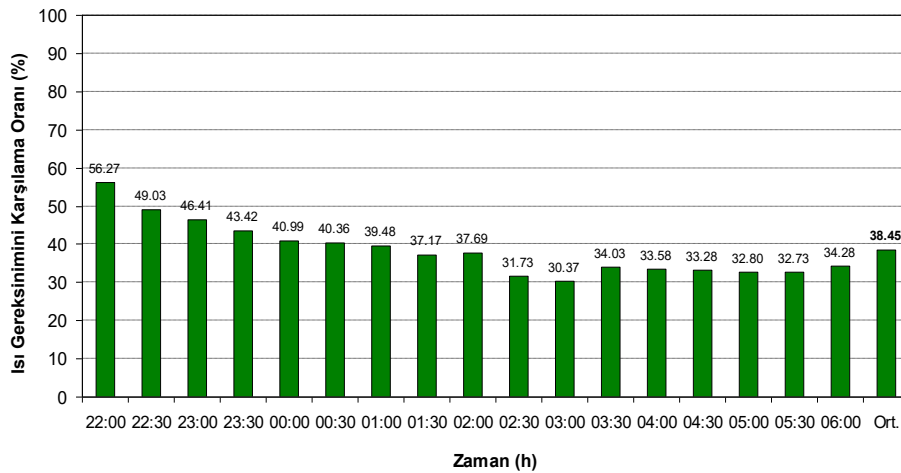
Su ile ısıtma yapılan dönemde (1-31 Mart 2020), ısı depolama ünitesinden ısı geri kazanılarak serada sıcak su ile ısıtma yapılan gece sürelerinde (22:00-06:00) sera ısıl güç gereksinimi ve seraya verilen ısıl güç değerlerinin değişimi Şekil 9'da verilmiştir. Su ile ısıtma yapılan gece dönemlerinde sera ısıl güç gereksinimi 11,79-18,70 kW aralığında değişmiştir. Isı depolama ünitesinden gelen sıcak suyun, sera iç ortamındaki ısıtma borularında dolaştırılarak seraya verilen ısıl güç 5,71-6,63 kW aralığında değişmiştir. Serada sıcak su ile ısıtma yapılan gece sürelerinde (22:00-06:00) sera ısıl güç gereksinimi ve seraya verilen ısıl güç ortalaması sırasıyla, 15,74 kW ve 5,92 kW olarak belirlenmiştir. Sıcak su ile ısıtma uygulamasının sera ısıl güç gereksinimini karşılama oranı % 30,37-56,27 aralığında değişmiş ve ortalama % 38,4 olarak



hesaplanmıştır (Şekil 10). Bu dönemde, gündüz sürelerinde güneş ışınım enerjisini vakum borulu toplaçlar ile ısı enerjisine dönüştürüp, ısı depolama ünitesindeki suya aktararak ısı depolama ve güce sürelerinde ısı depolama ünitesi ile sera ortamı arasında sıcak su dolaşımı ile sera ortam havasına ısı güç aktarılması sonucunda, ısı gereksiniminin ortalama % 38,4'ü karşılanabilmiştir.

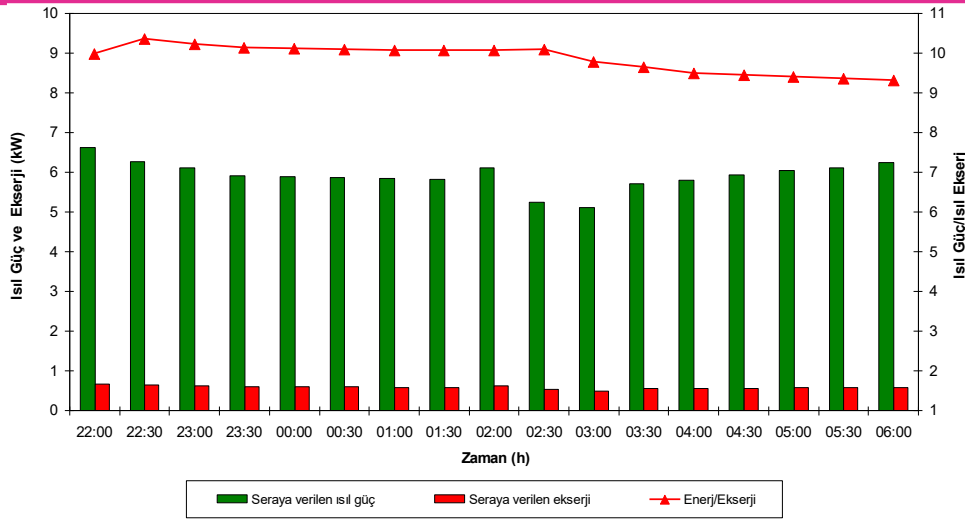


Şekil 9. Su ile ısıtma yapılan dönemde gece sürelerinde ısı güç değişimi



Şekil 10. Sıcak su ile ısıtma uygulamasının sera ısı güç gereksinimini karşılama oranı

Isı depolama ünitesinden ısı geri kazanılarak serada sıcak su ile ısıtma yapılan gece sürelerinde (22:00–06:00) seraya verilen ısı güç ve ekserji değerlerinin değişimi Şekil 11’de verilmiştir. Sera ortamında sıcak su dolaşımı sonucunda, sera ortam havasına aktarılan ısı güç 5,71–6,63 kW aralığında değişmesine karşın, sera ortam havasına aktarılan ısı ekserji miktarı 0,55–0,66 kW aralığında değişmiştir. Serada sıcak su ile ısıtma yapılan gece sürelerinde (22:00–06:00) seraya verilen ısı güç ve ekserji ortalaması sırasıyla, 5,92 kW ve 0,58 kW olarak hesaplanmıştır. Seraya verilen ısı güç/ekserji oranı 9,31–10,36 aralığında değişmiş ve ortalama 9,86 olarak belirlenmiştir. Bu durumda, su ile ısıtılan dönemde gece sürelerinde, ısıtma akışkanı olarak kullanılan sıcak su ile sera ortam havasına aktarılan ısı gücün ortalama 9,86’da biri oranında daha az ısı ekserji aktarılabilmektedir.



Şekil 11. Serada sıcak su ile ısıtma yapılan gece sürelerinde seraya verilen ısı güç ve eksjerji değerlerinin değişimi

Yakıt ve Enerji Tasarrufu

Su ile ısıtma yapılan dönemde (1-31 Mart 2020), ısı depolama ünitesinden ısı geri kazanılarak serada sıcak su ile ısıtma yapılan gece sürelerinde (22.⁰⁰-06.⁰⁰), ısıtma yapılan toplam 8 saatlik süre için, günlük toplam ısı enerjisi gereksinimi ve bu gereksinimi karşılamak için kullanılması gereken doğal gaz ve kömür miktarları Tablo 5’de verilmiştir. Su ile ısıtma yapılan dönemde, günlük toplam 8 saatlik süre için toplam ısı enerjisi gereksinimi 125 kWh olarak belirlenmiştir. Belirlenen bu ısı enerjisi gereksiniminin doğal gaz veya kömür kullanılarak karşılanması için sırasıyla, 13,19 kg doğal gaz veya 29,30 kg kömür gerektiği hesaplanmıştır.

Tablo 5. Su ile ısıtma yapılan dönemde sera için ısı enerjisi ve yakıt gereksinimi

Sera Isıtma Yöntemi	Günlük Enerjisi (kWh)	Toplam Isı Gereksinimi	Günlük Doğal Gereksinimi (kg)	Toplam Gaz	Günlük Kömür Gereksinimi (kg)	Toplam	
A) Isıtmasız	15,738 kW × 8 h =	125,90 kWh	(125,90 kWh / 0,9 =	139,88 kWh / 10,6 kWh/kg)=	13,19 kg	209,83 kWh / 7,16 kWh/kg =	29,30 kg

Su ile ısıtma yapılan dönemde, doğal gaz veya kömür kullanımından yapılacak olan günlük toplam enerji ve yakıt tasarrufu değerleri Tablo 6’da verilmiştir. Bu dönemde, toplam 8 saatlik ısıtma süresinde 47,37 kWh ısı enerjisi, gündüz döneminde vakum borulu toplaçlar aracılığı ile güneş enerjiden ısı kazanılarak ısı depolanan ısı depolama ünitesinden su dolaşımı ile ısı geri kazanılarak sera ortam havasına aktarılmıştır. Günlük toplam 8 saatlik ısı geri kazanma süresinde, ısı depolama ünitesinden sera ortam havasına aktarılan ısı enerjisinin (47,37 kWh), yakıt olarak doğal gaz veya kömür kullanılması durumundaki karşılıkları, sırasıyla 4,9 kg doğal gaz veya 11,02 kg kömür olarak hesaplanmıştır. Diğer bir deyişle, serada sıcak su ile ısıtma yapılmaması idi, 4,9 kg daha fazla doğal gaz veya 11,02 kg daha fazla kömür kullanılması gerekecek idi. Bu durumda, serada ısıtma yapılmaması durumundaki Tablo 5’de verilen toplam ısı enerjisi ve yakıt gereksinimi değerleri dikkate alınarak, tasarruf oranları; su kullanılarak ısı depolama uygulanıp ısı geri kazanması, yakıt olarak doğal gaz veya kömür kullanılması durumunda % 37,6 olarak belirlenmiştir.



Tablo 6. Su ile ısıtma yapılan dönemde günlük toplam enerji ve yakıt tasarrufu

Sera Isıtma Yöntemi	Günlük Toplam Isı Enerjisi (kWh)	Günlük Toplam Doğal Gaz Karşılığı (kg)	Günlük Toplam Kömür Karşılığı (kg)
B) Su ısıtılmalı	$5,922 \text{ kW} \times 8 \text{ h} = 47,37 \text{ kWh}$	$(47,37 \text{ kWh} / 0,9 = 52,63 \text{ kWh} / 10,6 \text{ kWh/kg}) = 4,96 \text{ kg}$	$47,37 \text{ kWh} / 0,6 = 78,95 \text{ kWh} / 7,16 \text{ kWh/kg} = 11,02 \text{ kg}$
C) Tasarruf oranı (%) (B \times 100) / A	$(47,37 \text{ kWh} \times 100) / 125,90 \text{ kWh} = \% 37,6$	$(4,36 \text{ kg} \times 100) / 13,19 \text{ kg} = \% 37,6$	$(11,02 \text{ kg} \times 100) / 29,30 \text{ kg} = \% 37,6$

Karbondioksit Emisyonu Tasarrufu

Su ile ısıtma yapılan dönemde (1-31 Mart 2020), ısı depolama ünitesinden ısı geri kazanılarak serada sıcak su ile ısıtma yapılan gece sürelerinde (22.⁰⁰-06.⁰⁰), ısıtma yapılan toplam 8 saatlik süre için, günlük toplam CO₂-eş emisyonu ve emisyon tasarrufu oranları Tablo 7’de verilmiştir. Serada ısı enerjisi gereksiniminin tamamının doğal gaz veya kömür kullanılarak karşılanması durumunda bir günlük ısıtma sunucunda, sırasıyla 33,15 kgCO₂-eş veya 80,79 kgCO₂-eş emisyonu gerçekleşecektir. Gündüzden-geceye güneş enerjisi depolayarak sıcak su ile sera ısıtma yapılması durumunda, doğal gaz veya kömür ile yapılan ısıtma ile karşılaştırıldığında, sırasıyla 20,68 kgCO₂-eş veya 50,40 kgCO₂-eş emisyon tasarrufu sağlanacaktır. Bu durumda, serada ısıtma yapılmaması ve güneş enerjisi depolanarak su ile ısıtma durumundaki Tablo 7’de verilen emisyon değerleri dikkate alınarak, yakıt olarak doğal gaz veya kömür kullanılması durumlarına kıyasla emisyon tasarruf oranları; % 37,6 olarak belirlenmiştir.

Tablo 7. Su ile ısıtma yapılan dönemde günlük toplam emisyon tasarrufu

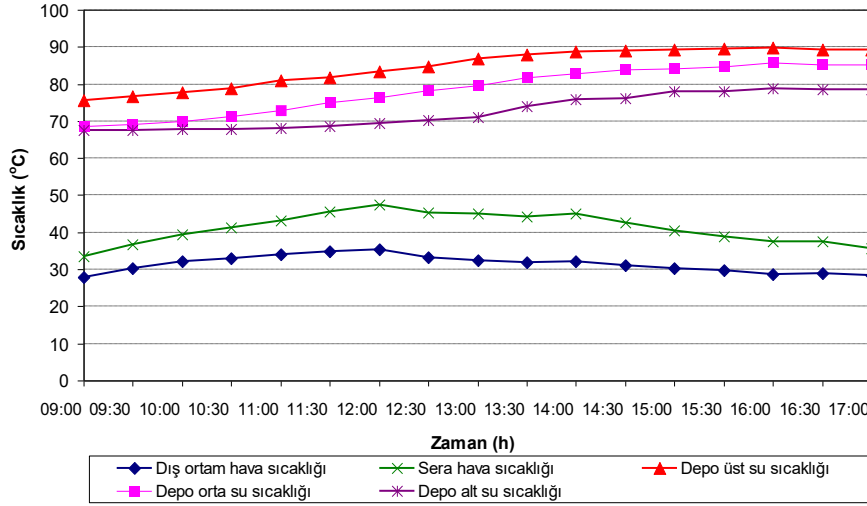
Sera Isıtma Yöntemi	Doğal Gaz Kullanımında Günlük Toplam CO ₂ -eş Emisyonu (kg CO ₂ -eş/gün)	Kömür Kullanımında Günlük Toplam CO ₂ -eş Emisyonu (kg CO ₂ -eş/gün)
D) Isıtmasız	$125,90 \text{ kWh} / 0,9 = 139,88 \text{ kWh} \times 0,237 \text{ kgCO}_2\text{-eş/kWh} = 33,15 \text{ kgCO}_2\text{-eş/gün}$	$125,90 \text{ kWh} / 0,6 = 209,83 \text{ kWh} \times 0,385 \text{ kgCO}_2\text{-eş/kWh} = 80,79 \text{ kgCO}_2\text{-eş/gün}$
E) Su ısıtılmalı	$47,37 \text{ kWh} / 0,9 = 52,63 \text{ kWh} \times 0,237 \text{ kgCO}_2\text{-eş/kWh} = 12,47 \text{ kgCO}_2\text{-eş/gün}$	$47,37 \text{ kWh} / 0,6 = 78,95 \times 0,385 \text{ kgCO}_2\text{-eş/kWh} = 30,39 \text{ kgCO}_2\text{-eş/gün}$
F) Emisyon tasarrufu (D-E)	$33,15 \text{ kgCO}_2\text{-eş/gün} - 12,47 \text{ kgCO}_2\text{-eş/gün} = 20,68 \text{ kgCO}_2\text{-eş/gün}$	$80,79 \text{ kgCO}_2\text{-eş/gün} - 30,39 \text{ kgCO}_2\text{-eş/gün} = 50,40 \text{ kgCO}_2\text{-eş/gün}$
G) Emisyon tasarruf oranı (%) (F \times 100) / D	$(12,47 \text{ kgCO}_2\text{-eş/gün} \times 100) / 33,15 \text{ kgCO}_2\text{-eş/gün} = \% 37,6$	$(30,39 \text{ kgCO}_2\text{-eş/gün} \times 100) / 80,79 \text{ kgCO}_2\text{-eş/gün} = \% 37,6$

Nanoakışkan İle Isıtma Yapılan Dönem Gündüz Dönemi Sıcaklık Değişimi

Nanoakışkan ile ısıtma yapılan dönemde (21 Nisan-9 Mayıs 2020), güneş enerjisinden vakum borulu topaclar aracılığı ile ısı enerjisi kazanılarak, ısı depolama ünitesinde ısı depolama yapılan gündüz sürelerinde (09:⁰⁰-17:⁰⁰) hava ve su sıcaklıklarının değişimi Şekil 12’de verilmiştir. Belirtilen dönemde, gündüz sürelerinde dış ortam hava sıcaklığı 27,82-35,47 °C aralığında, sera iç ortamındaki hava sıcaklığı ise 33,39-47,56 °C aralığında değişmiştir. Gündüz sürelerinde, belirtilen saatler (09:⁰⁰-17:⁰⁰) arasındaki süreçte hava sıcaklığı ortalaması dış



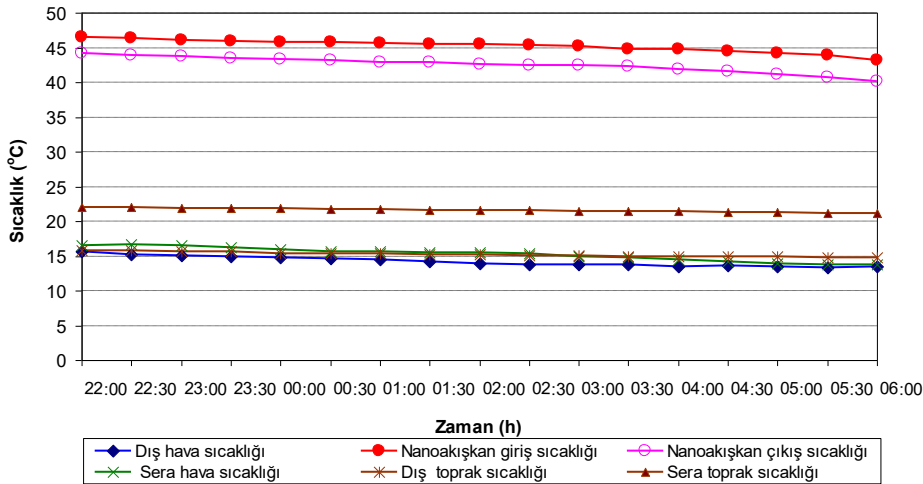
ortamda 31,44 °C, iç ortamda ise 41,45 °C olarak belirlenmiştir. Isı depolama ünitesinin, üst, orta ve alt kısımlardaki su sıcaklıkları sırasıyla, 75,57–89,79 °C, 68,56–85,86 °C ve 67,57–78,70 °C aralıklarında değişmiştir. Gündüz sürelerinde belirtilen saatler (09:00–17:00) arasındaki süreçte, ısı depolama ünitesinin, üst, orta ve alt kısımlardaki ortalama su sıcaklıkları sırasıyla, 84,68 °C, 78,55 °C ve 72,71 °C olarak belirlenmiştir.



Şekil 12. Nanoakışkan ile ısı depolama yapılan gündüz sürelerinde sıcaklık değişimi

Gece Dönemi Sıcaklık Değişimi

Su ile ısıtma yapılan dönemde (21 Nisan–9 Mayıs 2020), ısı depolama ünitesinden ısı geri kazanılarak serada nanoakışkan ile ısıtma yapılan gece sürelerinde (22:00–06:00) hava, toprak ve su sıcaklıklarının değişimi Şekil 13’de verilmiştir. Isı depolama ünitesinde depolanan ısı enerjisi ile ısınarak seraya giren nanoakışkan sıcaklığı 43,25–46,55 °C aralığında değişmiştir. Sera iç ortamındaki ısıtma borularında dolaşarak taşıdığı ısı enerjisini sera ortamındaki havaya aktararak, seradan çıkan nanoakışkanın sıcaklığı 40,19–44,15 °C aralığında değişmiştir. Serada nanoakışkan ile ısıtma yapılan gece sürelerinde (22:00–06:00) seraya giren ve seradan çıkan ortalama nanoakışkan sıcaklıkları sırasıyla, 45,25 °C ve 42,52 °C olarak belirlenmiştir. Seraya giren ve seradan çıkan nanoakışkan sıcaklıkları farkı, 2,40–3,10 °C aralığında değişmiş ve ortalama 2,73 °C olarak hesaplanmıştır.



Şekil 13. Nanoakışkan ile ısıtma yapılan dönemde gece sürelerinde sıcaklık değişimi

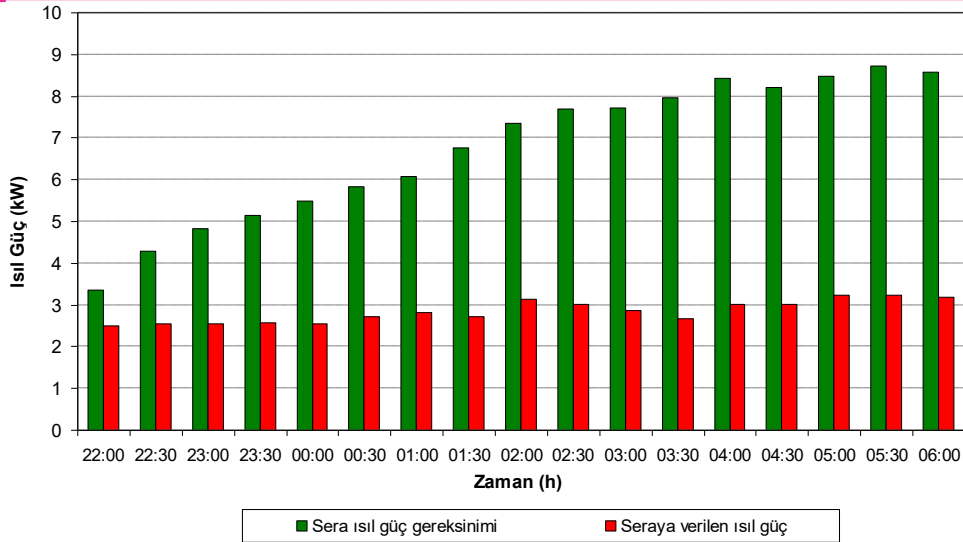


Belirtilen dönemde, gece sürelerinde dış ortam hava sıcaklığı 13,39–15,61 °C aralığında, sera iç ortamındaki hava sıcaklığı ise 13,75–16,69 °C aralığında değişmiştir. Gece sürelerinde, belirtilen saatler (22:00–06:00) arasındaki süreçte hava sıcaklığı ortalaması dış ortamda 14,21 °C, sera iç ortamında ise 15,26 °C olarak belirlenmiştir. Nanoakışkan ile ısıtma yapılan sera ortamı ile dış ortam arasındaki hava sıcaklığı farkı 0,30–1,56 °C aralığında değişmiş ve ortalama 1,06 °C olarak hesaplanmıştır. Nanoakışkan ile ısıtma yapılan gece sürelerinde toprak sıcaklığı dış ortamda 14,75–15,81 °C aralığında, sera iç ortamındaki ise 21,15–20,00 °C aralığında değişmiştir. Gece sürelerinde, belirtilen saatler (22:00–06:00) arasındaki süreçte toprak sıcaklığı ortalaması dış ortamda 15,22 °C, sera iç ortamında ise 21,60 °C olarak belirlenmiştir. Sera ısıtma yapılan gece sürelerinde belirtilen saatler (22:00–06:00) arasındaki süreçte, Isı depolama ünitesinin, üst, orta ve alt kısımlardaki su sıcaklıkları sırasıyla, 73,99–82,35 °C, 69,37–78,12 °C ve 68,37–75,03 °C aralıklarında değişmiştir. Isı depolama ünitesinin, üst, orta ve alt kısımlardaki ortalama su sıcaklıkları sırasıyla, 77,89 °C, 73,48 °C ve 71,50 °C olarak belirlenmiştir.

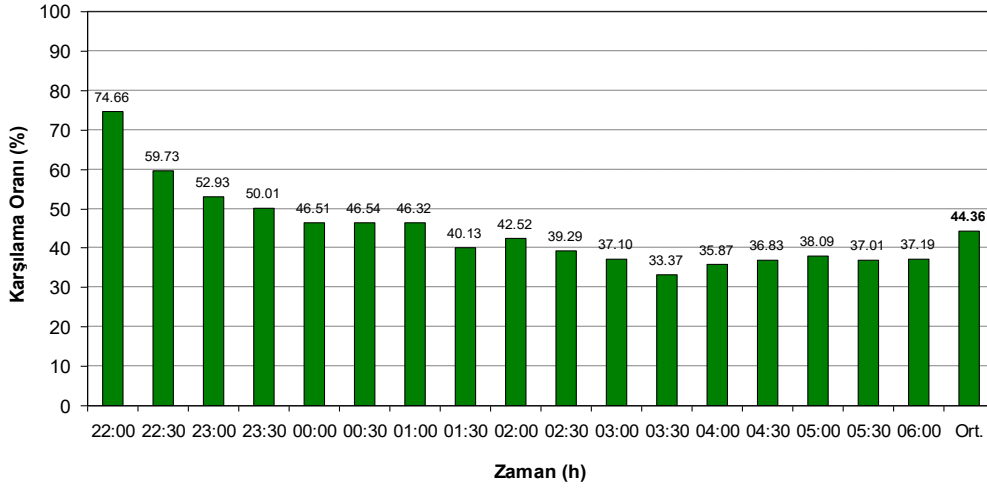
Gece Dönemi Isıl Güç ve Ekserji Değişimi

Nanoakışkan ile ısıtma yapılan dönemde (21 Nisan–9 Mayıs 2020), ısı depolama ünitesinden ısı geri kazanılarak serada nanoakışkan ile ısıtma yapılan gece sürelerinde (22:00–06:00) sera ısı güç gereksinimi ve seraya verilen ısı güç değerlerinin değişimi Şekil 13’de verilmiştir. Nanoakışkan ile ısıtma yapılan gece dönemlerinde sera ısı güç gereksinimi 3,35–8,74 kW aralığında değişmiştir. Isı depolama ünitesinden gelen sıcak nanoakışkanın, sera iç ortamındaki ısıtma borularında dolaştırılarak seraya verilen ısı güç 2,50–3,23 kW aralığında değişmiştir. Serada nanoakışkan ile ısıtma yapılan gece sürelerinde (22:00–06:00) sera ısı güç gereksinimi ve seraya verilen ısı güç ortalaması sırasıyla, 6,76 kW ve 2,85 kW olarak belirlenmiştir. Nanoakışkan su ile ısıtma uygulamasının sera ısı güç gereksinimini karşılama oranı % 33,37–74,66 aralığında değişmiş ve ortalama % 44,36 olarak hesaplanmıştır (Şekil 14). Bu dönemde, gündüz sürelerinde güneş ışınım enerjisini vakum borulu toplaçlar ile ısı enerjisine dönüştürüp, ısı depolama ünitesindeki suya aktararak ısı depolama ve güce sürelerinde ısı depolama ünitesi ile sera ortamı arasında sıcak su dolaşımı ile sera ortam havasına ısı güç aktarılması sonucunda, ısı gereksiniminin ortalama % 44,36’sı karşılanabilmiştir. Sera ortamında sıcak nanoakışkan dolaşımı sonucunda, sera ortam havasına aktarılan ısı güç 2,50–3,23kW aralığında değişmesine karşın, sera ortam havasına aktarılan ısı ekserji miktarı 0,28–0,33 kW aralığında değişmiştir.

Serada sıcak nanoakışkan ile ısıtma yapılan gece sürelerinde (22:00–06:00) seraya verilen ısı güç ve ekserji ortalaması sırasıyla, 2,85 kW ve 0,30 kW olarak hesaplanmıştır. Seraya verilen ısı güç/ekserji oranı 10,08–11,10 aralığında değişmiş ve ortalama 10,69 olarak belirlenmiştir. Bu durumda, nanoakışkan ile ısıtılan dönemde gece sürelerinde, ısıtma akışkanı olarak kullanılan nanoakışkan ile sera ortam havasına aktarılan ısı gücün ortalama 10,69’da biri oranında daha az ısı ekserji aktarılabilmiştir.



Şekil 13. Nanoakışkan ile ısıtma yapılan dönemde gece sürelerinde ısıtma gücü değişimi



Şekil 14. Nanoakışkan ile ısıtma uygulamasının sera ısıtma gücü gereksinimini karşılama oranı

Yakıt ve Enerji Tasarrufu

Nanoakışkan ile ısıtma yapılan dönemde (21 Nisan–9 Mayıs 2020), ısı depolama ünitesinden ısı geri kazanılarak serada sıcak nanoakışkan ile ısıtma yapılan gece sürelerinde (22:00–06:00), ısıtma yapılan toplam 8 saatlik süre için, günlük toplam ısı enerjisi gereksinimi ve bu gereksinimi karşılamak için kullanılması gereken doğal gaz ve kömür miktarları Tablo 8’de verilmiştir.

Tablo 8. Nanoakışkan ile ısıtma yapılan dönemde ısı enerjisi ve yakıt gereksinimi

Sera Isıtma Yöntemi	Günlük Enerjisi (kWh)	Toplam Isı Gereksinimi	Günlük Toplam Doğal Gaz Gereksinimi (kg)	Günlük Kömür Gereksinimi (kg)	Toplam Gereksinimi
A) Isıtmasız	54,08 kWh		(54,08 kWh / 0,9 = 60,1 kWh / 10,6 kWh/kg) = 5,66 kg	54,08 kWh / 0,6 = 90,13 / 7,16 kWh/kg = 12,58 kg	

Nanoakışkan ile ısıtma yapılan dönemde, günlük toplam 8 saatlik süre için toplam ısı enerjisi gereksinimi 54,08 kWh olarak belirlenmiştir. Belirlenen bu ısı enerjisi gereksiniminin doğal



gaz veya kömür kullanılarak karşılanması için sırasıyla, 5,66 kg doğal gaz veya 12,58 kg kömür gerektiği hesaplanmıştır.

Nanoakışkan ile ısıtma yapılan dönemde, doğal gaz veya kömür kullanımından yapılacak olan günlük toplam enerji ve yakıt tasarrufu değerleri Tablo 9'da verilmiştir. Bu dönemde, toplam 8 saatlik ısıtma süresinde 22,8 kWh ısı enerjisi, gündüz döneminde vakum borulu toplaçlar aracılığı ile güneş enerjiden ısı kazanılarak ısı depolanan ısı depolama ünitesinden, nanoakışkan dolaşımı ile ısı geri kazanılarak sera ortam havasına aktarılmıştır. Günlük toplam 8 saatlik ısı geri kazanma süresinde, ısı depolama ünitesinden sera ortam havasına aktarılan ısı enerjisinin (22,8 kWh), yakıt olarak doğal gaz veya kömür kullanılması durumundaki karşılıkları, sırasıyla 4,9 kg doğal gaz veya 11,02 kg kömür olarak hesaplanmıştır. Diğer bir deyişle, serada sıcak su ile ısıtma yapılmaması idi, 2,38 kg daha fazla doğal gaz veya 5,30 kg daha fazla kömür kullanılması gerekecek idi. Bu durumda, serada ısıtma yapılmaması durumundaki Tablo 9'de verilen toplam ısı enerjisi ve yakıt gereksinimi değerleri dikkate alınarak, tasarruf oranları; su kullanılarak ısı depolama uygulanıp ısı geri kazanması, yakıt olarak doğal gaz veya kömür kullanılması durumunda % 42 olarak belirlenmiştir.

Tablo 9. Nanoakışkan ile ısıtma yapılan dönemde enerji ve yakıt tasarrufu

Sera Isıtma Yöntemi	Günlük Toplam Enerjisi (kWh)	Toplam Isı Kazanımı	Günlük Toplam Doğal Gaz Karşılığı (kg)	Günlük Toplam Kömür Karşılığı (kg)
B) Nano akışkan ısıtmalı	$2,85 \text{ kW} \times 8 \text{ h} = 22,8 \text{ kWh}$		$22,8 \text{ kWh} / 0,9 = 25,33 \text{ kWh} / 10,6 \text{ kWh/kg} = 2,38 \text{ kg}$	$22,8 \text{ kWh} / 0,6 = 38 \text{ kWh} / 7,16 \text{ kWh/kg} = 5,30 \text{ kg}$
C) Tasarruf oranı (%) (B×100)/A	$(22,8 \text{ kWh} \times 100) / 54,08 \text{ kWh} = \% 42$		$(2,38 \text{ kg} \times 100) / 4,66 \text{ kg} = \% 42$	$(5,3 \text{ kg} \times 100) / 12,58 \text{ kg} = \% 42$

Karbondiyoksit Emisyonu Tasarrufu

Nanoakışkan ile ısıtma yapılan dönemde (1-31 Mart 2020), ısı depolama ünitesinden ısı geri kazanılarak serada sıcak nanoakışkan ile ısıtma yapılan gece sürelerinde (22:00–06:00), ısıtma yapılan toplam 8 saatlik süre için, günlük toplam CO₂-eş emisyonu ve emisyon tasarrufu oranları Tablo 20'de verilmiştir hesaplanmıştır.

Serada ısı enerjisi gereksiniminin tamamının doğal gaz veya kömür kullanılarak karşılanması durumunda bir günlük ısıtma sunucunda, sırasıyla 14,24 kgCO₂-eş veya 34,68 kgCO₂-eş emisyonu gerçekleşecektir. Gündüzden-geceye güneş enerjisi depolayarak sıcak nanoakışkan ile sera ısıtma yapılması durumunda, doğal gaz veya kömür ile yapılan ısıtma ile karşılaştırıldığında, sırasıyla 8,25 kgCO₂-eş veya 20,05 kgCO₂-eş emisyon tasarrufu sağlanacaktır. Bu durumda, serada ısıtma yapılmaması ve güneş enerjisi depolanarak nanoakışkan ile ısıtma durumundaki Tablo 20'de verilen emisyon değerleri dikkate alınarak, yakıt olarak doğal gaz veya kömür kullanılması durumlarına kıyasla emisyon tasarruf oranları; % 42 olarak belirlenmiştir.

SONUÇ VE ÖNERİLER

Sonuçlar

Güneş ışınım enerjisini vakum borulu toplaçlar ile ısı enerjisine dönüştürerek, duyulur ısı depolama materyali olarak su kullanılan bir ısı depolama ünitesinde gündüzden-geceye kısa süreli ısı depolayarak, gece dönemlerinde su dolaşımı ile plastik ısıtma boruları aracılığı ile sera ortam havasına ısı geri kazanılan sistemden belirlenen başlıca sonuçlar şunlardır:



- Isıtma akışkanı olarak sıcak su kullanılması durumunda, ısıtma yapılan gece dönemlerindeki belirtilen sürelerde, sera ısı gereksiniminin karşılanma oranı ortalama % 38,45, sıcak nanokışkan kullanılan dönemde ortalama % 44,36 olarak belirlenmiştir.
- Isıtma akışkanı olarak sıcak su kullanılması durumunda, ısıtma yapılan gece dönemlerindeki belirtilen sürelerde, ısı gücü/ekserji oranı ortalama % 9,86 iken, sıcak nanokışkan kullanılan dönemde ortalama % 10,69 olarak belirlenmiştir.
- Isıtma akışkanı olarak sıcak su kullanılması durumunda, hıyar verimi ısıtılmayan seraya kıyasla, 393 kg (% 34,2 oranında) daha yüksek olarak gerçekleşmiştir.
- Sera ısıtmak için günlük toplam enerji, yakıt ve emisyon tasarrufu; su ile ısıtma yapılan dönemde, % 37,6 olarak belirlenirken, nanoakışkan ile ısıtma yapılan dönemde % 42 olarak belirlenmiştir. Bu durum nanoakışkan ile ısı geri kazma etkinliğinin daha yüksek olmasından kaynaklanmaktadır.
- Su ile ısıtma durumunda, doğal gaz tasarrufuna ilişkin geri ödeme süresi 5,84 yıl, kömür tasarrufuna ilişkin geri ödeme süresi 4,47 yıl olarak hesaplanmıştır.

Öneriler

Güneş enerjili aktif ısıtma sistemlerinde, seradan bağımsız durumda tasarılan ısı toplama ve depolama ünitelerinden yararlanır. Sera örtüsüyle güneş ışınımından kazanılan ısı enerjisiyle birlikte, aktif ısıtma sistemindeki ısı toplama ünitesiyle toplanılan ısı enerjisi uygun şekilde depolanarak, ısı gereksiniminin önemli bir bölümü karşılanabilir. Bununla birlikte, bu sistemlerdeki özellikle ısı toplama ünitelerinin fazla alan kaplaması, ilk yatırım ve daha sonraki işletme giderlerinin yüksek olması, bu sistemlerin ekonomik uygulanabilirliğini önemli ölçüde kısıtlamaktadır. Son yıllarda, güneş enerjili aktif ısıtma sistemlerine ilişkin araştırma ve geliştirme çalışmalarıyla, uygulamada karşılaşılan bu tür sorunların giderilmesine yönelik belirli teknik çözümler sağlanmıştır.

Isı toplama ünitesi olarak kullanılan güneş toplaçları, sera dışına yerleştirilebildiği gibi, sera çatısına da yerleştirilebilir. Toplaçların sera çatısına yerleştirilmesi durumunda sera içerisine ulaşan güneş ışınımı önemli oranda azalır. Bu tip sistemlerde de pasif ısıtma sistemlerindeki gibi; su, çakıl-kırma taş veya tuğla, toprak ve faz değiştiren materyaller (PCM) gibi ısı depolama materyallerinden biri veya bir kaç tanesi birlikte kullanılabilir. Isı depolama ünitesinin boyutları; sera alanı, işletme sıcaklığı, ısı değiştirici tipi ve kullanılan ısı toplama ünitesinin boyutlarına bağlıdır.

Güneş enerjili aktif ısıtma sisteminde ısınan suyun sıcaklığı, seraya gönderilmek için gerekli su sıcaklığından (dağıtım sıcaklığından) daha yüksek olduğunda, sistemde ısınan su serayı ısıtmak için doğrudan kullanılabilir. Sistemde ısınan suyun sıcaklığı dağıtım sıcaklığından daha düşük olduğunda, su dağıtım sıcaklığına ulaşmaya kadar yardımcı ısıtma sistemiyle ısıtılır. Serada dolaşım sonucunda soğuyan suyun sıcaklığı toplaç sıcaklığından daha düşük olduğunda, su toplaçlar içerisinden dolaştırılır. Yardımcı ısıtma sistemi kullanılmaması durumunda, güneş enerjisiyle ısıtılan su serayı ön ısıtma veya sadece düşük sıcaklıklardan koruma amacıyla kullanılabilir. Sistemin çalışma sıcaklığının düşük olduğu bu durumda, güneş toplaçlarından daha yüksek oranda yararlanılabilir. Bu nedenle, yapılan araştırmalarda uygulanan sistemlerin sera ısı gereksinimlerini karşılama oranlarının belirtilmesi yerine, güneş enerjili sistem bulunmayan (kontrol) seraya oranla sıcaklık farkının belirtilmesi daha uygundur.

Güneş enerjili aktif ısıtma sistemleriyle sera ısı gereksiniminin önemli bir bölümü karşılanmakla birlikte, uygulamada bu sistemlerin kullanımında bazı sorunlarla karşılaşılmaktadır. Seraların güneş enerjili aktif sistemler ile ısıtılması konusunda yapılacak olan araştırma ve geliştirme çalışmalarının aşağıda belirtilen konulara yönlendirilmesi, bu sorunların giderilmesine katkı sağlayacaktır:



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- Isı toplama ünitesi olarak özellikle soğurucu yüzeyi cam malzeme ile örtülü toplaçların kullanılması durumunda, sistemin ilk yatırım maliyeti yüksektir. Maliyetin azaltılması için daha ucuz olan değişik tip plastik toplaçlardan yararlanılmakla birlikte, plastik toplaçlar kolay bir şekilde yıprandığından bakım giderleri yükselmektedir.
- Güneş toplaçlar sera dışına yerleştirildiğinde fazla alan kapladığından, sera iç ortamına veya çatısına yerleştirilmektedir. Toplaçların sera çatısına yerleştirilmesi durumunda, sera içerisine ulaşan güneş ışınımı önemli oranda azalır. Bu nedenle, fotosentez için etkin ışınımı (PAR) sera ortamına geçiren toplaçlardan yararlanılmalıdır.
- Güneş enerjili ısıtma sisteminin yardımcı ısıtma sistemiyle birlikte kullanılması durumunda, bazı teknik sorunlarla karşılaşılabilir. Yardımcı ısıtma sisteminin uygun olmaması durumunda, güneş enerjili sistemin yararlanılabilirliği önemli oranda azalır. Bu sorunun giderilmesi için, sistemde bir ısı pompasından yararlanılabilir.
- Yardımcı ısıtma sistemiyle birlikte, güneş enerjili ısıtma sistemlerinin önemli birer alt ünitesi olan, ısı toplama ve depolama ünitesi kapasitelerinin belirlenmesine ve sistemin etkin olarak çalışma ve kontrolüne gerekli önem verilmelidir.

Bilgi: Bu çalışma, birinci yazarın ikinci yazar danışmanlığında hazırladığı 2188 kod nolu “Su ve Nanoakışkan (Al2O3) Kullanılarak Depolanan Güneş Enerjisi ile Sera Isıtma Üzerine Bir Araştırma” başlıklı doktora tezinden üretilmiştir.



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EFFECT OF SOWING METHODS, SOWING DEPTH AND SOWING DISTANCES ON SOME CHARACTERISTICS OF GROWTH AND WHEAT YIELD

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ABSTRACT

The effect of sowing methods (SM), on the wheat (Iba'a 99) cultivar was observed based on some technical indicators, under two levels of sowing depth (SDE) and three sowing distances (SD). The experiments were conducted in a factorial experiment under complete randomized design with three replications. The sowing depth (SDE 6cm) was significantly better than (SDE 8cm) in all studied parameters. For sowing depth (SDE 6cm), the weight of 1000grains , number of grains in spike, dry weight of 100 plants, seedling emergence, one plant productivity and biological yield, were 49.09 g, 89.01 grain/spike, 0.997 g ,77.15%, and 3.859 tha-1 respectively. The sowing methods (SM-SGR) was significantly superior than sowing methods (SM-SRO) in all study properties .The sowing distances (SD -5cm) was significantly better than (SD-7 and 9cm) in all studied parameters. For sowing distances (SD- 5cm), the weight of 1000grains ,number of grains in spike, dry weight of 100 plants, seedling emergence, one plant productivity and biological yield, were 50.36 g, 89.86 grain/spike, 1.125 g ,77.78%, and 4.183 tha-1 respectively.

Keywords: Machines, wheat, sowing methods, sowing depth , sowing distances



INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop for the majority of world's populations. It is the most important staple food of about 32 million people in Iraq. Wheat production suffers from variability in yield from year to year and from location to location. Iraq decreased wheat production during 2018, recording a production of just over two million tons, down by about one million tons from the previous year, which reached 3 million tons reason for this is attributed to the no scientific use of cultivation and crop service operations . In 2010, Iraq launched a national project to develop wheat cultivation through programs implemented by the Ministry of Agriculture, relying on the production of seeds that are resistant to salinity and drought, with high productivity and disease resistance as well as process of introducing agricultural machinery and equipment into the agricultural sector is an important matter in order to improve production and take advantage of its capabilities and technical and economic characteristics (Al Sharifi ,2018) .

Shtewy and Al-Sharifi (2020) mentioned that there is a significant effect of planting depths, planting distances, and methods of cultivation on the productivity and growth characteristics of the wheat. The best results were obtained from the interaction among planting method (SMBGR), 4 cm depth and 8 cm planting distance of seeder in all growth properties for wheat crop . The crop characteristics are affected by all stages of its growth, from germination rate and productivity, by planting methods and mechanical handling of the soil Al-Sharifi et al.,(2019) . The fertilizer rate can be adjusted. Seed planting and fertilizing can be carried out separately but in one operation. Seeds can be planted safely without being burned by the fertilizer. The planting can be operated conveniently and easily can adapt to different sowing conditions including very dry conditions, it can help to save energy and improve water conservation, Alaamer and Al-Sharifi (2020). The effects of different tillage methods for maize on the some soil physical properties and yield were investigated. The results showed that tillage methods were significant at as regards crop yields, and the highest yields for wheat Al-Sharifi and Ameen (2018).

Shtewy et al., (2020a) the number of grains in spike, weight of 1000 grains, and grains yield, as explained by many researchers. There is a clear increase in vegetative growth and its components, The yield and the yield of grains per unit area, by addition Nitrogen fertilizer for the wheat crop. According to Shtewy et al, (2020b) the productivity of any crop is affected by many factors, including the type and size of seeds, climatic conditions and fertilizers, in addition to the soil physical properties and the planting depth. wheat production may be affected by factors including the use of low yielding varieties and poor-quality seed, poor disease and pest management, inadequate soil fertility.

The main goal of this research is to study the effect of planting methods, and planting distances, on some properties wheat yield.

MATERIALS and METHODS

This study was conducted in 2020 to evaluate the performance of the planting machine (type Famarol). The experiments were done at two levels of planting methods by going and return (SGR) and planting method of rotation oceanic (SRO), two planting depth at levels 6cm and 8cm, and three planting distances at levels of 5, 7and 9 cm taken soil moisture with 11cm depth, and the depth of the planting machine for determining the moisture content of the soil at 12-14%. The Famarol type machine was a planting speed of 2.432km hr⁻¹. The study was adopted in the Alhashemia area which determines by the directorate of the Babylon Department of Agriculture.



This study New Holland 66 S-80 tractor with a horsepower 80 hp was used with four cylinders with mold board plow on depth 0.20- 0.23 m to stir the soil and create a suitable place for seed growth .

Planting method

Planting method by going and return (SGR) ,The planting is done from the left toward the corresponding pillow than move to the right after lifting the planting unit and resume the planting process with back to the corresponding pillow, Figure (1).

Planting method by rotation oceanic (SRO)In this method, the field is planted from outer borders and rotation to the right until the remaining spot is planted in going and return as in first method .The advantage of this method is to reduce time and increase the productive efficiency of the planting machine as in Figure (2) Hamzah and Alsharifi(2020)

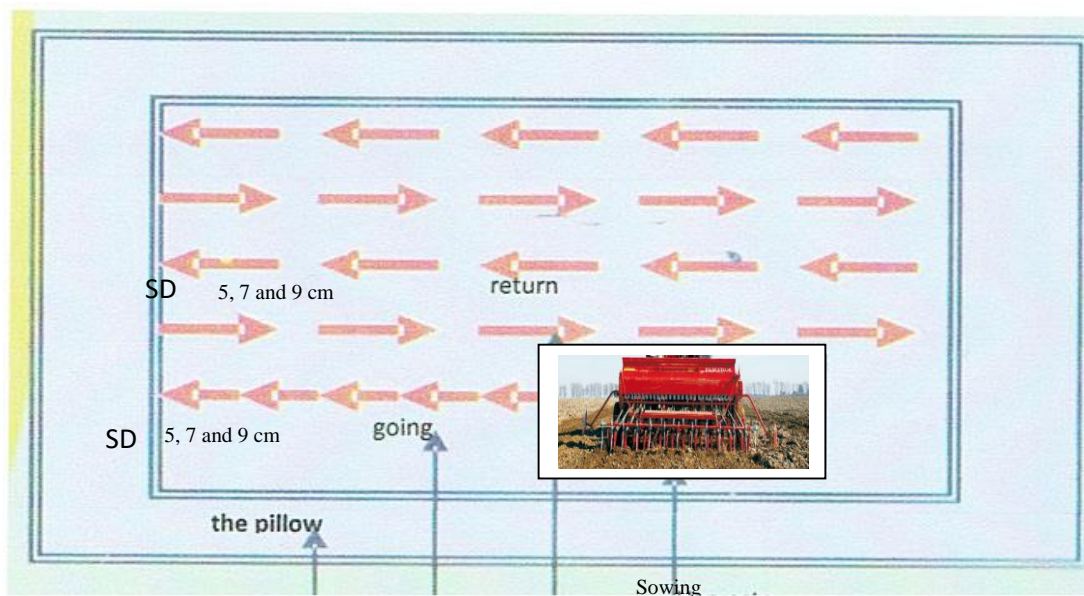


Fig. 1. Sowing method by going and return (SGR)

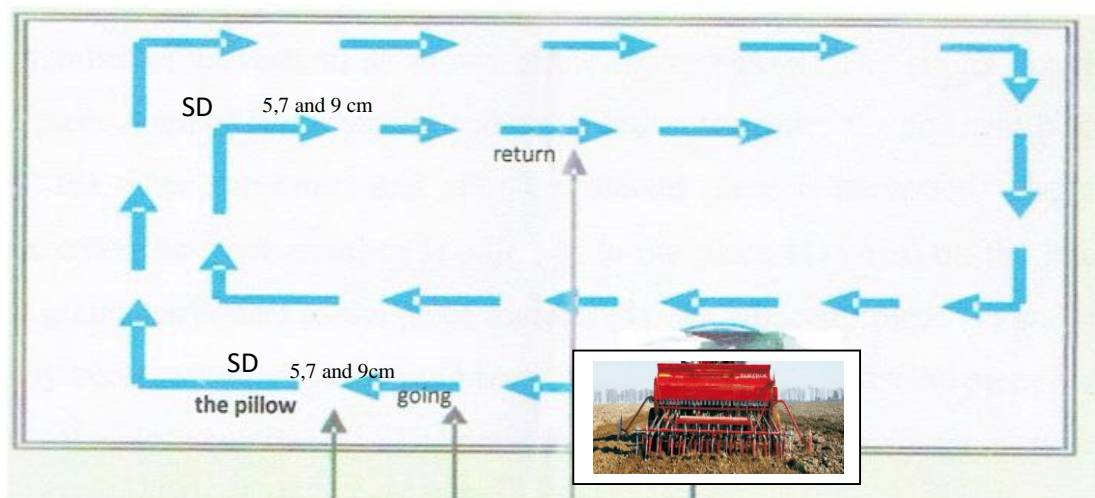


Fig. 2. Sowing method of rotation oceanic (SRO)



List of Abbreviations and Symbols

SGR	Sowing methods by going and return
SRO	Sowing method of rotation oceanic
SDE	Sowing depth
SD	Sowing distances
SS	Sowing speed
SM	Sowing methods
H	Hour
Ha	Hectare
Hp	Horse power
SMA	Sowing methods average
SDEA	Sowing depth average
SDA	Sowing distances average
LSD	Least square difference

Soil texture:

Soil separators were estimated by the pipette method mentioned in Al-Sharifi (2009). Table (I): Soil texture in the field of experiment.

Soil texture	Sand (gm.kg ⁻¹)	Silt (gm.kg ⁻¹)	Clay (gm.kg ⁻¹)
Silty caly	132	426	442

Table (II): Soil characteristics of the experiment field.

Soil moisture %	Sowing depth cm	Penetration resistance kN.m ⁻² (bulk density Mg.m ⁻³ (
12-14%	6	1627.24	1.32
	8	1873.41	1.34

1. The crop and its components:

1.1.Weight of 1000 grains

The samples random were taken for ten and calculated weight of the 1000 grains in one square meter in three replications (Al-Sharifi et al.,2020) .

1.2.Number of grains in spike

The samples random were taken for 25 plants and calculated number of grains in a spike in one square meter in three replications (Aleawi et al .,2020 and Al-Sharifi et al.,2021a)

1.3. Dry Weight of 100 Plants (Weight Recorded About seed 25 Days after Emergence) , 100 plants on two rows were harvested , then putting the seedlings in oven at 75°C as long as 48 hours . (Al-Sharifi et al.,2021b).

1.4. Seedling emergence

The seedling emergence percentage was measured about 15 days from emergence of plant .

1.5. One plant productivity

Productivity of one plant and it was calculated as follow: according of the method used by (Al-Sharifi and Ameen 2018) .



$$O_{P_P} = \frac{P_P}{P_T}$$

Where : O_{P_P} is productivity of von plant (g), P_P is plants productivity (g), P_T total of plants (10 plants each experimental unit) (g).

1.6. Biological yield

The samples random were taken for 25 plants in one square meter and calculate biological yield of the crop in three replications .

The results were analyzed statistically by using the randomized complete block design RCBD and the difference among treatments for each factor was tested according to the least significant difference L.S.D test (Oehlent ,2010) .

3. Results and discussion :

3.1. Weight of 1000 grains :

Figure 1 shows the effect of sowing methods, sowing depth and sowing distances, the results of the statistical analysis showed a significant effect for sowing methods (SM), on weight of 1000 grains and results were 49.21 and 47.71 g respectively for the SGR and SRO ,while sowing depth significantly affected the weight of 1000 grains , reaching 49.09 and 47.81 g for 6 and 8cm sowing depth (SDE) respectively. These results are consistent with the results obtained by Alsharifi et al. (2021a) which concluded that there is a direct relationship between increasing sowing depth(SDE) and increase in the weight of 1000 grains .The sowing distances (SD) had a significant effect on the weight of 1000 grains as the low SD of 5cm gave the highest weight of 1000 grains average of 50.36 g while the SD of 9cm gave 46.95 g. These results are consistent with Shtewy et al.,(2020b).

3.2. Number of grains in spike

Figure 2 shows the effect of SM,SDE and SD on number of grains spike . The results showed that the SM-SRO had the lowest number of grains spike average of 89.15 grain/spike compared to SM-SGR gave high ratio of number of grains spike 87.43 grain /spike ,depth had a significant effect on number of grains spike . As the SDE increased, the number of grains spike decreased by 89.01 and 87.58 grain/spike for 6 and 8cm SDE respectively. (Aleawi et al .,2020),the increasing SD leads to the decrease in number of grains spike and which was 89.86, 88.15 and 86.88 grain/spike respectively. The reason for this is to create suitable conditions for germination in addition to soil fertility. This is consistent with Shtewy and Al-Sharifi (2020) . Table 1. The interaction among Sm-SGR ,SDE of 6cm and the SD 5 cm was the best (91.13 grain/spike).

3.3.Dry weight of 100 plants :

The decrease in the SDE leads to increase the dry weight of 100 plants , and the results were 0.997 and 0.762 g respectively. These results are consistent with the results of Shtewy and Al-Sharifi (2020).Shown in (Figure. 3). The SD of5 cm indicated the highest dry weight of 100 plants of 1.125 g against 0.714 g at SD of 9cm. This is consistent with Shtewy et al., (2020a). The results showed that the SM-SRO had the lowest dry weight of 100 plants average of 0.971 g compared to SM-SGR gave high ratio of dry weight of 100 plants0.788 g, shown in (Table. 1)The interaction among SM-SGR ,SDE of 6cm and the SD of 5 cm provided the dry weight of 100 plants of 1.703 g.

3.4. Seedling emergence:

The decrease in the SDE leads to increase the seedling emergence , and the results were 77.15 and 76%respectively. These results are consistent with the results of Al-Sharifi et al.,(2019).Shown in (Figure. 4). The SD of5 cm indicated the highest seedling emergence of 77.78% against 75.45% at SD of 9cm. This is consistent with ., Al-Sharifi et al.,(2019). The results showed that the SM-SRO had the lowest seedling emergence of 77.25% compared to



SM-SGR gave high ratio of seedling emergence of 75.90%, shown in (Table. 1) The interaction among SM-SGR, SDE of 6cm and the SD of 5 cm provided the seedling emergence of 79.1%

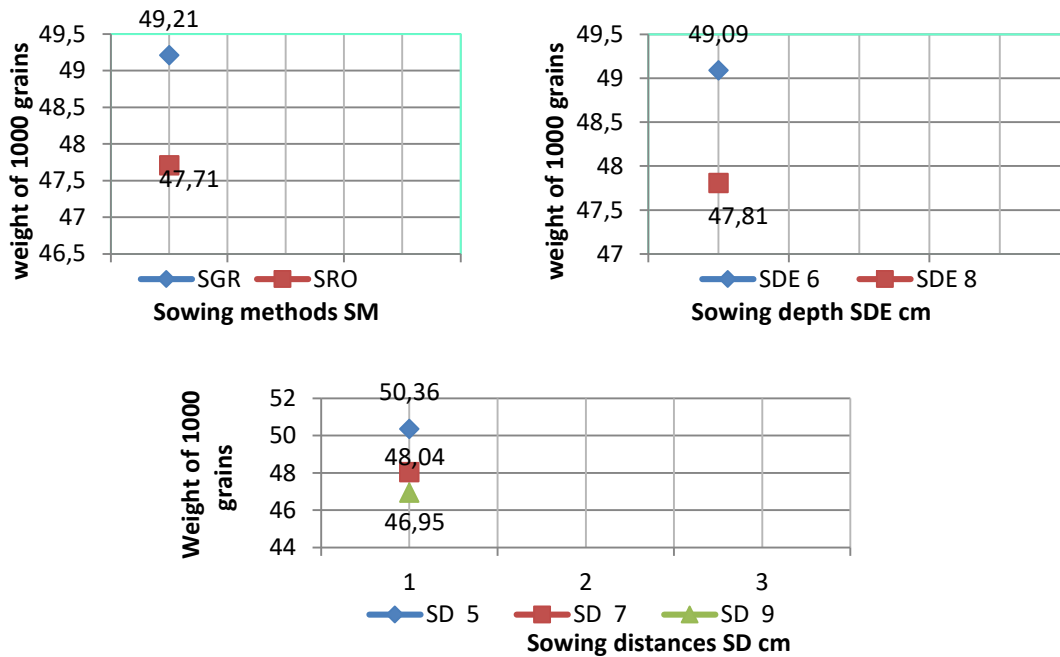


Figure 1. Effect SD, SDE and SD on weight of 1000 grains .

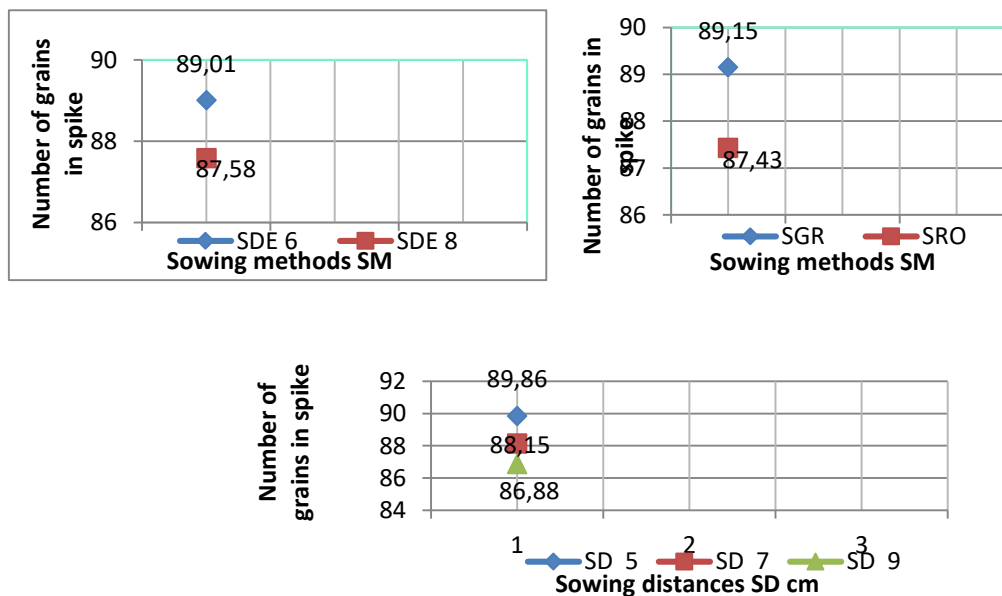


Figure 2. Effect SD, SDE and SD on number of grains in spike .

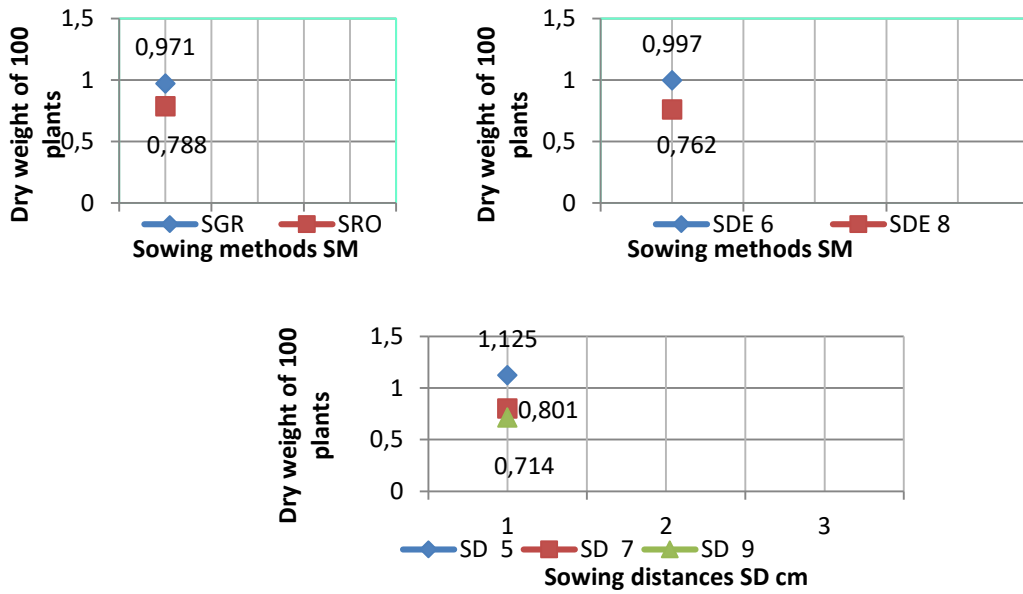


Figure 3. Effect SD, SDE and SD on dry weight of 100 plants .

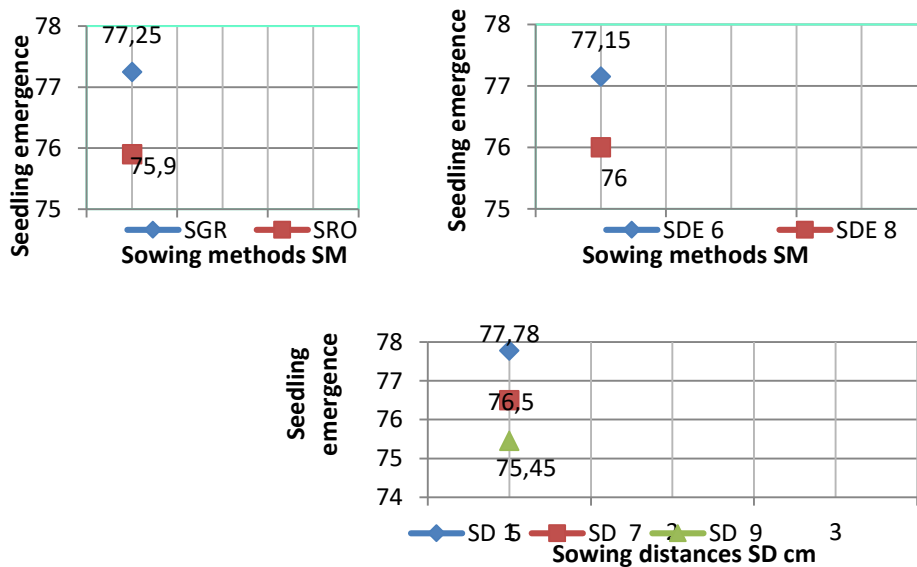


Figure 4. Effect SD, SDE and SD on seedling emergence

One plant productivity

Figure 5 shows the influence of SM, SDE and SD on one plant productivity . The results indicated that increasing the SDE led to the decrease of one plant productivity , and the results were 16.89 and 15.24 g respectively. These results are consistent with the results that gained by Al-Sharifi and Ameen (2018), the SD of 5 cm indicated the highest one plant productivity of 17.84 g, and the SD of 9 cm indicated the lowest one plant productivity of 14.40 g. This is due to the creating suitable conditions for germination and increasing root length .This is consistent with ,Hamzah and Alsharif i(2020). However, the SM-SGR was significantly better than the



SM-SRO and the results were 16.46 and 15.67 g. This is due to the provide suitable conditions for plant growth and increase its root length .These results are consistent with the results gained from , Hamzah and Alsharifi(2020). Table 1 .The interaction among parameters of SM-SGR , SDE of 6 cm and the SD of 5 cm caused the best result of 19.38 g.

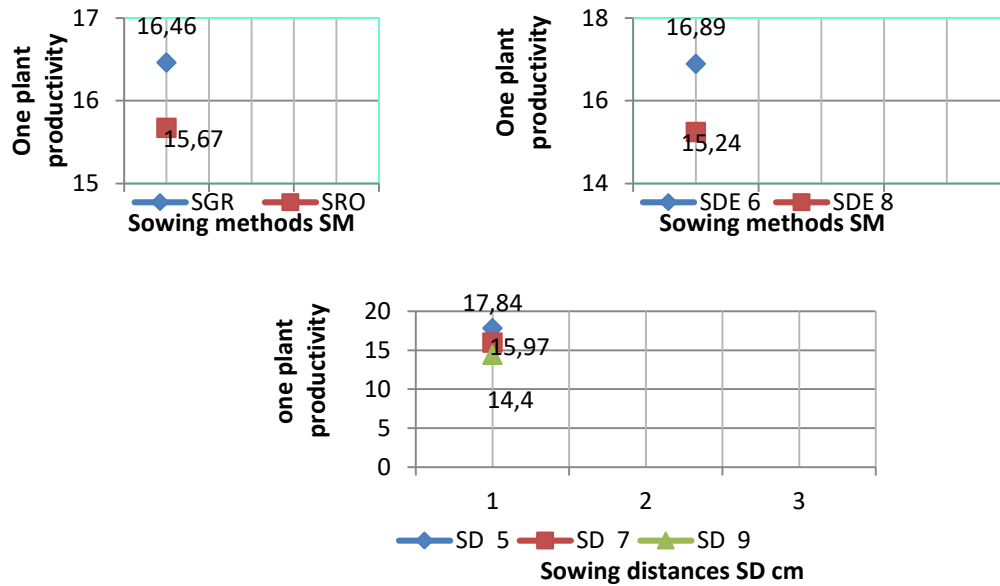


Figure 5. Effect SD, SDE and SD on one plant productivity .

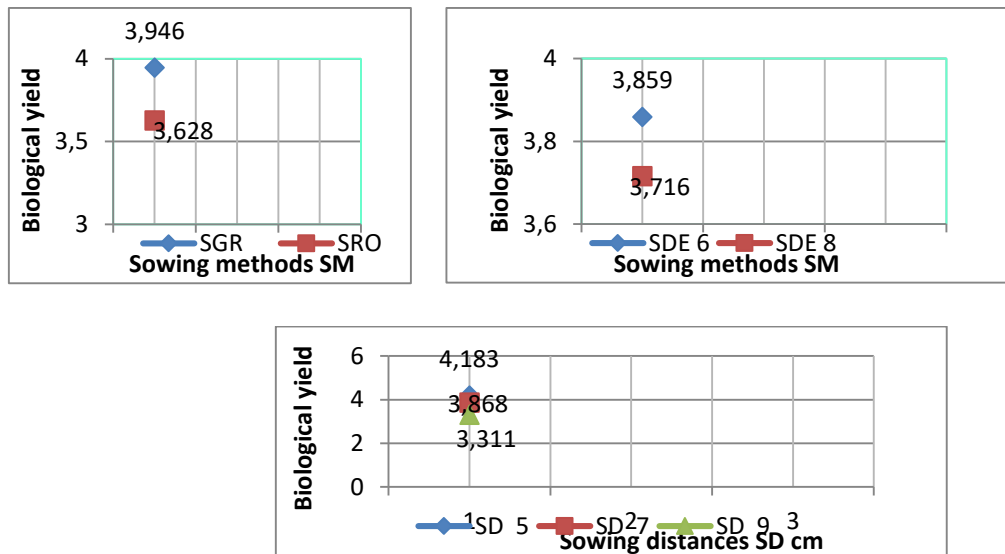


Figure 5. Effect SD, SDE and SD on biological yield .



Table 1 Effect of SM, SDE and SD on grain yield and root growth parameters

SM	SDE cm	SD cm	Weight of 1000grains g	Number of grains in spike Grain/spike	Dry weight of 100 plants g	Seedling emergence %	One plant productivity G	Biological yield t.ha ⁻¹
	6	5	51.68	91.13	1.703	79.1	19.38	4.608
		7	49.17	89.54	0.898	78.2	17.26	4.032
SGR		9	48.65	88.26	0.806	76.2	15.17	3.381
	8	5	50.26	90.08	0.991	78.4	17.52	4.043
		7	48.44	88.75	0.765	76.5	15.17	3.934
		9	47.03	87.19	0.668	75.1	14.26	3.682
SRO	6	5	50.59	90.02	0.993	77.3	18.28	4.088
		7	48.28	88.14	0.803	76.2	17.01	3.917
		9	46.19	86.98	0.779	75.9	14.24	3.126
	8	5	48.93	88.21	0.811	76.3	16.18	3.995
		7	46.29	86.18	0.738	75.1	14.44	3.591
		9	45.96	85.09	0.604	74.6	13.91	3.055
SMA		SGR	49.21	89.15	0.971	77.25	16.46	3.946
		SRO	47.71	87.43	0.788	75.9	15.67	3.628
SDEA	6		49.09	89.01	0.997	77.1	16.89	3.859
	8		47.81	87.58	0.762	76.0	15.24	3.716
SDA		5	50.36	89.86	1.125	77.7	17.84	4.183
		7	48.04	88.15	0.801	76.5	15.97	3.868
		9	46.95	86.88	0.714	75.4	14.40	3.311
LSD=0.05		SM	1.36	1.13	0.035	1.01	1.56	0.104
		SDE	1.41	1.12	0.043	1.02	1.63	0.130
		SD	1.43	1.11	0.045	1.04	1.71	0.154
		SM * SDE	1.63	1.34	0.051	1.05	1.58	0.126
		SM * SD	1.64	1.41	0.056	1.06	1.55	0.137
		SDE * SD	1.56	1.46	0.062	1.07	1.62	0.153
		SM*SDE * SD	1.72	1.71	0.075	1.09	1.78	0.164

3.6. Biological yield

Figure 6 shows the effect of sowing methods, sowing depth and sowing distances, the results of the statistical analysis showed a significant effect for sowing methods (SM), on biological yield and results were 3.946 and 3.628 t.ha⁻¹ respectively for the SGR and SRO, while sowing depth significantly affected the biological yield, reaching 3.859 and 3.716 t.ha⁻¹ for 6 and 8 cm



sowing depth (SDE) respectively. These results are consistent with the results obtained by Alsharifi et al. (2021a) .The sowing distances (SD) had a significant effect on the biological yield as the low SD of 5cm gave the highest biological yield average of 4.183 t.ha⁻¹ while the SD of 9cm gave 3.311 t.ha⁻¹. These results are consistent with Alsharifi et al. (2021b) .

4.CONCLUSIONS

The MS-SGR is significantly better than the MS-SRO. The SD of 5 cm was superior significantly to other two levels 7 and 9 cm. Additionally, the SDE of 6cm was superior significantly than the SDE 8CM in all studied properties. The overlap between the MS-SGR and SD of 5 cm was also superior significantly. The overlap between the MS-SGR and the SDE was 6 cm, as compared with the overlap of SM-SRO with SD and SDE in all studied properties. The best results were obtained from the interaction SM-SGR, SDE 6 cm, and Sd of 5cm in all studied properties.

5.Acknowledgement

The authors would like to thank the engineering staff at the directorate Agricultural Al hashemia for their support in the completion of this research .



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BEYDERE TOHUM SERTİFİKASYON TEST MÜDÜRLÜĞÜ'NDE BİYORYAKIT ÜRETİMİ AMACIYLA DEĞERLENDİRİLEBİLECEK BİTKİSEL VE HAYVANSAL BİYOKÜTLE POTANSİYELİNİN BELİRLENMESİ

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ÖZET

Bu çalışmada, Manisa Beydere Tohum Sertifikasyon Test Müdürlüğü yerleşkesinde bulunan mevcut biyokütle atıklardan, (150,82 ton/yıl) üretilebilecek biyogaz miktarı 30164 m³ olarak hesaplanmış ve bu biyogazın toplam ısıl değeri 684722,8 MJ olarak belirlenmiştir. Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi ile birlikte, değerlendirilebilecek biyokütle miktarı toplam 473,74 ton olması ve bu atıklardan elde edilebilecek biyogazın toplam ısıl değeri 2150779,6 MJ olarak tahmin edilmektedir. Enerji üretimi amacıyla faydalanılabilecek hayvansal atıklardan mevcut koşullarda toplam 76080 kWh elektrik üretilebilecek birleşik ısı ve güç tesisinin (kojenerasyon tesisi) kurulu gücü, 15 kW olarak hesaplanmıştır. 2024-2025 yılı üretimi sonunda bu değerlerin 238975 kWh elektrik üretimi, kurulu gücün ise 60 kW olacağı tahmin edilmektedir.

Anahtar Kelimeler: Biyokütle, biyogaz üretimi, kojenerasyon, çevresel etki

*: Bu çalışma, yüksek lisans tezinden üretilmiştir.



**DETERMINING THE POTENTIAL OF THE PLANT AND ANIMAL BIOMASS
ASSESSED FOR BIOFUEL PRODUCTION AT BEYDERE SEED CERTIFICATION
TEST DIRECTORATE**

ABSTRACT

In this study, the amount of biogas that can be produced (150.82 tons / year) from existing biomass wastes in Manisa Beydere Seed Certification Test Directorate campus was calculated as 30164 m³ and the total calorific value of this biogas was determined as 684722.8 MJ. With the Beydere Seed Certification Test Directorate Animal Production Development and Waste Management Project, the total amount of biomass that can be utilized is estimated to be 473.74 tons and the total calorific value of biogas that can be obtained from these wastes is 2150779.6 MJ. The installed power of the combined heat and power plant (cogeneration facility), which can produce a total of 76080 kWh of electricity under current conditions from animal wastes that can be used for energy production, has been calculated as 15 kW. It is estimated that these values will be 238975 kWh electricity generation and the installed power will be 60 kW at the end of 2024-2025. total calorific value to be gained from animal biomass wastes is the wastes generated from cattle breeding. Operation and 45-digit lodging wastes were not included in the study as there is no relevant record.

Keywords: Biomass, biogas production, cogeneration, environmental impact



GİRİŞ

Yenilenebilir enerji kaynakları arasında biyokütle enerji kaynağının pek çok artışı vardır. Biyokütle kaynaklarından değişik muameleler sonucu sıvı, katı, gaz yakıtlar, ısı, elektrik gibi ürünler elde edilebilmektedir. Aynı zamanda bu kaynaklar tamamen enerji getirisi için kullanılmamaktadır. Biyokütle; enerji eldesi ile birlikte birtakım değerli kimyasallar, kereste, gıda ve kağıt sağlamak için de işletebilmektedir. Bu sebeple, daha etkin faydalanma için, biyokütle kaynakları öteki öncelik sahibi işlemlerle birleştirilmeli ve sürdürülebilir bir şekilde kullanılmalıdır. Ayrıca, biyokütle içeriğinde fosil yakıtların ihtiva ettiği doğaya zarar veren maddeler ve kükürt bulunmadığı için de doğa dostu bir yakıttır. Bahsedilen nitelikleri ile beraber, güneş enerjisi mevcut olduğu müddetçe tarımsal ve endüstriyel alanlarda bitki üreticiliğinin de sürecek olması, biyokütleye tükenmez bir enerji kaynağı özelliği sağlamaktadır.

Biyokütle rezervlerini deniz ve kara, yerküredeki bütün alanlarda bulmak mümkündür. Var olan doğal rezervlerin haricinde günümüzde bu kaynağı üretim yoluyla sağlamak için de uygulamalar başlamıştır. Biyokütle rezervleri olarak; tarımsal ve bitkisel atıklar, hayvansal üretim atıkları, orman atıkları, enerji bitkileri ve az süren döngülü enerji ormanları, endüstriyel atıklar, şehir katı atıkları, kanalizasyon atıkları ve suda yetişen bitkiler değerlendirilmektedir.. Biyokütle artıkları büyümekte olan ülkelerde geniş bir varlık göstermektedir. Halen bu artıkların çok küçük bir miktarı yakıt olarak kullanılmaktadır. Yüksek nem, düşük ısı değere sahip ve oldukça fazla çeşitte olan biyokütle artıklarının doğrudan yakıt olarak tüketimi kolay değildir. Bu özelliklerinden dolayı taşıma ve depolama giderleri yükselmektedir.

Bu araştırmanın amacı, BTSTM yerleşkesinde bitkisel ve hayvansal kaynaklı biyokütle atıklardan, elektrik ve ısı enerjisi kazanımı için sürdürülebilir biçimde faydalanmaktır. Araştırmanın asıl hedefi, bitkisel ve hayvansal atıkları; uygun maliyetli, yüksek kaliteli, doğaya daha zararsız, yerli ve yenilenebilir bir biyokütle enerji kaynağı olarak kazanabilmektir. Araştırma çalışmaları kapsamında; enerji üretimi için kullanılacak biyokütle atıklar tür ve mevcutları belirlenecek, biyokütle atıklardan üretilebilecek biyogaz miktarı ve üretilecek biyogazdan ısı ve elektrik üretimi için kullanılacak olan birleşik ısı ve güç üretim (kojenerasyon) tesisine dair değişkenler tespit edilecektir. Bu araştırmanın ışığında BTSTM yerleşkesindeki bitkisel ve hayvansal kökenli biyokütle atıklardan üretilecek biyogazdan elektrik ve ısı enerjisi eldesi için fizibilite çalışmaları yapılarak BÜGEM'e sunulacaktır. Araştırmanın temel hedefi; farklı dönemlerde yapılan önceki araştırmalarla ortak bir amaca hizmet etmek ve destek olmaktır. Bu amaç, Türkiye'deki biyokütle enerji kaynaklarını sürdürülebilir bir metodla ve çevresel-ekonomik-sosyal faydaları göz önüne alınarak, denetimli bir biçimde yeni teknolojilerle kullanma imkanlarını geliştirmektir.

MATERYAL ve YÖNTEM

Atık Miktarı ve Enerji Potansiyelinin Hesaplanması

Tarla Atıkları ve Enerji Potansiyellerinin Hesaplanması

Tarla artıklarının miktarı, üretim miktarı ile atık ürün oranı olarak belirlenen ve Çizelge 2.1'de verilen oranların çarpımı ile hesaplanabilmektedir. Çarpım sonucu bulunan atık miktarı ile atıkların enerji üretimi için kullanılabilirlik oranı çarpılarak, enerji üretimi amacıyla değerlendirilebilecek atık potansiyeli Eşitlik 3.1'de belirlenmiştir (Karaca ve ark., 2016).



$$AM = \ddot{U}M \times A\ddot{U}O \times KO \quad (2.1)$$

Burada;

- AM = Atık miktarı (kg),
 $\ddot{U}M$ = Üretim miktarı (kg),
 $A\ddot{U}O$ = Atık/ürün oranı ($kg_{\text{atık}}/kg_{\text{ürün}}$) ve
 KO = Kullanılabilirlik oranıdır (%).

Atıklardan üretilebilecek enerji miktarı yani atıkların enerji potansiyeli, atık miktarı ve atığın ısıl değeri çarpımı ile bulunabilir (Eşitlik 3.2).

$$EP = AM \times ID \quad (2.2)$$

Burada;

- EP = Enerji potansiyeli (MJ),
 AM = Atık miktarı (kg) ve
 ID = Atık ısıl değeridir (MJ/kg).

Tablo.1. Tarla ürünleri atık ürün oranı ve kullanılabilirlik değerleri (Başçetinçelik ve ark., 2005a)

Ürünler	Atıklar	Atık ve Ürün Oranı	Kullanılabilirlik Oranı (%)
Buğday	Saman	0,98	15
Arpa	Saman	0,95	15
Çavdar	Saman	0,78	15
Yulaf	Saman	0,75	15
Mısır	Sap	2,10	60
	Sömek	0,64	60
Pamuk	Sap	1,50	60
	Çırçır atığı	0,30	80
Yer Fıstığı	Kabuk	0,40	80

Tablo.2. Bazı tarımsal materyallerin ısıl değerleri ve kül içerikleri (Başçetinçelik ve ark., 2005a; 2005b)

Ürünler	Isıl Değer (MJ/kg)	Kül İçeriği	Ürünler	Isıl Değer (MJ/kg)	Kül İçeriği
Mısır koçanı	18,40	1,20	Yerfıstığı kabuğu	20,74	6,00
Ayçiçeği sapı	14,20	1,90	Arpa samanı	17,50	10,30
Zeytin Çekirdeği	19,50	3,20	Pirinç samanı	16,70	15,50
Badem kabuğu	19,38	4,80	Tütün tozu	16,10	19,10
Pamuk sapı	18,20	5,35	Pirinç kabuğu	12,98	22,40

Diğer Bitkisel, Orman ve Budama Atıklarının Hesaplanması

Manisa Milli Emlak Müdürlüğü, orman ürünlerinin tahsisini henüz Kuruma vermediği için 432 dekarlık orman arazisi atıkları çalışmaya dahil edilmemiştir.

Hayvansal Atık Miktarı ve Enerji Potansiyellerinin Hesaplanması

Gübre Miktarının Hesaplanması

Büyükbaş/küçükbaş ve kanatlı hayvanlardan açığa çıkan gübre miktarı aşağıdaki eşitlikten hesaplanmıştır. (Başçetinçelik ve ark., 2006, Karaca, 2017)

$$GGM = (HS \times HG\ddot{U}M) / 1000 \quad (2.3)$$

Burada;



GGM = Günlük gübre miktarı (t/gün);

HS = Hayvan sayısı (adet) ve

$HGÜM$ = Hayvan başına günlük gübre üretim miktarıdır (kg/gün×hayvan).

Hesaplama $HGÜM$ değeri süt sığırları için 27,24 olarak alınmıştır.

Günlük Katı Gübre Miktarı

Günlük katı gübre miktarı ($GGM_{katı}$), günlük gübre miktarı (GGM) ve katı gübre oranına (KGO) bağlı olarak aşağıdaki gibi belirlenmiştir (Karaca, 2017).

$$GGM_{katı} = GGM \times (KGO/100) \quad (2.4)$$

Burada;

$GGM_{katı}$: Günlük katı gübre miktarı (t/gün) ve

KGO : Katı gübre oranıdır (%)

Kullanılabilir Katı Gübre Miktarı

Yıllık toplam kullanılabilir katı gübre miktarı ($TKGM$), $GGM_{katı}$ ve gübre kullanılabilirlik oranına (GKO) bağlı olarak aşağıdaki gibi hesaplanmıştır (Karaca, 2017).

$$TKGM_{katı} = GGM_{katı} \times (GKO/100) \times 365 \quad (2.5)$$

Burada;

$TKGM_{katı}$: Yıllık Kullanılabilir katı gübre miktarı (t/yıl) ve

GKO : Gübre kullanılabilirlik oranı (%)

Biyogaz Potansiyelinin Hesaplanması

Hayvansal biyokütle atıklardan üretilecek biyogaz miktarları aşağıdaki eşitlikler kullanılarak hesaplanmıştır (Karaca, 2017).

Hayvansal biyokütle atıklardan üretilecek biyogaz miktarları

$$BM = TKGM_{katı} \times BDO \quad (2.6)$$

Burada;

BM : Biyogaz miktarı (m^3/y)

BDO : Katı gübre biyogaz dönüşüm oranıdır ($200 m^3/t$).

$$TID = BM \times BID \quad (2.7)$$

Burada;

TID : Yıllık toplam ısı değer (MJ/y)

BID : Biyogazın birim ısı değeridir.

BTSTM yerleşkesi için bu hesaplamalar 2018 yılı verilerine göre şu şekildedir;

Biyogazın gaz motorunda yakıt olarak kullanılmasıyla üretilen elektrik miktarı aşağıdaki eşitlik kullanılarak hesaplanacaktır.

$$EÜ = (TID/3600) \times EÜV_{net} \quad (2.8)$$

Burada;

$EÜ$: Yıllık elektrik üretim miktarı (MWh_{el}/y)

$EÜV_{net}$: Gaz motorunun net elektrik verimi (40%)

Hesaplamalarda Kullanılan Sera Gazı Emisyonları

Kömür ve doğal gaz yakıtlı termik santrallerden ve yenilenebilir enerji kaynakları olarak dikkate alınan güneş PV ve karasal rüzgar enerjisi santrallerinden açığa çıkan sera gazı emisyonlarının hesaplanmasında literatürde verilen değerlerin ortalaması dikkate alınmış ve kullanılan emisyon değerleri Çizelge 3.3'te verilmiştir. (Öztürk ve ark., 2019)



Tablo 3. Hesaplamalarda dikkate alınan sera gazı emisyon değerleri

Elektrik Üretim Santrali	Sera Gazı Emisyonları			Çevre Maliyeti (€/kWh)
	kgCO ₂ -eş/kWh	kgNO _x /kWh	kgSO ₂ /kWh	
Kömür yakıtlı termik santral	0,996	0,00210	0,00337	0,0859
Doğal gaz yakıtlı termik santral	0,55675	0,0020	0,00017	0,1879
Biyokütle elektrik santrali (BES)	0,045	0,00089	0,00049	0,077
Hidroelektrik santrali (HES)	0,011	0,00003	0,00002	0,003

Elektrik Üretimi Sonucunda Oluşan Sera Gazı Emisyonlarının Hesaplanması

Kömür ve doğal gaz yakıtlı termik santraller ile hidroelektrik ve biyokütleden elektrik üretilen yenilenebilir enerji santrallerinden açığa çıkan toplam sera gazı emisyonları aşağıdaki Eşitlik 2.9 ile hesaplanmıştır.

$$SGE = EKE \times ÜEM \quad (2.9)$$

Burada;

SGE = Sera gazı emisyonu (kgCO₂-eş),

EKE = Eşdeğer karbondioksit emisyonu (kgCO₂-eş/kWh) ve

ÜEM = Üretilen toplam elektrik miktarıdır (kWh).

Elektrik Üretimi Çevre Maliyetlerinin Hesaplanması

Kömür ve doğal gaz yakıtlı termik santraller ile hidroelektrik ve biyokütleden elektrik üretilen yenilenebilir enerji santralleri için elektrik üretimine ilişkin çevre maliyetleri aşağıdaki eşitlik ile hesaplanmıştır.

$$TÇM = ÖÇM \times ÜEM \quad (2.10)$$

Burada;

TÇM = Toplam çevre maliyeti (€),

ÖÇM = Özgül çevre maliyeti (€/kWh) ve

ÜEM = Üretilen toplam elektrik miktarıdır (kWh).

BTSTM yerleşkesindeki biyokütle atık potansiyelinin belirlenmesi için, BTSTM Bitkisel Üretim Birim Koordinatörlüğü, Hayvansal Üretim Birim Koordinatörlüğü ve İdari Maili İşler Birim Koordinatörlüğü (01.01.2019–31.12.2019) Üretim Raporunda yer alan bitkisel ve hayvansal üretim değerlerine ilişkin verilerden yararlanılmıştır.

BULGULAR ve TARTIŞMA

3.1. Biyokütle Atık Potansiyeli

3.1.1. Bitkisel Kökenli Biyokütle Atık Potansiyeli

BTSTM Bitkisel Üretim Birim Koordinatörlüğü, 2019 üretim sezonunda yetiştirilen ürünler ve üretim değerleri Tablo 4’de verilmiştir. BTSTM Bitkisel Üretim Birim Koordinatörlüğü tarafından üretilen ürünler içerisinde, buğday, arpa ve mısır atıklarından bitkisel kökenli biyokütle kaynağı olarak yararlanılabileceği dikkate alınmıştır. Bu nedenle, belirtilen ürünlere ilişkin üretim değerleri dikkate alınarak biyokütle atık potansiyelleri hesaplanmıştır (Tablo 4).



Tablo 4. Bitkisel üretim birim koordinatörlüğünce 2019 sezonunda yetiştirilen ürünler ve üretim değerleri

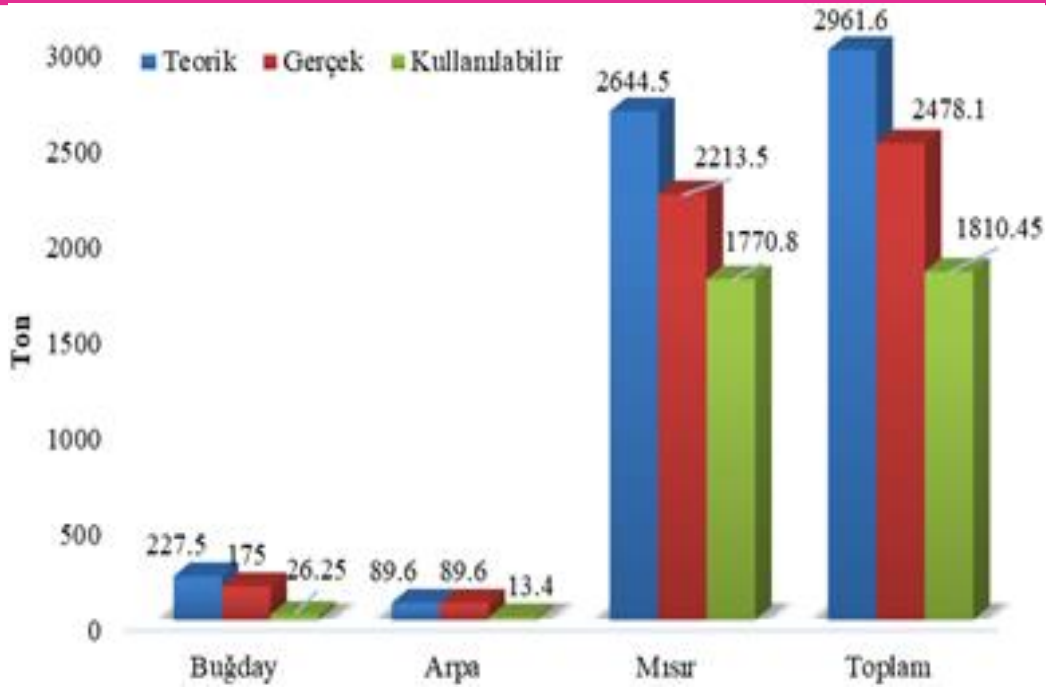
ÜRÜNLER	ALAN (da)	ÜRETİM (kg)	VERİM (kg/da)
Buğday	280	175000	625
Arpa	220	89600	407
Mısır	748	1165160	1558

BTSTM Bitkisel Üretim Birim Koordinatörlüğü tarafından, 2018–2019 üretim sezonunda 280 da alanda buğday üretimi yapılmıştır (Tablo 4). Toplam 175 ton buğday üretilmiş olup, dekardan ortalama 625 kg verim elde edilmiştir. Aynı üretim döneminde 748 da alanda 1. ürün tane mısır üretimi yapılmıştır. Toplam 1165 ton tane mısır üretilmiştir.

BTSTM Bitkisel Üretim Birim Koordinatörlüğü tarafından üretilen buğday, arpa ve mısır atıklarının miktarları Tablo 5’de verilmiştir. Belirtilen ürünleri atık bölümleri olarak sap, saman ve sömek kısımları ve bu kısımlara ilişkin enerji değerleri dikkate alınmıştır. 2019 üretim sezonunda buğday, arpa ve mısır atıklarının toplam miktarı teorik olarak 2988,5 ton düzeyindedir. Belirtilen ürünlere ilişkin bu atıkların gerçek değerleri 2478,1 ton düzeyindedir. Bitkisel kökenli biyokütle atıklarının enerji üretimi için değerlendirilebilecek miktarı 1810 ton/yıl olarak hesaplanmıştır. Buğday üretimi sonucunda açığa çıkan samanın hayvan yemi olarak kullanılabilirliği çok yüksektir. Bu nedenle, buğday samanından enerji üretimi amacıyla kullanılabilirlik oranı %15 gibi düşük bir değerde dikkate alınmıştır. 2018–2019 üretim sezonunda yetiştirilen buğday, arpa ve mısır ürünlerinin kullanılabilir bitkisel biyokütle senelik atık miktarları sırasıyla 26,25, 13,4 ve 1770,8 ton olarak hesaplanmıştır (Şekil 1). Toplam 748 da alanda tane mısır üretimi sonucunda senede 1491,2 ton sap ve 279,6 ton sömek olmak üzere toplam 1.770,8 ton kullanılabilir bitkisel biyokütle atık oluşmaktadır.

Tablo 5. 2019 sezonunda yetiştirilen tarla ürünlerinin atık miktarları

Tarla Ürünleri	Atık	Üretim (ton)	Alan (da)	Ürün Atık Oranı		Toplam Atıklar (ton)		Kullanılabilir Atık (ton)	Kullanılabilirlik (%)
				Teo	G	T	G		
Buğday	Saman	175	280	1,30	1,0	227,5	175	26,25	15
Mısır	Sap	1165	748	2,0	1,60	2330	1864	1491,2	80
	Sömek	1165		0,27	0,30	314,5	349,5	279,6	80
Arpa	Saman	89,6	220	1,30	1,00	116,5	89,6	13,4	15
Toplam						2988,5	2478,1	1810	
T: Teorik, G: Gerçek (Gerçek Değerler BTSTM Bitkisel Üretim Birim Koordinatörlüğünce saptanmıştır)									



Şekil 1. Tarla Ürünlerinin Bitkisel Biyokütle Atık Miktarları

Hayvansal Kökenli Biyokütle Atık Potansiyeli

BTSTM Bitkisel Hayvansal Üretim Birim Koordinatörlüğü tarafından, 2019 senesi sonu itibariyle, hayvan varlığı değerleri Tablo 6’da verilmiştir. BTSTM Bitkisel Hayvansal Üretim Birim Koordinatörlüğüne yetiştirilen sığır katı atıklarından (dışkılarında) hayvansal kökenli biyokütle atık olarak yararlanılabileceği dikkate alınmıştır. Belirtilen hayvan türlerine ilişkin katı atık değerleri dikkate alınarak hayvansal biyokütle atık potansiyelleri hesaplanmıştır. Hayvansal kökenli biyokütle atık potansiyellerinin hesaplanmasında, hayvan sayısı olarak birimlerdeki dönem başı ve dönem sonu canlı hayvan varlığı değerlerinin ortalaması dikkate alınmıştır. Hayvan sayıları olarak 163 adet sığır, değerleri dikkate alınmıştır.

Tablo 6. Hayvansal üretim birim koordinatörlüğü 2019 yılı sonu itibariyle mevcut hayvan varlığı (Adet)

Hayvanın Biyolojik Durumu	Dönem başı (01.01.2019)	Dönem Sonu (31.12.2019)	Doğan	Ölen	Satılan ve Kesilen
Toplam	152	163	42	7	24

Tablo 7. 2019 sezonunda yetiştirilen hayvanların atık miktarları

Hayvan Türü	Mevcut Hayvan Sayısı	Atık Miktarı (ton/yıl)	Kuru Gübre Oranı (%)	Toplam Kuru Gübre (ton/yıl)	Kullanılabilirlik (%)	Kullanılabilir Kuru Gübre (ton/yıl)
Sığır	163	1784,88	12,99	232,03	65	150,82

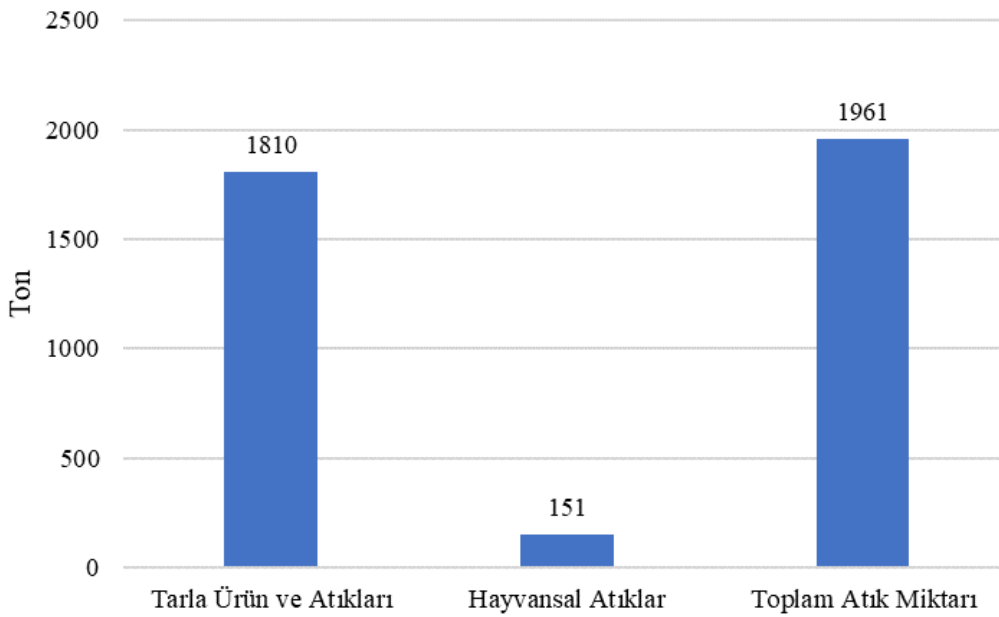
BTSTM Bitkisel Üretim Birim Koordinatörlüğü, Hayvansal Üretim Birim Koordinatörlüğü 2019 üretim sezonunda enerji üretimi amacıyla değerlendirilebilecek toplam 1810 ton/yıl miktarında bitkisel kökenli ve 151 ton/yıl miktarında hayvansal kökenli olmak üzere, senelik



1961 ton biyokütle atık açığa çıkmıştır (Şekil 2). Enerji üretimi amacıyla değerlendirilebilecek toplam biyokütle atıkların %92,29'sini bitkisel kökenli biyokütle atıklar, %7,71'ini ise hayvansal kökenli biyokütle atıklar oluşturmaktadır (Tablo 8).

Tablo 8. Enerji üretimi amacıyla değerlendirilebilecek toplam biyokütle atık miktarları

Biyokütle Atıklar	Atık Miktarı (ton/yıl)	Toplam Atık Miktarına Oranı (%)
Tarla ürünleri atıkları	1810	92,29
Hayvansal atıklar	151	7,71
TOPLAM	1961	100



Şekil 2. Enerji üretimi amacıyla değerlendirilebilecek toplam biyokütle atık miktarları

BTSTM Yerleşkesinde Atıkların Isıl Değerleri

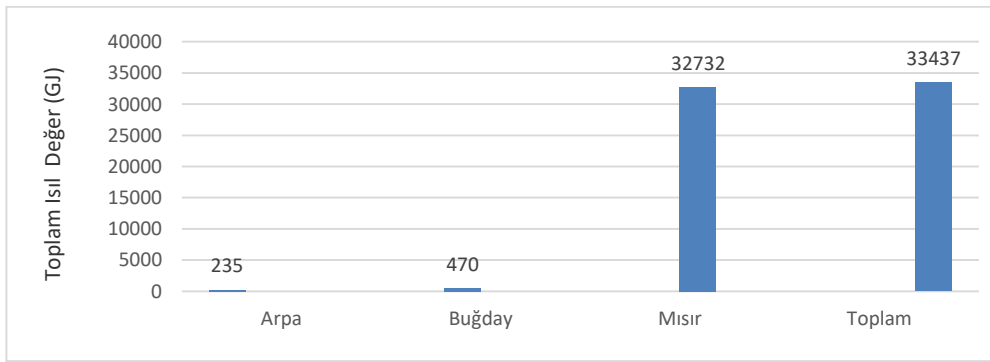
Bitkisel Kökenli Biyokütle Atıkların Isıl Değerleri

BTSTM Bitkisel Üretim Birim Koordinatörlüğü tarafından üretilen buğday, arpa ve mısır atıklarının ısı değerleri Tablo 9'da verilmiştir. Belirtilen tarla ürünlerinin atık bölümleri olarak sap, saman ve sömek kısımları ve bu kısımlara ilişkin enerji değerleri dikkate alınmıştır. 2019 üretim sezonunda buğday, arpa ve mısır atıklarının toplam ısı değeri 33437 GJ düzeyindedir. 2019 yılında yetiştirilen buğday, arpa ve mısır atıklarının ısı değerleri sırasıyla, 470 GJ, 235 GJ ve 32732 GJ olarak hesaplanmıştır (Şekil 3). Bu atıklardan kazanılacak toplam ısı değerinin %82,5'ini mısır sapı, %15,3'ünü ise mısır sömeği atıkları oluşturmaktadır. Toplam 748 da alanda tane mısır üretimi sonucunda, senede 1491,2 ton sap ve 279,6 ton sömek olmak üzere toplam 1770,8 ton bitkisel biyokütle atığın ısı değeri 32732 GJ düzeyindedir.



Tablo 9. 2019 sezonunda yetiştirilen tarla ürünleri atıklarının ısı değerleri

Tarla ürünleri	Atık Kısım	Kullanılabilir Atık Miktarı (ton)	Enerji Değeri	
			Isıl Değer (MJ/kg)	Toplam Isıl Değer (GJ)
Buğday	Saman	26,25	17,9	470
Mısır	Sap	1491,2	18,5	27587
	Sömek	279,6	18,4	5145
Arpa	Saman	13,4	17,5	235
Toplam		1810		33437



Şekil 3. Mevcut durumda tarla ürünleri atıklarının ısı değerleri

Hayvansal Kökenli Biyokütle Atıklarının Isıl Değeri

BTSTM Bitkisel Hayvansal Üretim Birim Koordinatörlüğü tarafından yetiştirilen hayvanların atıkları ve üretilebilecek biyogaz miktarları Çizelge 4.7’de verilmiştir. 2019 üretim sezonunda enerji üretimi amacıyla yararlanılabilecek hayvansal atıklardan (150,82 ton/yıl) üretilebilecek toplam senelik biyogaz miktarı 30164 m³ olarak hesaplanmıştır.

Tablo 10. 2019 sezonunda yetiştirilen hayvanların atıklardan biyogaz üretimi

Hayvan Türü	Mevcut Kullanılabilir Kuru Gübre (ton/yıl)	Kuru Gübre Biyogaz Dönüşüm Oranı (m ³ /ton)	Biyogaz Üretimi (m ³ /yıl)	Isıl Değeri (MJ/m ³)	Toplam Isıl Değeri (MJ/yıl)
Sığır	150,82	200	30164	22,7	684722,8

Tarım ve Orman Bakanlığı’na bağlı BÜGEM’e sunulan “Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi” onay ve tamamlanma süreci sonunda ise planlan hayvansal üretim atık değerlerine göre ise Tablo 11 ve 12’de verilmiştir.



Tablo 11. Proje sonunda beklenen atık miktarları

Hayvan Türü	Planlanan Hayvan Sayısı	Atık Miktarı (ton/yıl)	Kuru Gübre Oranı (%)	Toplam Kuru Gübre (ton/yıl)	Kullanılabilirlik (%)	Kullanılabilir Kuru Gübre (ton/yıl)
Sığır	512	5606,49	12,99	728,83	65	473,74

Tablo 12. Proje Sonunda Beklenen Biyogaz Üretimi

Hayvan Türü	Planlanan Kullanılabilir Kuru Gübre (ton/yıl)	Kuru Gübre Biyogaz Dönüşüm Oranı (m ³ /ton)	Biyogaz Üretimi (m ³ /ton)	Isıl Değeri (MJ/m ³)	Toplam ısı Değeri (MJ/yıl)
Sığır	473,74	200	94748	22,7	2150779,6

Hayvansal Biyokütle Atıklardan Üretilen Biyogazdan Elektrik Üretimi

Hayvansal Biyokütle Atıklardan Üretilen Elektrik Üretimi

BTSTM Bitkisel Hayvansal Üretim Birim Koordinatörlüğü tarafından mevcut durumda yetiştirilen hayvanların atıklarından senelik toplam 30164 m³ biyogaz üretilbileceği hesaplanmıştır. Hayvansal atıklardan üretilen biyogazdan üretilen elektrik miktarı ve kurulu güç değerleri Tablo 12’de verilmiştir. Hayvansal kökenli biyokütle atıklardan üretilen toplam 30164 m³ biyogazdan toplam 76080 kWh elektrik üretilbilecektir. Hayvansal atıklardan toplam 76080 kWh elektrik üretilen birleşik ısı ve güç tesisinin (kojenerasyon tesisi) kurulu gücünün toplam 15 kW olması gerektiği belirlenmiştir. “Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi” onay ve tamamlanma süreci sonunda elde edilmesi planlanan biyogazdan üretilen elektrik miktarı ve kurulu güç değerleri Tablo 13’de verilmiştir. Senelik toplam 94748 m³ biyogaz üretilbileceği öngörülmektedir. 94748 m³ biyogazdan toplam 238975 kWh elektrik üretilen birleşik ısı ve güç tesisinin (kojenerasyon tesisi) kurulu gücünün toplam 60 kW olması gerektiği belirlenmiştir.

Tablo 12. Proje sonunda beklenen biyogaz üretimi

Hayvan Türü	Planlanan Kullanılabilir Kuru Gübre (ton/yıl)	Kuru Gübre Biyogaz Dönüşüm Oranı (m ³ /ton)	Biyogaz Üretimi (m ³ /ton)	Isıl Değeri (MJ/m ³)	Toplam ısı Değeri (MJ/yıl)
Sığır	473,74	200	94748	22,7	2150779,6

Hayvansal Biyokütle Atıklardan Üretilen Biyogazdan Elektrik Üretimi

Hayvansal Biyokütle Atıklardan Üretilen Elektrik Üretimi

BTSTM Bitkisel Hayvansal Üretim Birim Koordinatörlüğü tarafından mevcut durumda yetiştirilen hayvanların atıklarından senelik toplam 30164 m³ biyogaz üretilbileceği hesaplanmıştır. Hayvansal atıklardan üretilen biyogazdan üretilen elektrik miktarı ve kurulu güç değerleri Tablo 13’de verilmiştir. Hayvansal kökenli biyokütle atıklardan üretilen toplam 30164 m³ biyogazdan toplam 76080 kWh elektrik üretilen birleşik ısı ve güç tesisinin (kojenerasyon tesisi) kurulu gücünün toplam 60 kW olması gerektiği belirlenmiştir.



atıklardan toplam 76080 kWh elektrik üretilebilecek birleşik ısı ve güç tesisinin (kojenerasyon tesisi) kurulu gücünün toplam 15 kW olması gerektiği belirlenmiştir. “Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi” onay ve tamamlanma süreci sonunda elde edilmesi planlanan biyogazdan üretilebilecek elektrik miktarı ve kurulu güç değerleri Tablo 14’de verilmiştir. Senelik toplam 94748 m³ biyogaz üretilebileceği öngörülmektedir. 94748 m³ biyogazdan toplam 238975 kWh elektrik üretilebilecektir. Hayvansal atıklardan toplam 238975 kWh elektrik üretilebilecek birleşik ısı ve güç tesisinin (kojenerasyon tesisi) kurulu gücünün toplam 60 kW olması gerektiği belirlenmiştir.

Tablo 13. Hayvansal biyokütle atıklardan biyogaz ve elektrik üretimi değerleri

Mevcut Toplam Isıl Değeri (MJ/yıl)	Elektrik Üretimi (kWh)	Elektrik Üretimi (kVA)	Kurulu Güç (kW)
684722,8	76080	10,85	15

Tarım ve Orman Bakanlığı’na bağlı BÜGEM’e sunulan “Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi” onay ve tamamlanma süreci sonunda ise planlan hayvansal üretim atık değerlerine göre ise Tablo 14’de verilmiştir.

Tablo 14. Proje sonu hayvansal biyokütle atıklardan biyogaz ve elektrik üretimi değerleri

Planlanan Toplam Isıl Değeri (MJ/yıl)	Elektrik Üretimi (kWh)	Elektrik Üretimi (kVA)	Kurulu Güç (kW)
2150779,6	238975	34,10	60

Hayvansal Biyokütle Atıklardan Elektrik Üretiminin Çevresel Kazanımları

Hayvansal biyokütle atıklardan, kurulu gücü 15 kW olarak tasarılacak olan birleşik ısı ve güç tesisinde (kojenerasyon tesisi) yıllık toplam 76080 kWh elektrik üretilebileceği belirlenmiştir. Aynı miktar elektriğin (76080 kWh/yıl), Kömür Yakıtlı Termik Santral (TES_K), Doğal Gaz Yakıtlı Termik Santral (TES_{DG}) ve Hidroelektrik Santralde (HES) üretilmesi durumunda gerçekleşecek olan sera gazı Tablo 15’de verilmiştir.

Hayvansal biyokütle atıklardan üretilecek olan senelik toplam 76080 kWh elektriğin TES_K ve TES_{DG}’de üretilmesi durumunda sırasıyla, senede 75775 kgCO₂-eş ve 42357 kgCO₂-eş salımı gerçekleşecektir. Karbondioksit (CO₂) salımı, Biyokütle Elektrik Santralinde (BES) 3423 kgCO₂-eş olarak gerçekleşecek olup, bu değer TES_K’den %95,48 oranında (72352 kgCO₂-eş) daha azdır. BES’de gerçekleşecek olan CO₂ salımı (3423 kgCO₂-eş), TES_{DG}’de gerçekleşecek olan CO₂ salımından (42357 kgCO₂-eş) %91,92 oranında (38934 kgCO₂-eş) daha azdır.



Tablo 15. Hayvansal biyokütle atıklardan elektrik üretiminde sera gazı salımları

Elektrik Üretim Santrali (Mevcut Potansiyel)	Sera Gazı Salımları		
	kgCO ₂ -eş	kgNO _x	kgSO ₂
Kömür Yakıtlı Term. Sant. (TES _K)	75775	159	256
Doğal Gaz Yakıtlı Term. Sant. (TES _{DG})	42357	152	12
Biyokütle Elektrik Santrali (BES)	3423	67	37
Hidroelektrik Santrali (HES)	836	2	1

Hayvansal biyokütle atıklardan üretilecek olan senelik toplam 76080 kWh elektriğin TES_K ve TES_{DG}'de üretilmesi durumunda sırasıyla, senede 159 kgNO_x ve 152 kgNO_x salımı gerçekleşecektir (Tablo 16). Azotoksit (NO_x) salımı, BES'de 67 kgNO_x olarak gerçekleşecek olup, bu değer TES_K'den %57,65 oranında (92 kgNO_x) daha azdır. BES'de gerçekleşecek olan NO_x salımı (67 kgNO_x), TES_{DG}'de gerçekleşecek olan NO_x salımından (152 kgNO_x) %55,56 oranında (85 kgNO_x) daha azdır.

Hayvansal biyokütle atıklardan üretilecek olan senelik toplam 76080 kWh elektriğin TES_K ve TES_{DG}'de üretilmesi durumunda sırasıyla, senede 256 kgSO₂ ve 12 kgSO₂ salımı gerçekleşecektir (Tablo 15). Kükürtdioksit (SO₂) salımı, BES'de 37 kgSO₂ olarak gerçekleşecek olup, bu değer TES_K'den %85,5 oranında (219 kgSO₂) daha azdır. BES'de gerçekleşecek olan SO₂ salımı (37 kgSO₂), TES_{DG}'de gerçekleşecek olan SO₂ salımından (25 kgSO₂) fazladır.

Tarım ve Orman Bakanlığı'na bağlı BÜGEM'e sunulan "Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi" onay ve tamamlanma süreci sonunda ise planlan hayvansal üretim atık değerlerine göre sera gazı emisyon değerleri Tablo 16'daki gibi oluşacağı tahmin ve hesap edilmektedir.

Tablo 16. Proje sonu oluşması beklenen hayvansal biyokütle atıklardan elektrik üretiminde sera gazı salımları

Elektrik Üretim Santrali (Planlanan Potansiyel)	Sera Gazı Salımları		
	kgCO ₂ -eş	kgNO _x	kgSO ₂
Kömür Yakıtlı Termik Santral (TES _K)	2328019	502	805
Doğal Gaz Yakıtlı Termik Santral (TES _{DG})	144478	478	41
Biyokütle Elektrik Santrali (BES)	10753	212	117
Hidroelektrik Santrali (HES)	2629	7	5

Hayvansal Biyokütle Atıklardan Elektrik Üretiminin Çevresel Maliyeti

Hayvansal biyokütle atıklardan, kurulu gücü 15 kW olarak tasarılacak olan birleşik ısı ve güç tesisinde (kojenerasyon tesisi) yıllık toplam 76080 kWh elektrik üretilebileceği belirlenmiştir (Şekil 4.10). Aynı miktar elektriğin, Kömür Yakıtlı Termik Santral (TES_K), Doğal Gaz Yakıtlı Termik Santral (TES_{DG}) ve Hidroelektrik Santralde (HES) üretilmesi durumunda çevre maliyeti değerleri Çizelge 4.14'de verilmiştir.

Hayvansal biyokütle atıklardan üretilecek olan senelik toplam 76080 kWh elektriğin TES_K ve TES_{DG}'de üretilmesi durumunda çevre maliyeti sırasıyla, 6535 EURO (€) ve 14295 € olacaktır. Çevre maliyeti, Biyokütle Elektrik Santralinde (BES) 5858 € olarak gerçekleşecek olup, bu değer TES_K'den %10,36 oranında (677 €) daha azdır. BES'de üretilen elektriğin çevre maliyeti, TES_{DG}'de üretilen elektriğin çevre maliyetinden %59 oranında (8437 €) daha azdır.



Çizelge 4.1. Hayvansal Biyokütle Atıklardan Mevcut Durumda Elektrik Üretiminde Çevre Maliyeti

Elektrik Üretim Santrali (Mevcut Potansiyel)	Çevre Maliyeti (€)
Kömür yakıtlı termik santral	6535
Doğal gaz yakıtlı termik santral	14295
Biyokütle Elektrik Santrali (BES)	5858
Hidroelektrik Santrali (HES)	228

Tarım ve Orman Bakanlığı'na bağlı BÜGEM'e sunulan "Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi" onay ve tamamlanma süreci sonunda ise planlan hayvansal üretim atık değerleri Çizelge 4.15'teki şekilde oluşacağı tahmin ve hesap edilmektedir.

Çizelge 4.2. Hayvansal Biyokütle Atıklardan Proje Sonunda Elektrik Üretiminde Çevre Maliyeti

Elektrik Üretim Santrali (Mevcut Potansiyel)	Çevre Maliyeti (€)
Kömür yakıtlı termik santral	20528
Doğal gaz yakıtlı termik santral	44903
Biyokütle Elektrik Santrali (BES)	18401
Hidroelektrik Santrali (HES)	717

SONUÇ ve ÖNERİLER

BTSTM yerleşkesi içerisinde bitkisel kökenli biyokütle atıkların enerji üretimi amacıyla değerlendirilebilecek miktarı 1810 ton/yıl olarak hesaplanmıştır. 2019 üretim sezonunda yetiştirilen buğday, arpa ve mısır ürünlerinin kullanılabilir senelik atık miktarları sırasıyla, 26,25 ton, 13,4 ton ve 1770,8 ton olarak hesaplanmıştır. Toplam 748 da alanda tane mısır üretimi sonucunda senede 1491,2 ton sap ve 279,6 ton sömek olmak üzere toplam 1770,8 ton kullanılabilir bitkisel biyokütle atık oluşmaktadır. 2019 üretim sezonunda buğday, arpa ve mısır atıklarının toplam ısı değeri 33437 GJ düzeyindedir.

Hayvansal kökenli biyokütle atıkların enerji üretimi amacıyla değerlendirilebilecek miktarı 150,8 ton/yıl olarak hesaplanmıştır.

BTSTM Hayvansal Üretim Birim Koordinatörlüğü, 2019 üretim sezonunda enerji üretimi amacıyla yararlanılabilecek hayvansal atıklarının (150,8 ton/yıl) toplam ısı değeri senelik olarak 684722,8 MJ düzeyindedir.

Enerji üretimi amacıyla yararlanılabilecek hayvansal atıklardan (150,8 ton/yıl) üretilebilecek toplam senelik biyogaz miktarı 30164 m³ olarak hesaplanmıştır. Hayvansal biyokütle atıklardan senelik olarak üretilebilecek olan 30.164 m³ biyogazın toplam ısı değeri 684722,8 MJ/yıl düzeyindedir.

Hayvansal kökenli biyokütle atıklardan üretilen toplam 30164 m³ biyogazdan toplam 76080 kWh elektrik üretilebilecektir. Hayvansal atıklardan toplam 76080 kWh elektrik üretilebilecek birleşik ısı ve güç tesisinin (kojenerasyon tesisi) kurulu gücünün toplam 15 kW olması gerektiği belirlenmiştir.

Tarım ve Orman Bakanlığı'na bağlı BÜGEM'e sunulan "Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi" onay ve tamamlanma süreci sonunda ise planlan hayvansal üretim atık değerlerine göre ise;



BTSTM Hayvansal Üretim Birim Koordinatörlüğü, bir üretim sezonunda enerji üretimi amacıyla yararlanılabilecek hayvansal atık miktarı 473,47 ton ve bu atıkların toplam ısı değeri senelik olarak 2150779,6 MJ olacaktır.

Enerji üretimi amacıyla yararlanılabilecek hayvansal atıklardan (473,47 ton/yıl) üretilebilecek toplam senelik biyogaz miktarı 94748 m³ ve bu biyogaz miktarının toplam ısı değeri 2150779,6 MJ/yıl olarak hesap edilmektedir.

Hayvansal kökenli biyokütle atıklardan üretilen biyogazdan toplam 238975 kWh elektrik üretilebilecektir. Hayvansal atıklardan toplam 238975 kWh elektrik üretilebilecek birleşik ısı ve güç tesisinin (kojenerasyon tesisi) kurulu gücünün toplam 60 kW olması gerektiği belirlenmiştir.

Karbondiyoksit (CO₂) salımı, BTSTM mevcut verileriyle Biyokütle Elektrik Santralinde (BES) 3423 kgCO₂-eş olarak gerçekleşecek olup, bu değer TES_K'den %95,48 oranında (72352 kgCO₂-eş) daha azdır. BES'de gerçekleşecek olan CO₂ salımı (3423 kgCO₂-eş), TES_{DG}'de gerçekleşecek olan CO₂ salımından (42357 kgCO₂-eş) %91,92 oranında (38934 kgCO₂-eş) daha azdır.

Azotoksit (NO_x) salımı, BES'de 67 kgNO_x olarak gerçekleşecek olup, bu değer TES_K'den %57,65 oranında (92 kgNO_x) daha azdır. BES'de gerçekleşecek olan NO_x salımı (67 kgNO_x), TES_{DG}'de gerçekleşecek olan NO_x salımından (152 kgNO_x) %55,56 oranında (85 kgNO_x) daha azdır.

Kükürtdiyoksit (SO₂) salımı, BES'de 37 kgSO₂ olarak gerçekleşecek olup, bu değer TES_K'den %85,5 oranında (219 kgSO₂) daha azdır. BES'de gerçekleşecek olan SO₂ salımı (37 kgSO₂), TES_{DG}'de gerçekleşecek olan SO₂ salımından (12 kgSO₂) 25 kgSO₂ daha fazladır.

Tarım ve Orman Bakanlığı'na bağlı BÜGEM' e sunulan "Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi" onay ve tamamlanma süreci sonunda ise planlan hayvansal üretim atık değerlerine göre ise;

Karbondiyoksit (CO₂) salımı, Biyokütle Elektrik Santralinde (BES) 10753 kg CO₂-eş olarak gerçekleşecek olup, bu değer TES_K'den %95,48 oranında (227266 kg CO₂-eş) daha düşük olacaktır. BES'de gerçekleşecek olan CO₂ salımı (10753 kg CO₂-eş), TES_{DG}'de gerçekleşecek olan CO₂ salımından (144478 kg CO₂-eş) %92,57 oranında (133725 kg CO₂-eş) daha az olarak hesaplanmıştır.

Azotoksit (NO_x) salımı, BES'de 212 kgNO_x olarak gerçekleşecek olup, bu değer TES_K'den %57,76 oranında (290 kgNO_x) daha az olacaktır. BES'de gerçekleşecek olan NO_x salımı (212 kgNO_x), TES_{DG}'de gerçekleşecek olan NO_x salımından (478 kgNO_x) %55,64 oranında (266 kgNO_x) daha az hesaplanmıştır.

Kükürtdiyoksit (SO₂) salımı, BES'de 117 kgSO₂ olarak gerçekleşecek olup, bu değer TES_K'den %85,46 oranında (688 kgSO₂) daha azdır. BES'de gerçekleşecek olan SO₂ salımı (117 kgSO₂), TES_{DG}'de gerçekleşecek olan SO₂ salımından (41 kgSO₂) 76 kgSO₂ daha fazla olacağı hesap edilmektedir.

Mevcut durumu itibarıyla BTSTM yerleşkesindeki hayvansal biyokütle atıklardan üretilen senelik toplam 76080 kWh elektriğin TES_K ve TES_{DG}'de üretilmesi durumunda çevre maliyeti sırasıyla, 6535 EURO (€) ve 14295 € olacaktır. Çevre maliyeti, Biyokütle Elektrik Santralinde (BES) 5858 € olarak gerçekleşecek olup, bu değer TES_K'den %10,36 oranında (677 €) daha azdır. BES'de üretilen elektriğin çevre maliyeti, TES_{DG}'de üretilen elektriğin çevre maliyetinden %59 oranında (8.437 €) daha azdır.



Tarım ve Orman Bakanlığı'na bağlı BÜGEM'e sunulan "Beydere Tohum Sertifikasyon Test Müdürlüğü Hayvansal Üretimi Geliştirme ve Atık Yönetimi Projesi" onay ve tamamlanma süreci sonunda ise planlan hayvansal üretim atık değerlerine göre ise;

BTSTM yerleşkesindeki hayvansal biyokütle atıklardan üretilmesi planlanan olan senelik toplam 238975 kWh elektriğin TES_K ve TES_{DG} 'de üretilmesi durumunda çevre maliyeti sırasıyla, 20528 EURO (€) ve 44903 € olacaktır. Çevre maliyeti, Biyokütle Elektrik Santralinde (BES) 18401 € olarak gerçekleşecek olup, bu değer TES_K 'den %10,36 oranında (2127 €) daha azdır. BES'de üretilen elektriğin çevre maliyeti, TES_{DG} 'de üretilen elektriğin çevre maliyetinden %59 oranında (26.500 €) daha az olacağı hesap edilmektedir.

Bu çalışma ile BTSTM yerleşkesindeki tarımsal kaynaklı bitkisel ve hayvansal biyokütle atıklarını sürdürülebilir bir metod dahilinde ve sosyo-ekonomik faydaları göz önünde bulundurarak, denetimli biçimde güncel teknolojilerden faydalanma imkanlarını geliştirecektir. Tarımsal biyokütle gereçlerinin enerji üretimi için değerlendirilmesi, artıkların ekonomiye katılımını sağlayacak ve BTSTM'nin enerji harcamalarını özellikle yerleşke enerji tüketimini karşılayacak olup kurumsal elektrik harcamalarını düşürecek ve örnek modern bir üretim tesisi olarak çevre tesislere faydalı olacaktır.



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DENTAL ANATOMY OF RABBITS AND ITS BLOCK ANESTHESIA

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ABSTRACT

Regional anesthesia is a commonly used adjunct to orofacial dental and surgical procedures in companion animals and humans. Applications in rabbits include analgesia related to dental procedures, treatment of trauma, and pain control during study procedures. We describe techniques for blocking the infraorbital nerve, maxillary nerve, mandibular nerve and mental (or incisive) nerve. All of the above methods of cranial nerve blockade will be used in further research. Complications of similar techniques in other species are rare and largely transitory.

Keywords: dental anatomy, analgesia, local anaesthetics, local block



BACKGROUND

Pain management in veterinary patients is an essential component of good patient care. Rabbits are usually anesthetized by intravenous or intraperitoneal injection, but rabbits may experience unsatisfactory analgesic effects or death due to overdose of the anesthetics during surgery. Local anaesthetic can completely block the transmission of nociceptive impulses, decreasing both intraoperative nociception and postoperative pain, while decreasing the potential incidence of adverse effects that can be associated with systemic boluses of drugs. All regional blocks described in this article can be effectively completed using knowledge of exotic animals anatomy, good palpation skills and appropriate injection technique (i.e. gentle insertion of the needle, aspiration prior to injection).

DISCUSSION

The dental formula of the rabbit is $2(I\ 2/1, C\ 0/0, PM\ 3/2, M\ 3/3) = 28$.

Rabbits are unique. They have 4 maxillary incisors (101, 102, 201, and 202) and 2 mandibular incisors (301 and 401) (picture 1, picture 3). Two of the maxillary incisors (102 and 202) are much smaller and are called the peg teeth. The peg teeth are located directly behind the larger set of 2 incisors (101 and 201). The premolars and molars are anatomically identical, making it difficult to differentiate of each tooth (Quesenberry, Katherine E., Carpenter, James W. 2012). Thus, the premolars and molars are simply called the cheek teeth. The lack of canine teeth creates an elongated diastema between the incisors and premolars. Rabbit mouths exhibit anisognathism, which means that their lower jaw is narrow when compared to the upper. Rabbits also have a maximum gape of about 20-25 degrees, which makes it difficult to evaluate teeth and dental procedures (Capello, Vittorio, 2005).

Rabbit teeth are classified as *elodont* (for their continuous growth with no anatomic root) and *hypsodont* (for having a long crown). Occlusal surfaces of the cheek teeth are irregular, providing a rough surface for grinding coarse, fibrous material. Normal side-to-side grinding movements of the jaw during mastication keep the teeth worn down to a proper length. Teeth wear down approximately 2 to 2.4 mm per week, depending on the rate of tooth growth and attrition. Any process that impedes the normal eruption and wear of elodont teeth has the potential for causing dental disease, which is divided into four main classes: congenital, traumatic, metabolic bone disease, and abnormal wear (Bohmer, Estella, 2015) (picture 2, 4).

TECHNIQUE

The infraorbital nerve is a branch of the maxillary nerve that exits the skull through the infraorbital foramina, located along the bony ridge just ventral to the eye. The infraorbital block is used for analgesia in the extraction of maxillary incisors. The infraorbital nerve is blocked near the infraorbital foramen. The infraorbital foramen, located rostrally from the medial angle of the eye, at the level of the first cheek tooth, serves as a reference point. The needle is inserted into the infraorbital foramen at an angle of 135° from the medial angle of the eye, then an aspiration test is performed and the anesthetic is injected (picture 5).

The maxillary nerve supplies sensation to the side of the nose, lower eyelid, upper lip, maxillary palate, maxillary teeth, and maxillary gingiva. A maxillary block is used to analgesic the maxillary cheek teeth and surrounding tissues. The infraorbital foramen serves as a reference point. The needle is inserted at an angle of 180° to the medial angle of the eye, parallel to the line of occlusion of the cheek teeth. In this case, in large rabbits, the needle is inserted deeper into the infraorbital canal (up to 1–2 cm), then an aspiration test is performed and the anesthetic is injected (picture 6).



The mental nerve exits the mandible at the mental foramen and enervates the soft tissues of the mandible abutting the canines and incisors. A mental nerve block is used to analgesia the mandibular incisors. The part of the mandibular nerve that exits through the mental foramen is blocked. The needle is inserted from the gum side into the mental foramen, then an aspiration test is performed and the anesthetic is injected (picture 5).

Mandibular block is used to analgesia the mandibular cheek teeth and surrounding tissues. The mandibular branch of the trigeminal nerve is blocked at the entrance to the mandibular foramen. Intraoral access is performed. (Yong-Di L, Zheng-Long T, Jian-Qin T, Dong-Xiang W, You-Li C., 2018).

There is also an alternative for this blockade (Lichtenberger, 2007). The needle is inserted from the medial side of the mandibular ramus 2–5 mm distal to the 3rd cheek tooth. It is inserted along the mandible towards a point midway between the distal part of the mandibular molar and the ventral point of the mandible (picture 6).

CONCLUSION

Locoregional techniques are used in exotic animals to improve perioperative analgesia as well as decrease the requirement of systemic analgesics during and after invasive surgeries. Numerous local and regional blocks are proven effective, thus providing the clinician with ample opportunity to include these blocks in practice. Unfortunately, there are downsides and complications to local anesthesia. For local anesthesia of the head area in rodents and lagomorphs, blind techniques are used, the implementation of which cannot provide one hundred percent effectiveness. In addition, there is a risk of intravenous injection of anesthetic, which in some cases can be fatal. Despite this, we must strive to provide quality anesthetic support for any patient, and in this case the use of local anesthesia can be an effective tool to achieve this goal.

All of the above methods of cranial nerve blockade will be used in further research.



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pic.6 (Atlas of Topographical Anatomy of Domestic Animals by Peter Popesko, edited by Vittorio Capello).



DROUGHT TOLERANT COOL SEASON FORAGE GRASS SPECIES TO COMBAT DESERTIFICATION

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ABSTRACT

Grasslands are an important source of feeds and biodiversity. Fresh forages are natural source of animal diets for sustainable production of good quality meat products. Overgrazing, desertification and climate change is threatening natural grasslands especially in Mediterranean region. High yielding forage grass species are important components for productivity in grasslands. High yielding and persistent grass cultivars in complex mixtures are needed be adopted drought-prone Mediterranean grasslands. Genebanks all around the world contain important wild cultivated plant species from *Poaceae* (grasses) which cover nearly all Earth's inhabitable ranges and contain important traits like apomixis. Some features of selected drought tolerant cool season forage grass species to combat grassland degradation and desertification in Mediterranean agroecology are subject in this review.

Keywords: Drought, cool season, forage grass, desertification, overgrazing



INTRODUCTION

Sustainable intensification concept was developed to increase productivity while reducing environmental costs which targets to increase yields per input (fertilizer, water, energy, land and chemicals) and to lower undesirable outputs (greenhouse gas emissions, water pollution and biodiversity loss). Grasslands are very important source of feeds to ruminants, habitats of biodiversity and soil carbon storages. But, grasslands are under threat due to intensification and land use shifts to arable fields worldwide (Taube et al., 2014). Grasslands are important all for agricultural production, socio-economic conditions and climatic environments in zones. High yielding forage grass species are major components for sustainable production in grasslands (Kopecký and Studer, 2014).

Fresh forages are natural source of vitamins and fatty acids in ruminant diets to produce high quality dairy and meat products (Elgersma et al., 2013). Variety of grass forage have significant impacts on the nutritional profile of animals (Van Elswyk and McNeill, 2014). Rapid improvement of community living standards increase the demand to animal products greatly, which led to shortage of high-quality forage supply which we observed a big scale example of this situation in China in last two decades. Insufficient supply of high-quality forage is preventing further increases in animal numbers. In China, grasslands cover 42% of the total land area however a gap exists between production of grass and livestock. Grass products like hay and silage are the bridges connecting grass cultivation and animal husbandry (Zhong et al., 2018).

Genebanks all around the world contain important genetic variation of both wild species and cultivated crop species. However, most of this genetic variation, especially wild species and minor crops, is uncharacterized. Using multiple (molecular and phenotypic) characterization systems for assessing diversity in genebank collections might be an appropriate method (Fjellheim et al., 2015). Understanding the morphologic and genetic characteristics related to the form and function of forage species will help to identify highly productive plants (Silveira et al., 2010).

Flowering plant taxon *Poaceae* (grasses) cover nearly all Earth's inhabitable ranges. It also includes most commonly utilised families (wheat, rice, maize etc.) for human and animal nutrition. Some members with important traits are considered orphan crops due to the lack of sequenced genome which make them attractive for sequencing. As an example to these traits is the apomixis (clonal reproduction by seeds) in *Poaceae*. Understanding and manipulating the genetics of apomixis may totally revolutionize agriculture (Carballo et al., 2019).

Candidate species to combat desertification and drought stress

Extensive livestock production is a basic system in rainfed Mediterranean agriculture but overgrazing and desertification of natural grasslands and climate change is threatening this system. Cultivation of improved, drought-tolerant perennial forages may help to alleviate these constraints. When yield and persistence of grass cultivars assessed across Mediterranean drought-prone areas, tall fescue (*Festuca arundinacea*) has general interest. Completely summer-dormant cocksfoot (*Dactylis glomerata*) with improved yield can be useful in warmer sites (Annicchiarico et al., 2013).

Approximately 41% of the earth's land surface is covered with arid, semi-arid or dry subhumid areas. Desertification and soil degradation are common problems leading to low soil fertility and productivity in these regions. Revegetation by using locally adapted native species may help to ameliorate desertification processes in these zones. C4 perennial grass *Trichloris crinita* has good forage quality, drought tolerance, resistance to grazing and rapid growth capacity. Worldwide different field trials showed great forage and for restoration potential of



T. crinita genotypes under different habitats and environments (Kozub et al., 2018). *Trichloris crinita* is a perennial forage grass native to arid zones of the American continent. It is a widely distributed and utilised species with good forage quality and resistance to grazing and drought. This species is suitable for revegetation purposes in environments with low water availability. But genetic improvement of *Trichloris crinita* is limited due to lack of reproducing knowledge. It is a sexually reproducing, self-compatible and autogamous species (Kozub et al., 2017).

Plants develop physiological responses triggered by genetic or epigenetic changes to overcome environmental stress. Apomixis is the formation of asexual seeds without meiosis which occurs through deregulation of the sexual process by genetic and epigenetic factors under influence of the environment (Rodrigo et al., 2017). Apomixis mechanism is a clonal propagation through seeds avoiding meiosis to generate an embryo sac, parthenogenesis and endosperm. *Eragrostis curvula* (weeping lovegrass) is an apomictic species native to Southern Africa that is used as forage grass in semiarid regions of Argentina (Zappacosta et al., 2019). It is an invasive species (Roberts et al., 2021). Weeping lovegrass is well adapted for soil conservation and forage production in semi-arid regions (Zappacosta et al., 2011).

Livestock production is the main source of livelihood in Africa in the arid and semi-arid zones. But desertification (vegetation degradation and soil erosion) threatening sustainability production systems in these areas. Native rangeland forage species *Cenchrus ciliaris* (Buffel grass), *Eragrostis superba* (Maasai love grass) and *Enteropogon macrostachyus* (Bush rye grass) have been used to overcome desertification. These species are forage for livestock and tools for rehabilitation purposes (Mganga et al., 2015). Genetic improvement by conventional breeding at apomictic forage grass *Cenchrus ciliaris* L. is difficult and time-consuming (Kumar and Bhat, 2012).

Efforts to breed tropical grasses are still limited to species such as *Panicum* spp, *Cenchrus* spp, *Pennisetum* spp and *Bracharia* spp. Because, apomixis, poor seed set, high levels of photosensitivity and thermosensitivity are often problem for other species in breeding programmes. But modern biotechnology tools for identification of sexual lines open new opportunities to improve these crop groups (Sandhu et al., 2019).

Physiological and biochemical reactions of five forage grass species (*Lolium perenne*, *Lolium multiflorum*, *Festuca pratensis*, *Festuca arundinacea* and *Festulolium braunii*) were evaluated under mild drought stress conditions in an experiment. *L. multiflorum* in the first and *F. arundinacea* in the second year were most drought tolerant species based on total dry matter yield and drought tolerance (Fariaszewska et al., 2020).

Elephant grass (*Pennisetum purpureum*) shows a great potential to alleviate the problem of shortage of feed, particularly during the dry season in the tropics by its drought resistance and high dry matter yield potential (Rusdy, 2016). Elephant grass is a perennial, tropical, high forage yielding C-4 grass. To improve its productivity and nutritive forage value more under low temperature and drought stress, pearl millet × napier grass hybrids were developed (Turano et al., 2016).

Cool season grasses

Forage-based livestock systems have complex interactions among animals, plants and the environment at multiple levels (Pequeno et al., 2014). Freezing tolerance and adaptation to extreme temperature is crucial for the survival of perennials in different environments (Borawska-Jarmułowicz et al., 2014).

Dry matter production by complex forage mixtures is generally highly affected by dominant species, but nutritive value relate to multiple components. In Pennsylvania and Wisconsin 15 mixtures and monocultures of orchardgrass (*Dactylis glomerata*), quackgrass (*Elymus repens*), alfalfa (*Medicago sativa*), and white clover (*Trifolium repens*), or of meadow fescue



(*Schedonorus pratensis*), reed canarygrass (*Phalaris arundinacea*), red clover (*Trifolium pratense*), and kura clover (*Trifolium ambiguum*) were harvested five times every year. White clover (*T. repens*) and meadow fescue (*S. pratensis*) had a positive additive effect on forage digestibility, but alfalfa (*M. sativa*) and reed canarygrass (*P. arundinacea*) had no additive effect on digestibility. Legumes generally had a negative additive effect and grasses a positive effect on forage neutral detergent fiber concentration. As a result, it was found that highly nutritive species have a disproportionate effect on nutritive feature of complex mixtures (Brink et al., 2015).

Examples to cool season grass species are perennial ryegrass (*Lolium perenne*), tall fescue (*Festuca arundinacea*), and orchardgrass (*Dactylis glomerata*). Perennial forage grass Orchardgrass is economically important with high biomass, abundant carbohydrates, shade tolerance and wide adaptability. Time of flowering is an important agronomic character strongly related to the quality and yield of orchardgrass (Feng et al., 2020). Understanding vertical distribution of nutritive value in cool season grasses may help to manage nutritional value of residual mass and plant height (Naveet al., 2014). Determining nonstructural carbohydrates in plant tissues may help to estimate resources available for growth and stress tolerance or for feed value of plant to grazing animals (Zhao et al., 2010). Tools assisting producers to make decisions in forage–livestock production systems are rare. Crop models simulating forage production may help to predict growth of grasses under rainfed conditions (Pequeno et al., 2014).

Five grass species of *Festuca* and *Lolium* genera were compared under two fertilization regimes (190 or 300 kg N ha⁻¹ yr⁻¹). Highest yielding species was Hybrid ryegrass (*Lolium x boucheanum*) in the first year but tall fescue (*Festuca arundinacea*) in the second year. Meadow fescue (*Festuca pratensis* L.) species was always yielded lowest (Cougnon et al., 2014).

Cool-season grasses (*Poaceae* subfamily *Pooideae*) are an important forage component for livestock but many have seed-transmitted symbionts of fungal endophytes genus *Epichloë*. *Epichloë* strains can produce several classes of alkaloids (ergot alkaloids and indole-diterpenes) which can be toxic to mammalian and invertebrate herbivores (Shi et al., 2017).

CONCLUSIONS

Adaptation of high yielding, toxic ergot alkaloids and indole-diterpenes tolerant, drought tolerant, cool season forage grass species are needed to be determined to combat grassland degradation and desertification in Mediterranean agroecology. As a selection criteria, existence of environmental stress overcome mechanism Apomixis may be a good indicator to select suitable forage species to combat desertification. Need to conduct different complex mixture studies in Mediterranean regions with species of *Festuca arundinacea*, *Dactylis glomerata*, *Trichloris crinita*, *Eragrostis curvula*, *Cenchrus ciliaris*, *Eragrostis superba*, *Enteropogon macrostachyus*, *Lolium multiflorum*, *Pennisetum purpureum*, *Elymus repens*, *Schedonorus pratensis*, *Phalaris arundinacea*, *Lolium perenne*, Hybrid ryegrass (*Lolium x boucheanum*).

Need to support breeders in choosing target species and plant types, support and agronomists in setting site-specific forage recommendations for each agroclimatic macro basin in Anatolia. But species tolerance to toxic ergot alkaloids and indole-diterpenes must be a criteria to protect feeding mammalian and invertebrate herbivores.



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ACUTE TOXICOLOGICAL EFFECTS, *IN VITRO* AND *IN VIVO* ANTIMALARIAL ACTIVITIES OF AQUEOUS ROOT BARK EXTRACT OF *CALOTROPIS PROCERA*

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ABSTRACT

Toxicity of the indigenous herbal plant and emergence of resistant strains of malarial parasite to conventional antimalarial drugs used in the treatment of malaria cannot be underestimated. Therefore, this necessitates continuous search for new non-toxic antimalarial drugs to combat the menace. As such, acute toxicological effects, *in-vitro* and *in-vivo* antimalarial activities of aqueous extracts of *Calotropis procera* root bark were carried out using standard methods. The LD₅₀ was found to be greater than 5000 mg/kg bodyweight as no mortality was observed after the single administration of all selected doses. *In-vitro* antimalarial activities of the aqueous extract at dose 500 µg/mL showed 100 % clearance of the parasite ($P < 0.01$) when compared with 1000 µg/mL, 2000 µg/mL, 5000 µg/mL and ACT. Likewise, aqueous extract at dose of 500 mg/kg bw. showed the highest parasitemia clearance ($P < 0.05$) in *P. berghei* infected mice as compared to the group of mice that received 150 mg/kg bw. and 250 mg/kg bw. of the aqueous extract. Therefore, the results indicate that *C. procera* root bark is practically safe with high *in vitro* and *in vivo* antimalarial activities in red blood cells and *Plasmodium berghei* infected mice respectively.

Keywords: Acute toxicity, aqueous extract, *C. procera*, *Plasmodium berghei*



INTRODUCTION

Malaria is a protozoa disease caused by a eukaryotic protist of the genus *Plasmodium*. There are four distinct species that infect humans: *P. falciparum*, *P. vivax*, *P. malariae* and *P. ovale*. A fifth species, *P. knowlesi*, is a zoonotic that causes malaria in macaques but can also infect human (Singh *et al.*, 2004). The parasites are naturally transmitted by the female Anopheles mosquito from the blood of an infected host to the blood of an uninfected. Malaria even though today is a disease of poverty and underdeveloped countries, but it still remains an important health problem globally. In the last decade, the prevalence of malaria has been escalating at an alarming rate, especially in Africa. An estimated 300 to 500 million cases each year cause 1.5 to 2.7 million deaths, more than 90% in children under 5 years of age in Africa (Good, 2001; Sachs and Malaney, 2002). It is widespread in tropical and subtropical regions, including parts of the Americas, Asia and Africa. A total of 109 countries were endemic for malaria in 2008, within the WHO African region (WHO, 2008; Batista *et al.*, 2009). Antimalarial drug resistance typically arises when there are spontaneous mutations that are selected by different concentrations of antimalarial drug that impart differential inhibition to distinct genetic parasite types, that is, the drug concentrations are sufficient to reduce the susceptible parasite population, but can either not inhibit multiplication or cause less inhibition of the mutants (Peters, 1990). Drug resistance to several antimalarials is sometimes either due to changes in drug accumulation or efflux mechanisms (chloroquine, amodiaquine, quinine, halofantrine, mefloquine resistance) or due to decreased affinity of the drug target which may result from point mutations in the respective genes that encode these targets (pyrimethamine, cycloguanil, sulphonamide, atovaquone, artemisinin resistance) (Ariey, *et al.*, 2014; Miotto *et al.*, 2013). In view of the problems associated with antimalarial drug resistance and prevalence of fake drugs in general circulation in Nigeria, new drugs or drug combinations are urgently required today for treatment of malaria.

Calotropis procera is a plant which grows as a spreading shrub or a small tree. It belongs to the plant family Asclepiadaceae and is called by many names, some of which are; apple of Sodom, ashkhar, desert apple, giant milkweed, rubber bush, Sodom apple and Sodom's milkweed. In Hausa language, the plant is known as *tumfafiya* and it is used to treat ingested poison by the Hausas. It is also used by the 'yan tauri' to make their medicinal mixture which makes weapons made out of iron incapable of penetrating their bodies. It is used in the Sudanese, Unani, Arabic and Indian traditional medicinal system for the treatment of various diseases namely leprosy, ulcers, piles and diseases of the spleen, liver and abdomen (Kartikar and Basu, 1994).

There are two common species of *Calotropis* and they are *Calotropis gigantea* (Linn.)R.Br. and *Calotropis procera* (Ait.)R.Br. as described by the Sanskrit writers (Yelne *et al.*, 2000). *Calotropis procera* is a highly adapting plant, which can withstand 2000mm annual precipitation and establishes very fast in open habitat with little competition. It is a multi-function plant. The bark and latex are used in brewing and to curdle milk. Its young pods, senescing leaves and flowers are eaten by goats, occasionally by sheep in times of need, and rarely by cattle and other livestock.

Toxicity studies of herbal extracts in animals are commonly used to assess potential health risk in humans, caused by intrinsic adverse effects of chemical compounds or plant extracts (Ashafa and Olunu, 2011). Research up to this point has been able to establish that ethanolic extracts of *Calotropis procera* flowers, flower buds, roots and stem possess antimalarial properties (*in vitro*) but with cytotoxicity (due to haemolysis) (Gupta *et al.*, 2012). But research on the antimalarial activity (*in vitro* and *in vivo*) of aqueous and methanol extracts of the plant and their safety on erythrocytes is yet to be ascertained.



MATERIALS and METHODS

Plant Material

Sample Collection

Fresh samples of *C. procera* roots were obtained at various locations in the city of Kano, Kano State, Nigeria. The plant was taxonomically identified and authenticated by the botanist at the Herbarium of the Department of Plant Biology, Bayero University Kano and was given a Herbarium Accession Number BUKHAN 0265.

Sample preparation

The fresh root barks of *C. procera* were shade dried at room temperature and then pulverized using mortar and pestle to a coarse powder.

Preparation of Aqueous Extract

The pulverized dried root (200g) was soaked in 1000ml of distilled water and left to macerate for 48 hours with intermittent shaking. It was filtered using three layers of cheese cloth and a clear extract was obtained using Whatman no.1 filter paper. The filtrate was finally dried in a water bath, weighed and kept in a cool dry place.

Acute Oral Toxicity Study

This was designed and conducted in two phases. Phase I consisted of 12 rats of the 16 albino rats. They were grouped into three (3) groups of four (4) rats each, and treated with 10, 100 and 1000 mg/kg body weight of root bark aqueous extract and observed after 24 hours for signs of toxicity such as weakness, puffy hair, shivering and death. In Phase II, 4 rats were used and grouped into four (4) groups of one (1) rat each. The groups were treated with 1,500, 2,500, 3,500, and 5,000mg/kg body weight and observed after four hours and beyond, according to Lorke (1983).

Calculation

To determine the LD₅₀, this formula is used:

$$LD_{50} = \sqrt{\text{maximum concentration of no death} \times \text{minimum concentration of full death}}$$

Preparation of Methanol Extract

Exactly 600g of the pulverized plant material were defatted with n-Hexane for 72 hours by modification of the method of Githinji *et al.*, (2012). Afterwards, the filtrate was decanted off and the residue allowed to air dry at room temperature and macerate in absolute methanol (500ml per 100g) for 48 hours with shaking at regular intervals. It was finally filtered to a clear extract as for the aqueous extract, evaporated in water bath and the residues kept in an airtight container in cool dry place until used.

Extract and standard drug (ACT) dilution for *in vitro* antimalarial assay

Exactly 20mg of the prepared extract, ACT (for positive control) and NaCl (for normal control) was measured into labeled sterile bottles. To each bottles, 1.0ml of Dimethyl sulfoxide (DMSO) was added to give a stock solution.

Serial doubling dilution was employed to give four different concentrations (0.5mg/ml, 1mg/ml, 2mg/ml and 5mg/ml). This was achieved by the addition of 0.95ml of DMSO to 0.05ml of the stock solution to obtain 0.5mg/ml, 0.9ml of DMSO to 0.1ml of stock solution to obtain 1mg/ml, 0.8ml of DMSO to 0.2ml of stock solution to obtain 2mg/ml and 0.5ml of DMSO to 0.5ml of stock solution to obtain 5mg/ml.



Preparation of working concentration of extract and standard drug (ACT) for *in vivo* antimalarial assay

Each of the extract of above (aqueous and methanol extracts respectively) of *C. procera* was diluted to 15mg/ml by dissolving 0.75g in 50ml of water for administration to different group of experimental animals at doses 150mg/kg, 250mg/kg and 500mg/kg. Likewise, solution of an artemisinin based drug (ACT) (positive control) was prepared by dissolving 0.75g equivalent active components of crushed tablets in 50ml of distilled water to achieve 15mg/ml concentration and treated the animal with dose of 250mg/kg body weight.

***Plasmodium beighei* culture medium**

Roswell Park Memorial Institute 1640 (RPMI 1640) medium was prepared and sterilized using the standard method of Trager (1982), in which 10.4g of the powdered material was dissolved in 1 litre of distilled and then was autoclaved at 121°C for 15mins. The medium was then sterilized with 40µg/ml of gentamycin sulphate. The medium was then supplemented with about 5ml of serum obtained from apparently healthy rabbits and thus, was ready for subsequent *in vitro* antimalarial study.

Parasitized mice “source of malaria parasite”

Parasitized mice already infected with chloroquine-sensitive strain of *Plasmodium beighei* were obtained for the *in vitro* antimalarial assay from the College of Pharmaceutical Sciences, Obafemi Awolowo University, Ile-Ife, Oyo State. They were also fed with standard pellet diet (Pelletised Growers Feed, Vital Feed, U.A.C.) and water *ad libitum*. The existence of *P. beighei* schizogonic phases (young and mature trophozoite and schizont stages) in erythrocytes were confirmed by microscopic examination of thin blood smears, hence the % parasitaemia in each mouse.

Evaluation of *in vitro* antimalarial activity

Inoculation of *P. beighei* into RPMI 1640 medium and incubation with extracts

Blood obtained from the parasitized mice with % parasitaemia (6.5%), was collected in a plain, sterile bottle and centrifuged at 1500rpm for 15mins. The supernatant was discarded and the sediment (erythrocytes) diluted with normal saline. This was centrifuged at 2500rpm for another 10mins. The supernatant was discarded leaving the parasitized erythrocytes suspended in the normal saline. 1ml of each of the aqueous, methanol, ACT and normal saline working extracts was added to labeled sterile bottle and then, 1ml of the culture medium (above) prepared was added. Finally 0.1ml of the parasitized erythrocytes was added to each of the bottles. The bottles were shaken mildly to ensure even distribution of the erythrocytes and were then incubated at 37°C in a bell jar containing a lighted candle to ensure the supply of required quantity of gas (about 5% O₂, 2% CO₂ and 93% Nitrogen) as demonstrated by Mukhtar *et al.* (2006).

Determination of antimalarial activity of extracts

At the end of the incubation period (24-48 hours,) a drop of the thoroughly mixed aliquot of the culture was smeared on microscopic slides to make thin films. These were then fixed in absolute alcohol and stained by Giemsa staining technique. The mean number of erythrocytes appearing as blue discoid cells containing life rings of parasites (that appeared red pink) was estimated and the average percentage elimination of the samples determined. The activity of the tested extract was calculated as the percentage elimination of the parasites after the incubation period using the formula below:

$$\% \text{ Activity} = \frac{\text{No. of cleared RBC}}{\text{Total no. of RBC}} \times 100$$



Making of Thin Film, Fixing of Thin Film and Giemssa Staining Technique were carried out as described by Cheesebrough (2010).

Microscopy

Each of the stained slides was mounted on the stage of the microscope. A drop of immersion oil was applied onto the slide and $\times 100$ objectives (oil immersion objective) was used to selected three (3) areas/fields for counting number of parasitized cells. Percentage parasitaemia of the mice were obtained by using the formula:

$$\% \text{ Parasitaemia} = \frac{\text{Number of infected cells}}{\text{Total number of cells}} \times 100$$

Results

Table 1a: Phase I LD₅₀ (Oral, Rat) Determination of the Aqueous Extracts of *C. Procera* Root Bark

Doses(mg/kg body weight)	No. of Animals Used	Mortality
10	3	0
100	3	0
1000	3	0

Table 1b: Phase II LD₅₀ (Oral, Rat) Determination of the Aqueous Extracts of *C. Procera* Root Bark

Doses (mg/kg body weight)	No. of Animals Used	Mortality
1500	1	0
2500	1	0
3500	1	0
5000	1	0

In vitro antimalarial analysis

Figure 1 shows the result of *in vitro* antimalarial activity of aqueous and methanol extracts of *C. procera* and ACT (artemether and lumefantrine) as positive control while normal saline was used as the negative control. Each of the samples (aqueous, methanol, ACT and normal saline) were administered in 4 doses each. The doses were; 500 $\mu\text{g/ml}$, 1000 $\mu\text{g/ml}$, 2000 $\mu\text{g/ml}$ and 5000 $\mu\text{g/ml}$. The percentage of cells cleared of parasitaemia in 48 hours of treatment was given as %Activity while the percentage of parasitized cells remaining after 48 hours of treatment was given as %Parasitaemia. The aqueous and methanol extract showed significant percentage antimalarial activity ($P < 0.05$) at doses of 500 $\mu\text{g/ml}$ and 1000 $\mu\text{g/ml}$ each when they were compared with both %Activity and %Parasitaemia of WHO recommended ACT. Although the %Activity of the ACT was low at lower doses, it still served as an excellent standard with which the extracts were compared.

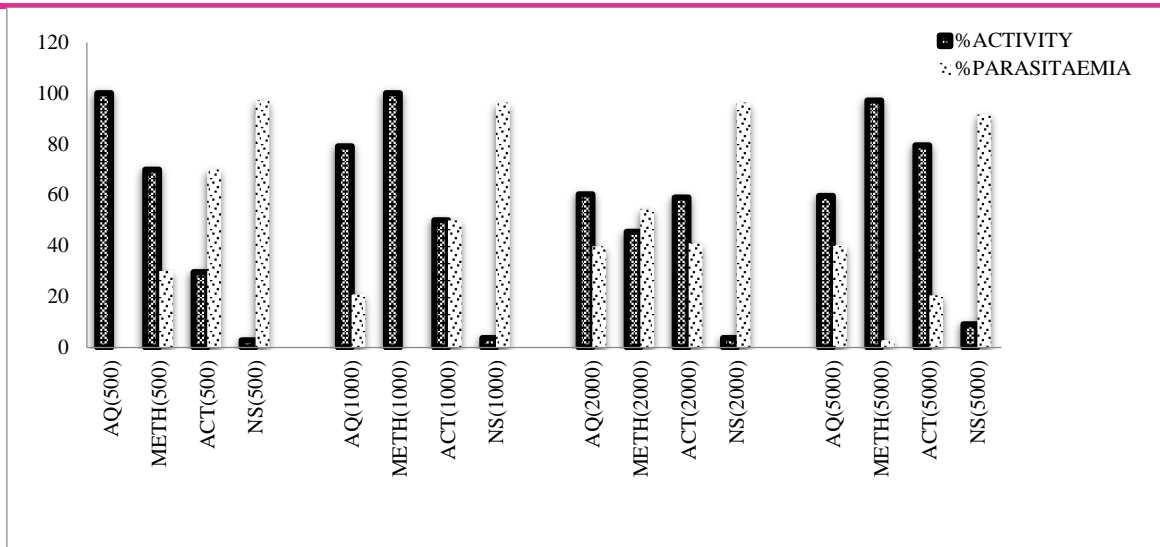


Fig. 1: Forty-Eight Hours *In Vitro* Percentage Antimalarial Activity of Aqueous And Methanol Root Bark Extracts of *C. Procera* And ACT in Media Inoculated with *P. Beighei* Infected Erythrocytes

Key: AQ: Aqueous Extract, METH: Methanol Extract, ACT: Artemisinin Combination Therapy, NS: Normal Saline

***In Vivo* Antimalarial Analysis**

Figure 2 shows the average percentage (%) parasitaemia obtained from mice infected with *P. beighei* on days 0, 3, 6 and 9 of commencement of treatment with aqueous and methanol extracts of *C. procera* and ACT tablets. Day 0 corresponds with the 7th day after infecting the mice with parasitaemia.

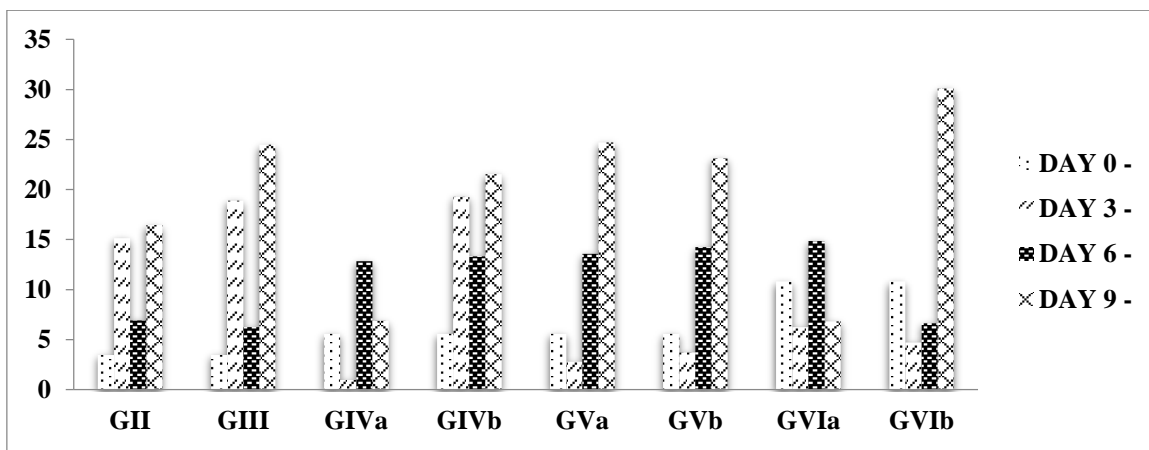


Fig. 2: Percentage Parasitaemia of Mice Treated with Aqueous and Methanol Extracts of *C. procera* and ACT on the Days 0, 3, 6 and 9 of Administration of Drug/Extract

Key: GI- Normal control, GII- Negative control, GIII- Chloroquine 250mg/kg treated, GIVa- Aqueous *C. procera* 150mg/kg treated, GIVb- Methanol *C. procera* 150mg/kg treated, GVa- Aqueous *C. procera* 250mg/kg treated, GVb- Methanol *C. procera* 250mg/kg treated, GVIa- Aqueous *C. procera* 500mg/kg treated, GVIb- Methanol *C. procera* 500mg/kg treated



DISCUSSION

The acute toxicity studies of aqueous extracts of *C. procera* were carried out in two phases. The extract did not produce any negative behavioural changes such as restlessness, excitement, respiratory distress, convulsions or coma. Also, no deaths were recorded in both phases.

Malaria is one of the most infectious diseases in the world today and of recent, antimalarial drug resistance has become one of the most important challenges to malarial control efforts (Abdellah, *et al.*, 2011; Hossein *et al.*, 2012). This is what has led researchers to look for other alternatives to solving the problem which also involves the search for new herbs that can cure malaria. This research was therefore, aimed at determining the *invitro* and *invivo* antimalarial activities of aqueous and methanol extracts of *C. procera* root bark in addition to carrying out the acute and sub-chronic toxicity studies of the plant.

In vitro antimalarial activity of both aqueous and methanol extracts of *C. procera* orally administered at four different concentrations is summarized in Fig. 1. Significant antimalarial activity was observed at 500µg/ml and 1000µg/ml of aqueous and methanol extracts of *C. procera* root barks respectively with 100% parasite clearance observed in both cases. This result agrees with the finding of Mudi and Bukar (2011) in which the highest antimalarial activity was observed at 1000µg/ml methanol fraction of *C. procera* leaf extracts. Although they had no lesser concentrations, this research shows that 500µg/ml, aqueous extract of *C. procera* is as good as the methanol extract of *C. procera* in *in vitro* antimalarial activity. This antimalarial activity could be attributed to the presence of flavonoids, cardiac glycosides (Kraft *et al.*, 2003; Chanphen *et al.*, 1998) and triterpenoids (Nogueira and Lopes, 2011). Also, in this research it is observed that the activity of these two extracts is higher than the WHO currently recommended ACT therapy, which showed high significant difference ($P<0.01$) and ($P<0.05$) at concentrations of 500µg/ml and 1000µg/ml respectively when compared with the ACT therapy. Moreso, *C. procera* root bark contains phytochemicals such as glycosides and terpenoids (Gupta *et al.*, 2003; Seiber *et al.*, 1982) which act more rapidly than other types of antimalarial, both in killing parasites and in inhibiting their major metabolic processes, such as glycolysis, nucleic acid and protein synthesis.

In vivo analysis was carried out and average percentage parasitaemia of each drug or extract was evaluated by observing the trend of apparent cure from Day 0 before commencement of treatment (7 days post-inoculation) to Day 9 of treatment (fig. 2). GVIA was observed to bring about the highest continuous reduction in parasitaemia with percentage parasitaemia ($P<0.05$) on Day 0, Day 3, Day 6 and Day 9 of treatment when compared with the initial percentage parasitaemia. This continuous decrease suggests clearance of the parasite by the drug but complete clearance could not be achieved probably due to the poor storage method employed during the course of the studies. The increase observed on Day 6 might be as a result of recrudescence of *P. beighei* parasite after apparent cure (Samuel, 1996). This is shown clearly on Plates 26 and 29 where merozoites bursting out of an erythrocyte could be seen.

CONCLUSION

The results obtained suggest that the aqueous root extract of *C. procera* is practically non-toxic. Both aqueous and methanol extracts of *C. procera* showed antimalarial activity at 500µg/ml and 1000µg/ml respectively in the *in vitro* analysis. In the same vein, the aqueous extract of *Calotropis procera* showed significant antimalarial activity when the extent of antimalarial activities of the extract on days 0, 3, 6 and 9 were compared.



ETLİK PİLİÇ KARMALARINDA FİTAZ ENZİMİ KULLANIMININ YEM FOSFORUNDAN YARARLANMAYA VE PERFORMANSA ETKİLERİ

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ÖZET

Bu çalışma mısır-soya küspesi temeline dayalı farklı düzeylerde toplam fosfor ve kalsiyum içeriğine sahip başlangıç ve bitirme etlik piliç karmalarına mikrobiyal fitaz enzimi ilavesinin canlı ağırlık, canlı ağırlık artışı, kesim randımanı, yem tüketimi, yemden yararlanma, dışkı fosfor ve kalsiyum içeriği, fosfor ve kalsiyumdan yararlanma, başlangıç ve bitirme dönemi gübre kuru madde ve kül içeriği, tibia kemik külü ve kuru madde içeriği, kemik fosfor ve kalsiyum içeriği gibi kriterler üzerine etkisini incelemek amacı ile yapılmıştır. Bu çalışmada standart düzeyde kalsiyum ve fosfor içeren DCP'li kontrol karması ile düşük fosforlu, düşük kalsiyumlu ve kalsiyum ve fosforu düşük 1000 ppm fitaz enzimi ilaveli karmalar hazırlanmıştır. Düşük fosfor içerikli karmalara (2. ve 4. grup) yapılan fitaz enzimi ilavesi neticesinde fosfordan yararlanma iyileşmiş ve gübre ile atılan fosfor miktarı azalmıştır. Diğer taraftan karma kalsiyum içeriğinin düşürülerek (3. ve 4. gruplar) fitaz enzimi ilavesi de kalsiyumdan yararlanmayı arttırmamış ve gübre ile atılan kalsiyum miktarını azaltmıştır. Kanatlı karmalarına fitaz enzimi ilavesi fosfor ve kalsiyumdan yararlanmayı arttırıp her iki dönemde de (0-3 hafta ve 3-6 hafta) en iyi canlı ağırlık artışını sağlamıştır ($P \leq 0.05$). Ayrıca, fitaz enzimi ilavesi ile başlangıç döneminde (0-3 hafta) canlı ağırlık artışı iyileşirken yem tüketimi ve gübre kuru madde içeriği düşmüş, her iki dönemde de gübre ile atılan fosfor içeriği azalmıştır ($P \leq 0.05$).

Anahtar Kelimeler: Fitaz enzimi, fosfor, kalsiyum, etlik piliç



EFFECTS OF USING PHYTASE ENZYME IN BROILER DIETS ON FEED'S PHOSPHORUS UTILIZATION AND PERFORMANCE

ABSTRACT

This study was carried out to the effects of supplementation of phytase enzyme to starter and finisher broiler diets that have different calcium and phosphorus levels to based on maize-soybean, on live weight, live weight gain, carcass yield, feed intake, feed conversion, phosphorus and calcium content of excreta, utilization phosphorus and calcium, excreta dry matter and ash contents of starter and finisher periods, tibia bone dry matter and ash contents, calcium and phosphorus contents of tibia bone. In this study was prepared control diet has standard calcium and phosphorus levels with DCP, a low phosphorus diet, a low calcium diet and another diet has a low phosphorus and calcium together supplemented with 1000 ppm phytase. Addition phytase enzyme on a low phosphorus diet (group 2 and 4) resulted in increase utilization phosphorus and decreased phosphorus excretion. On the other hand, decreasing calcium levels with phytase (group 3 and 4) didn't improved utilization calcium and decreased calcium excretion. Decreasing phosphorus and calcium levels together and adding phytase increased utilization phosphorus and calcium, body weight and body weight gain at the starter and finisher periods more than other treatments. This group had the best feed intake and excreta dry matter and calcium content of excreta at the starter period and phosphorus content of excreta at the starter and finisher periods.

Keywords: Phytase, phosphorus, calcium, broiler



GİRİŞ

Fosfor, hayvan beslemede esansiyel öneme sahip olan bir elementtir. Yaşamsal öneminin yanı sıra iskelet dokusunun yapımı ve gelişiminde ayrıca birçok metabolik fonksiyonun gerçekleşmesinde son derece önemlidir (Simons et al. 1990). Fosforun organizmada oldukça önemli görevleri bulunmaktadır. Kemik ve dişlerin formasyonunu ve hücre içi metabolizma faaliyetlerinin düzenlenmesini sağlar. Kas ve sinir sistemi fonksiyonlarında görev alır. Organizmada protein, yağ ve karbonhidrat metabolizmalarında görev alarak enerjinin serbest hale geçmesini ve taşınmasını sağlar. Kanın asit-baz dengesine etki eder. Çeşitli enzimlerin yapılarına girer. Molekül halinde nükleik asitlerin ve bazı proteinlerin yapılarında bulunur (Sevgican, 1977). Kanatlılar yemlerle aldıkları fosforun % 80'ini iskelet yapımında kullanırken geri kalan %20'sini nükleik asitlerin, fosfolipitlerin, koenzimlerin ve adozin fosfatların teşekkülünde kullanırlar (Dozier, 2000). Fosforun çok önemli olan bu yapısal ve fizyolojik görevlerinden dolayı hayvanlara mutlaka ihtiyaçları düzeyinde verilmesi gerekmektedir.

Ticari olarak yetiştiriciliği yapılan tüm kanatlı hayvanların karma yemlerinin hemen hemen tamamı bitkisel kaynaklı dane yemler ve küspelerden oluşmaktadır (Erkek ve ark., 1994). Kanatlı karmalarında kullanılan dane yemler, küspeler ve bitkisel kaynaklı yan ürünlerdeki toplam fosforun 2/3' ü kanatlılar tarafından yararlanılamayan ve çoğunluğu gübreyle dışarıya atılan fitik asite bağlı fosfor formunda (fitat fosforu) bulunmaktadır (Gheisari et al., 2003). Kanatlılar ve diğer monogastrik hayvanlar, danelerdeki fitik asidi hidrolize ederek fosfordan yararlanmalarını sağlayan fitaz enzimine sahip olmadıkları için karmalardaki yem hammaddelerinin yapısında bulunan fosfordan yararlanamazlar (Nelson et al. 1971). Bu durum ekonomik ve çevresel açıdan oldukça önemli sonuçları da beraberinde getirir. Fitaz enzimi, kanatlı karmalarında kullanılan yem hammaddelerinin yapısında bulunan ve normal koşullarda değerlendirilemeyen bir takım minerallerin ve diğer besin maddelerinin sindirime olanak sunarak yararlılıklarını artırır ve aynı zamanda bu besin maddelerinin artan sindirimi gübredeki miktarlarını azaltarak fosfor kaynaklı çevresel kirliliğin azalmasına yardımcı olur (Simons et al. 1990). 1990'lı yıllarda biyoteknoloji alanındaki gelişmeler neticesinde ticari olarak mikrobiyal fitazın üretilmeye başlanması 1999'lu yıllara gelindiğinde 50 milyon tona yakın yemin fitaz enzimi ile muamele edilmesini sağlamıştır (Chen, 2000). Karma yemlere fitaz enzimi ilavesi yemlerdeki fitik asit iskeletine bağlı olan fosfat grubunu hidrolize etmektedir (Perney et al., 1993). Fitazın gübreyle atılan fosfor miktarında meydana getirmiş olduğu azalma net olarak % 20 ile % 50 arasında değişmektedir (Kornegay, 2001).

Nelson et al. (1971) tarafından yapılan çalışmada fitaz enzimi ilavesi sonucu kemik külü iyileşmiş ve fitaz enzimi ilave düzeyinin %0.16-0.17 fosfora eşdeğer olduğu belirlenmiştir. Simons et al. (1990), tarafından yapılan çalışmada yem fosforu ve kalsiyumundan yararlanmanın, canlı ağırlık, yemden yararlanma ve gübre fosfor içeriğinin önemli düzeyde arttığı; enzim ilavesinin fosfordan yararlanmayı %60 arttırdığı ve gübre fosfor içeriğinde ise %50'lik bir düşmeye neden olduğu gözlemlenmiştir. Broz et al. (1992) canlı ağırlık, yem tüketimi ve yemden yararlanma önemli düzeyde iyileşmiş, kesim ağırlığının arttığını; Frapin ve Nys (1994) karmalara fitaz enzimi ilavesinin yem tüketimi, fosfor, kalsiyumdan yararlanmayı etkilemediğini belirlemiştir. Düşük fosforlu gruplardaki canlı ağırlık ve kemik külü kontrol grubuna kıyasla düşük olmuştur. Orta düzeyde toplam fosfor içeren karmalarla yemlenen grubun canlı ağırlıkları ve kemik külü içerikleri kontrol grubu ile kıyaslandığında önemli bir fark bulunamamıştır. Halle et al. (1995) tarafından yapılan çalışmada düşük fosforlu karmalara yapılan fitaz enzimi ilavesi fosforun sindirimi önemli ölçüde arttırmıştır. Bahtiyarca ve Aköz (1996) tarafından normal ve düşük seviyelerde yararlanılabilir fosfor içeren rasyonlara farklı seviyelerde fitaz enzimi ilavesi (0, 500, 1000, 1500 U/kg) arttıkça canlı ağırlık artmış yem



tüketimi, yemden yararlanma ve parmak külü ise fitaz enzimi ilavesinden etkilenmemiştir. Ahmad et al. tarafından yapılan çalışmada (2000) fitaz ilavesi, canlı ağırlığı, tibia, tırnak külünü, fosfor ve kalsiyum birikimini artırırken yemden yararlanmaya herhangi bir etkisi görülmemiştir. Çalışma sonuçlarına göre fitaz ilavesi etlik piliçlerin gelişimi ve fosfor ile kalsiyum birikimlerini arttırmakta, kemik mineral yapısını iyileştirmektedir. Johnston ve Southern (2000) tarafından yapılan çalışmada fitaz ilavesinin (0, 200, 400, 500, 600, 700, 800, 1000, 1200 FTU/kg) canlı ağırlık artışı ve yem tüketimi fitazsız karmalarla beslenen gruplarda önemli bir azalma görülmüştür. İki farklı kalsiyum ile fosfor içeren karmalarla yemlenen gruplar arasında hiçbir enzim düzeyinde canlı ağırlık, kalsiyum ve fosfor birikimi ve bu iki mineralin gübre ile atımları arasında herhangi bir fark saptanmamıştır. Rostagno et al. (2000) tarafından yapılan çalışmada fitaz enzimi ilavesi kalsiyum sindirimini %4.9 ile %7.9, yararlanılabilir fosfor oranını %10.6 ile %4.7 düzeyde iyileştirmiştir. Yılmaz ve Erkek (2000) tarafından yapılan çalışmada 500 ppm ve 1000 ppm iki fitaz enzimi düzeyinin dışı fosfor yoğunluğunu düşürmüş ve fosfordan yararlanmayı artırırken tibia kemik külü ve tibia fosfor içerikleri bakımından gruplar arasındaki fark önemsiz bulunmuştur. 1000 ppm fitaz ilavesi canlı ağırlık ve yemden yararlanmayı iyileştirirken 500 ppm fitaz enzimi, tibia kemik külü, tibia fosfor içeriği, canlı ağırlık artışı, yem tüketimini azaltmıştır. Blair et al. (2002), 900 FTU/kg fitaz enzimi ilavesi organizmada önemli düzeyde fosfor birikimine neden olmamıştır. Gheisari et al. (2003) tarafından yapılan çalışmada ise karmalara 0, 500 ve 1000 düzeylerinde fitaz enzimi ilavelerinin canlı ağırlık, yem tüketimi, yemden yararlanma, tibia kemik külü ve fosfor sindirimini önemli ölçüde artırırken gübre fosfor içeriğinin azalmasına neden olmuştur. Debicki ve Hruby (2003) tarafından yapılan çalışmada fitaz enzimini iki farklı 500 ve 1000 ünite düzeyinde betaninli ve betaninsiz olarak karmalara ilave edilmiştir. Her iki kaynaktan elde edilen fitaz enzimleri canlı ağırlık, yem tüketimi ve canlı ağırlık artışını önemli düzeyde iyileştirmiştir. Midilli et al, (2003) tarafından yapılan çalışmada çalışmada fitaz enzimi canlı ağırlık, yem tüketimi yemden yararlanma, karkas randımanı ve kemik fosfor ile kalsiyum içeriğini iyileştirmiştir.

Bu çalışmada mısır soya küspesi temeline dayalı ve farklı düzeylerde kalsiyum ve fosfor içeren başlangıç ve bitirme etlik piliç karma yemlerine fitaz enzimi ilavesinin; dışı kalsiyum ve fosfor içeriği, kalsiyum ve fosfordan yararlanma, tibia kemik külü, tibia kalsiyum ve fosfor içeriğini, canlı ağırlık, canlı ağırlık artışı, yem tüketimi, yemden yararlanma kriterleri üzerine etkileri incelenmiştir.

MATERYAL ve YÖNTEM

Denemede 40 adet Ross 308 genotipinde dişi erkek karışık etlik civciv kullanılmıştır. Civcivlere ilk gün kanat numarası takılarak tartılmış ve rasgele 10'ar hayvandan oluşan 4 grup halinde ayrılarak 1 hafta süreyle ana makinesinde yetiştirilmişlerdir. Bu süre içerisinde her gruba birer kilogram yem tartılarak su ile birlikte adlibitum olarak sunulmuştur. Hayvanlar 2. hafta tartılarak boyutları 32 x 32 x 34 olan tel ızgaralı bireysel metabolizma kafeslerine alınmış ve kesime kadar (42 gün) bu kafeslerde barındırılmışlardır.

Yem ve su metabolizma kafeslerinde de adlibitum olarak sunulmuştur. Çalışmada karma yemler, inorganik fosfor kaynağı olan DCP içeren %1 standart kalsiyumlu ve %0.60 standart fosforlu fitaz ilavesiz kontrol karması (1. grup); inorganik fosfor kaynağı içermeyen standart kalsiyumlu %1 düşük fosforlu %0.45 olan 1000 ppm fitaz enzimi ilaveli (2. grup); inorganik fosfor içermeyen düşük kalsiyumlu %0.80 standart fosforlu %0.60 olan 1000 ppm fitaz enzimi ilaveli (3. grup); inorganik fosfor içermeyen düşük kalsiyumlu %0.80 düşük fosforlu %0.45 olan 1000 ppm fitaz ilaveli (4. grup) başlangıç ve bitirme etlik piliç karmaları kullanılmıştır. Çizelge 1 de denemelerde kullanılan başlangıç ve bitirme etlik piliç karmalarında yem



hammadelerinin kullanım miktarları ile karmaların analiz sonuçları verilmiştir. Çalışmada enzim materyali olarak *Aspergillus niger*' den elde edilen granül formda ticari fitaz enzimi preparatı (Natuphos 10.000G) kullanılmıştır. Araştırmada farklı düzeyde kalsiyum ve fosfor içeren karmalara yapılan fitaz enzimi ilavesinin fosfor ve kalsiyumdan yararlanmaya etkisini saptamak amacıyla başlangıç döneminin son 3 günü ile bitirme döneminin son 3 günü olmak üzere toplam 6 defa gübre toplanmıştır. Toplanan gübreler başlangıç ve bitirme gübreleri ayrı ayrı olmak üzere analiz edilinceye kadar -20 °C de derin dondurucuda saklanmıştır.

Denemede canlı ağırlık, canlı ağırlık artışı ve yem tüketimi 3 ve 6. haftalarda bireysel olarak yapılan tartımlar ile elde edilmiştir. Canlı ağırlık artışı 0-3. haftalar arası (başlangıç dönemi) ve 3-6. haftalar arasında (bitirme dönemi) olmak üzere iki devrede hesaplanmıştır, hesaplamada 3. hafta canlı ağırlığından başlangıç (1. gün) ağırlığı çıkarılarak 0-3 haftalar arasındaki canlı ağırlık artışı, 6. haftadan 3. hafta canlı ağırlığı çıkarılarak 3-6. haftalar arasındaki canlı ağırlık bulunmuştur. Yemden yararlanma ise her kg canlı ağırlık artışına tekabül eden yem miktarı olarak hesaplanmıştır. İstatistik analizler SPSS paket programı ile değerlendirilmiştir.

Çizelge 1. Deneme karmalarında kullanılan yem hammaddelerinin kullanım payları ve karma yem içerikleri

Yem Ham Maddeleri	Başlangıç Yemi,% (0-3 Hf)				Bitirme Yemi,% (3-6 Hf)			
	1	2	3	4	1	2	3	4
Grup								
Mısır	57.59	58.02	55.03	56.72	57.21	58.78	54.59	59.59
Full Fat Soya	-	-	4.61	2.00	3.00	2.00	22.72	-
Soya küspesi	35.00	35.00	32.23	35.00	29.89	30.00	14.57	31.71
Et-kemik unu	3.00	3.05	5.29	2.89	3.50	3.42	5.60	3.40
Balık yağı	1.18	1.10	1.50	1.10	3.44	3.14	1.29	3.27
Soya yağı	0.40	0.40	-	0.40	0.40	0.50	-	0.40
Kireç taşı	0.38	0.98	-	0.51	0.31	0.91	-	0.40
Dikalsiyum fosfat	0.15	-	-	-	0.99	-	-	-
Tuz	0.21	0.29	0.28	0.29	0.28	0.27	0.28	0.27
Sodyum bikarbonat	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Lysin	0.13	0.13	0.05	0.08	0.03	0.05	0.01	0.04
DL-Methionin	0.33	0.33	0.31	0.31	0.25	0.23	0.25	0.23
Vitamin piremiksi ¹	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral piremiksi ²	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Hesaplanan değerler (%)								
Kuru madde	90.39	90.36	90.54	90.36	90.72	90.63	91.18	90.51
Ham protein	23.09	23.14	24.00	23.59	21.70	21.51	21.70	21.70
Ham yağ	4.64	4.59	5.62	4.91	7.43	7.08	8.68	6.77
Ham kül	5.77	5.50	5.30	5.06	5.66	5.31	5.13	4.82
Toplam kalsiyum	1.00	1.00	0.80	0.80	1.00	1.00	0.80	0.80
Toplam fosfor	0.60	0.45	0.60	0.45	0.60	0.45	0.60	0.45
Nişasta	38.49	38.76	36.87	37.98	38.17	39.17	36.58	39.68
Şeker	4.35	4.36	4.33	4.46	4.07	4.05	3.82	4.10
Fitaz (ppm)	-	1000	1000	1000	-	1000	1000	1000
Metabolik enerji (kcal/kg)	3000	3008	3050	3029	3175	3175	3220	3175

¹ Katkı miktarları mg/kg: Vitamin A. 15000 I.U; Vitamin D3. 2000 I.U; Vitamin E. 40.0 mg; Vitamin K. 5.0 mg; Vitamin B1 (thiamin). 3.0 mg; Vitamin B2 (riboflavin) 6.0 mg; Vitamin B6. 5.0 mg; Vitamin B12. 0.03 mg; Niacin. 30.0 mg; Biotin. 0.1 mg; Kalsiyum D-pantothenate. 12 mg; Folik asit. 1.0 mg; Kolin klorit. 400 mg; ² Katkı miktarları mg/kg: Manganes. 80.0 mg; demir. 35.0 mg; çinko. 50.0 mg; bakır. 5.0 mg; iyot. 2.0 mg; kobalt. 0.4 mg; selenyum. 0.15 mg.

1 DCP'li fitaz enzimi ilavesiz (kontrol)

2 DCP'siz standart kalsiyum %1, düşük fosfor % 0.45 ve 1000 ppm fitaz enzimi ilaveli

3 DCP'siz düşük kalsiyumlu % 0.80, standart fosforlu % 0.60 ve 1000 ppm fitaz enzimi ilaveli

4 DCP'siz düşük kalsiyumlu % 0.80, düşük fosforlu % 0.45 ve 1000 ppm fitaz ilaveli



BULGULAR ve TARTIŞMA

Deneme gruplarında 3. ve 6. hafta canlı ağırlıkları incelendiğinde 3. hafta canlı ağırlıkları deneme grupları arasında önemsizdir ($P>0.05$) (Çizelge 2). Karmalara fitaz enzimi ilavesi gruplar arasında 6. hafta canlı ağırlıkları etkilemiştir ($P<0.05$). Fitaz enzimi ilave edilen bütün gruplarda 6. hafta canlı ağırlık artışı kontrol grubundan yüksek olmuştur. Yapılan bu çalışmada canlı ağırlıklara ilişkin sonuçlar, fosfor ve kalsiyum içeriği düşük olan DCP'siz karmalara mikrobiyal fitaz enzimi ilavesi yapıldığında fosfor ve kalsiyum bakımından dengeli karmaları tüketen hayvanların gösterdikleri canlı ağırlıktan daha yüksek canlı ağırlığa ulaşabileceğini desteklemektedir. Benzer bulgular, Midilli et al.(2003), Debicki ve Hruby (2003), Gheisari et al. (2003), Ahmad et al. (2000), Bahtiyarca ve Aköz (1996), Frapin ve Nys (1994) ve Broz et al. (1992) tarafından yapılan araştırma sonuçları ile uyusmaktadır. Denemede elde edilen bulgular, Johnston ve Southern (2000) tarafından düşük fosforlu karmalara yapılan fitaz enzimi ilavesinin canlı ağırlık artışına herhangi bir etkisi olmadığına dair sonuçları ile uyum göstermemektedir. Fitaz enzimi ilavesi ilk üç haftalık canlı ağırlık artışını iyileştirmiştir ($P<0.05$) (Çizelge 2). Deneme gruplarında 0-3. haftalar arasındaki canlı ağırlık artışları incelendiğinde başlangıç döneminde en iyi canlı ağırlık artışı 4. grupta gözlemlenirken en kötü canlı ağırlık artışı ise 1. grupta görülmüş, 3-6. haftalar arasındaki canlı ağırlık artışı deneme grupları arasında önemli bulunmamıştır ($P>0.05$) (Çizelge 2). Debicki ve Hruby (2003), fosfor bakımından yetersiz karmalara ilave edilen fitaz enziminin canlı ağırlık artışını iyileştirdiği çalışma sonuçlarıyla uyumludur. Deneme gruplarının başlangıç dönemi (0-3 hafta) yem tüketimleri arasında önemli farklılık bulunmuştur ($P<0.05$) (Çizelge 2). En yüksek yem tüketimi kontrol grubunda görülürken en düşük yem tüketimi ise 4. grupta görülmüştür. Karmalarda kalsiyum ve fosfor düzeylerinin düşürülmesi ile fitaz enzimi ilavesi yem tüketimini azaltmıştır. Bu dönemde elde edilen bulgular, Frapin ve Nys (1994), Johnston ve Southern (2000), Yılmaz ve Erkek (2000), Debicki ve Hruby (2003)'nin yapmış oldukları çalışma sonuçları ile uyum göstermektedir. Bitirme döneminde (3-6 hafta) gruplar arasında yem tüketimi bakımından herhangi bir fark bulunmamıştır ($P>0.05$) (Çizelge 2). Frapin (1994), Johnston ve Southern (2000), Yılmaz ve Erkek (2000), Debicki ve Hruby (2003) yaptıkları çalışmalarda düşük fosfor içerikli yemlere fitaz enzimi ilavesinin yem tüketimini düşürdüğünü fakat Gheisari et al. (2003), Midilli ve ark. (2003) ise karmalara fitaz enzimi ilavesinin yem tüketimini arttırdığını belirtmektedirler.

Çizelge 2. Deneme gruplarına ait canlı ağırlık, canlı ağırlık artışı, kesim randımanı, yem tüketimi ve yemden yararlanma değerleri

Gruplar	Canlı Ağırlık g		Canlı Ağırlık Artışı g		Randıman %	Yem Tüketimi g		Yemden Yararlanma Oranı %	
	3 Hf	6 Hf	0-3 Hf	3-6 Hf	43.gün	0-3 Hf	0-6 Hf	0-3 Hf	3-6 Hf
1	684 ^b	2292 ^{ab}	647 ^a	1590	76.19	955 ^a	3749	1.35	1.61
2	708 ^{ab}	2352 ^a	670 ^{ab}	1608	76.86	930 ^{ab}	3659	1.31	1.57
3	707 ^{ab}	2258 ^b	670 ^{ab}	1581	76.47	928 ^{ab}	3763	1.31	1.61
4	738 ^a	2351 ^a	700 ^b	1641	75.87	895 ^b	3619	1.26	1.57
S. H.	12.72	25.55	12.51	38.69	0.47	13.25	46.39	0.025	0.019
P	0.051	0.050	0.049	0.733	0.505	0.032	0.107	0.093	0.194

1 DCP'li fitaz enzimi ilavesiz (kontrol)

2 DCP'siz standart kalsiyum %1, düşük fosfor % 0.45 ve 1000 ppm fitaz enzimi ilaveli

3 DCP'siz düşük kalsiyumlu % 0.80, standart fosforlu % 0.60 ve 1000 ppm fitaz enzimi ilaveli

4 DCP'siz düşük kalsiyumlu % 0.80, düşük fosforlu % 0.45 ve 1000 ppm fitaz ilaveli



Deneme gruplarında gerek başlangıç gerekse bitirme dönemi yemden yararlanma değerleri bakımından gruplar arası farklılık önemli bulunmamıştır ($P>0.05$) (Çizelge 2). Bu dönemlerde elde edilen bulgular, Bahtiyarca ve Aköz (1996), Ahmad et al.(2000), Midilli et al. (2003), un düşük fosfor içerikli karma yemlere fitaz enzimi ilavesinin yemden yararlanma değerine herhangi bir etkisi olmadığını belirten bulgularıyla uyum göstermektedir. Ancak bu bulgular, Simons et al. (1990), Broz (1992), Yılmaz ve Erkek (2000), Gheisari et al. (2003) tarafından düşük fosforlu karmalara yapılan fitaz enzimi ilavesinin yemden yararlanmayı iyileştirdiğini belirten araştırma sonuçları ile uyuşmamaktadır. Karmalara ilave edilen 1000 ppm fitaz enzimi kesim randımanını etkilememiştir ($P>0.05$) (Çizelge 2). Midilli et al. (2003) ise düşük fosfor içerikli karmalara fitaz ilave edilmesinin karkas randımanını arttırdığını belirtmektedir.

Çizelge 3. Deneme gruplarına ait gübre kuru madde, ham kül, fosfor, kalsiyum içerikleri ve fosfor ile kalsiyumdan yararlanma oranları %

Haftalar	KM		HK		Fosfor		Kalsiyum		Fosfordan		Kalsiyumdan	
	Yararlanma		Yararlanma		Yararlanma		Yararlanma		Yararlanma		Yararlanma	
Grup	0-3	0-6	0-3	0-6	0-3	0-6	0-3	0-6	0-3	0-6	0-3	0-6
1	24.8 ^a	22.9	3.90 ^a	3.82 ^a	0.36 ^a	0.34 ^{ab}	0.10 ^a	0.08 ^a	36.6 ^{bc}	39.6 ^a	88.6 ^a	91.2 ^a
2	21.5 ^b	21.5	3.36 ^b	3.56 ^{ab}	0.21 ^c	0.29 ^b	0.09 ^b	0.08 ^a	42.0 ^{ab}	35.7 ^a	88.1 ^a	92.0 ^a
3	22.7 ^b	22.7	3.34 ^b	3.68 ^a	0.30 ^b	0.38 ^a	0.08 ^c	0.09 ^a	32.1 ^c	37.1 ^a	86.3 ^b	89.4 ^a
4	22.6 ^b	23.4	3.15 ^b	3.32 ^b	0.20 ^c	0.29 ^b	0.07 ^d	0.07 ^a	46.1 ^a	35.8 ^a	88.8 ^a	91.3 ^a
S. H.	0.71	0.61	0.12	0.12	0.01	0.02	0.00	0.01	2.91	4.02	0.56	0.68
P	0.016	0.170	0.001	0.037	0.000	0.050	0.000	0.172	0.010	0.881	0.013	0.072

1 DCP'li fitaz enzimi ilavesiz (kontrol)

2 DCP'siz standart kalsiyum %1, düşük fosfor % 0.45 ve 1000 ppm fitaz enzimi ilaveli

3 DCP'siz düşük kalsiyumlu % 0.80, standart fosforlu % 0.60 ve 1000 ppm fitaz enzimi ilaveli

4 DCP'siz düşük kalsiyumlu % 0.80, düşük fosforlu % 0.45 ve 1000 ppm fitaz ilaveli

Başlangıç ve bitirme dönemi gübre fosfor içeriği gruplar arasında önemli düzeyde farklıdır ($P<0.05$) (Çizelge 3). Başlangıç döneminde karmalara fitaz enzimi ilavesi fosfordan yararlanma değerlerini önemli şekilde etkilemiştir ($P<0.05$) (Çizelge 3). Başlangıç döneminde en düşük gübre fosfor içeriği ve en iyi fosfordan yararlanma değeri 4. grupta gözlemlenirken en yüksek gübre fosfor içeriği ve en kötü fosfordan yararlanma değeri ise 1. ve 3. grupta görülmüştür. Bitirme dönemi fosfordan yararlanma ise gruplar arasında önemsizdir ($P>0.05$) (Çizelge 3). Bitirme döneminde en düşük gübre fosfor içeriği 4. grupta ve en iyi fosfordan yararlanma değeri de 1. grupta gözlemlenmiştir. Karmalara yapılan fitaz enzimi ilavesi başlangıç ve bitirme döneminde gübre fosfor içeriğini düşürmüş ve başlangıç döneminde fosfordan yararlanmayı arttırmıştır ($P<0.05$). Nelson et al., (1971), Simons et al. (1990), Halle et al. (1995), Yılmaz ve Erkek (2000), Blair et al. (2002), Rostagno et al. (2000), Gheisari et al. (2003)'nın fitaz enzimi ilavesi sonucu dışkı fosfor düzeyinin azalttığını ve buna bağlı olarak da fosfordan yararlanmanın iyileştiğini belirten araştırma sonuçlarıyla uyuşmaktadır.

Başlangıç dönemi gübre kalsiyum içeriği fitaz enzimi ilavesi ile azalırken bu dönemde kalsiyumdan yararlanma iyileşmiştir ($P<0.05$) (Çizelge 3). Başlangıç döneminde en düşük gübre kalsiyum içeriği ve en iyi kalsiyumdan yararlanma 4. grupta gözlemlenmiştir. Başlangıç



döneminde en yüksek gübre kalsiyum içeriği 1. grup gözlenirken, en kötü kalsiyumdan yararlanma değeri ise 3. grupta tespit edilmiştir. Bitirme döneminde karmalara yapılan mikrobiyal fitaz enzimi ilavesi gübre kalsiyum içeriğini azaltmamış ve kalsiyumdan yararlanmayı iyileştirmemiştir ($P>0.05$) (Çizelge 3). Araştırma sonucunda başlangıç dönemine dair elde edilen bulgular, Simons et al. (1990), Rostagno et al. (2000)'nın karmalara fitaz enzimi ilavesinin kalsiyumdan yararlanmayı arttırarak gübre ile dışarıya atılan kalsiyum miktarını düşüreceğine dair bulgular ile benzerlik göstermektedir.

Başlangıç dönemi gübre kuru madde ve kül içeriği fitaz enzimi ilavesi ile azalmıştır ($P<0.05$) (Çizelge 3). Deneme gruplarında başlangıç dönemi en düşük gübre kül içeriği 4. grupta ve en düşük değer ise 2. grupta gözlemlenmiştir. Bu dönemde en yüksek gübre kuru madde ve kül içeriği kontrol grubunda görülmüştür. Karmalara ilave edilen fitaz enziminin bitirme dönemi gübre kuru madde içeriğine bir etkisi görülmezken ($P>0.05$) gübre kül içeriği önemli düzeyde etkilenmiştir ($P<0.05$) (Çizelge 3). Karma yemlerin fosfor ve kalsiyum miktarını azaltarak fitaz enzimi ilave edilmesi gübre kül içeriğini azaltmıştır. Gübre ham kül içeriğinin azalmasındaki temel neden fitaz enzimi ilavesinden ziyade karma kalsiyum ve fosfor içeriğinin azaltılmasından kaynaklanmaktadır. Deneme gruplarından 2., 3. ve 4. gruplar arasındaki gübre ham kül içeriği bakımından tespit edilen fark önemsizdir ve bu üç gruba da 1000 ppm fitaz ilave edilmiştir. Bu üç grup arasındaki benzerlik, fosfor ve kalsiyum içeriklerinin düşük olması nedeni ile birbirleri ile benzer sonuçlar gösterirken kontrol grubu olan 1. grupta ise kalsiyum ve fosfor içerikleri bu üç gruba göre yüksek düzeydedir. Bu nedenle bu üç grup ile kontrol grubu arasında gübre kül içeriği bakımından önemli bir farklılık mevcuttur ($P<0.05$).

Çalışmada karmalardaki fosfor içeriğinin azaltılarak fitaz enzimi ilave edilmesi ile elde edilen sonuçlar ile kontrol grubuna ait kemik fosfor içeriği arasında önemli düzeyde farklılık bulunmamıştır ($P>0.05$) (Çizelge 4). Bu sonuca göre karma fosfor içeriğinin azaltılarak fitaz enzimi ilave edilmesinin kemik gelişimi üzerine olumsuz bir etkisi olmayacağı söylenebilir. Çalışmadan elde edilen sonuçlar; Ahmad et al. (2000), Johnston ve Southern (2000) ve Midilli ve ark.(2003), düşük fosfor içerikli karma yemlere fitaz enzimi ilavesi ile fosfor birikiminin arttığı ve fosfor içeriği dengelenmiş karmalarla sağlanan düzeye ulaştığını belirten bulguları ile benzerlik göstermektedir. Karmalara ilave edilen fitaz enzimi sonucunda sol tibia kemiği kalsiyum içeriği bakımından gruplar arasında önemli farklılık görülmemiştir ($P>0.05$) (Çizelge 4). Deneme sonucu; Broz et al. (1992), karmalara fitaz enzimi ilave edilmesinin kemik kalsiyum içeriğine herhangi bir önemli etkisi olmadığına dair bulgusu ile uyum gösterirken, Ahmad et al. (2000), Johnston ve Southern (2000), Midilli et al. (2003)'nin fitaz enziminin kalsiyum birikimini arttırdığına dair sonuçları ile uyuşmamaktadır. Karmalara yapılan fitaz enzimi ilavesinin kemik külü ve kemik kuru madde içeriğine etkisi bakımından deneme grupları arasında önemli bir farklılık görülmemiştir ($P>0.05$) (Çizelge 4). Frapin ve Nys (1994), Yılmaz (2000)'ın karma fosfor içeriğinin azaltılarak fitaz ilavesi yapılmasının kemik kül içeriğinde önemli bir iyileştirme yapmamaktadır. Diğer taraftan bu bulgular, Nelson et al. (1971), Broz et al. (1992), karmalara yapılan fitaz enzimi ilavesinin kemik külü içeriğini arttırdığını belirten araştırma verileriyle uyum göstermemektedir.



Çizelge 4. Deneme gruplarına ait tibbia kemiği kuru madde, ham kül, fosfor ve kalsiyum içerikleri %

Grup	Fosfordan		Kalsiyumdan		Fosfor		Kalsiyum		P	Ca
	Yararlanma %		Yararlanma %						%	%
	0-3 Hf	0-6 Hf	0-3 Hf	0-6 Hf	0-3 Hf	0-6 Hf	0-3 Hf	0-6 Hf	6 Hf	6 Hf
1	36.6 ^{bc}	39.6 ^a	88.6 ^a	91.2 ^a	0.36 ^a	0.34 ^{ab}	0.10 ^a	0.08 ^a	8.58	11.61
2	42.0 ^{ab}	35.7 ^a	88.1 ^a	92.0 ^a	0.21 ^c	0.29 ^b	0.09 ^b	0.08 ^a	8.25	12.21
3	32.1 ^c	37.1 ^a	86.3 ^b	89.4 ^a	0.30 ^b	0.38 ^a	0.08 ^c	0.09 ^a	8.11	10.59
4	46.1 ^a	35.8 ^a	88.8 ^a	91.3 ^a	0.20 ^c	0.29 ^b	0.07 ^d	0.07 ^a	8.58	11.22
S. H.	2.91	4.02	0.56	0.68	0.01	0.02	0.00	0.01	0.21	4.96
P	0.010	0.881	0.013	0.072	0.000	0.050	0.000	0.172	0.270	0.456

1 DCP'li fitaz enzimi ilavesiz (kontrol)

2 DCP'siz standart kalsiyum %1, düşük fosfor % 0.45 ve 1000 ppm fitaz enzimi ilaveli

3 DCP'siz düşük kalsiyumlu % 0.80, standart fosforlu % 0.60 ve 1000 ppm fitaz enzimi ilaveli

4 DCP'siz düşük kalsiyumlu % 0.80, düşük fosforlu % 0.45 ve 1000 ppm fitaz ilaveli

SONUÇLAR ve ÖNERİLER

Bu çalışmada düşük fosfor içerikli karmalara yapılan fitaz enzimi ilavesi neticesinde fosfordan yararlanma iyileşmiş ve gübre ile atılan fosfor miktarı azalmıştır. Diğer taraftan karma kalsiyum içeriği düşürülerek fitaz enzimi ilavesi de kalsiyumdan yararlanmayı arttırmamış ve gübre ile atılan kalsiyum miktarını azaltmıştır. Bilindiği gibi etlik piliç üretiminde iyi bir gelişme için karmalarda kalsiyum ve fosfor arasında belli bir oran bulunması gerekir. Bu nedenle fitaz enzimi kullanılarak hazırlanan karmaların bu ilişkinin göz önüne alınarak hazırlanması; sadece fosfor miktarının değil, aynı zamanda kalsiyum içeriğinin de düşürülmesi ile daha iyi sonuçlar elde edilebilir.

Sonuç olarak etlik piliç karmalarına yapılan mikrobiyal fitaz enzimi ilavesinin etlik piliç performansını önemli düzeyde arttırdığı saptanmıştır. Karmalarda kullanılan fitaz enzimi, yemlerin yapısındaki fitik asiti parçalayarak buna bağlı olan fosfor ve kalsiyum gibi minerallerden yararlanmayı önemli düzeyde arttırmış, gübre ile atılan fosfor miktarını azaltmıştır. Bu çalışmada karma fosfor içeriğinin azaltılmasının yanında kalsiyum içeriğinin de düşürülmesi ilave edilen fitaz enzimi ile deneme boyunca en iyi sonuçların alınmasını sağlamıştır. Fitaz enzimi, besi performansını arttırarak gübre ile atılan fosfor miktarını düşürmesi nedeni ile etlik piliç karmalarında başarılı bir şekilde kullanılabilir.



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**A RESEARCH ON DETERMINATION OF SOME PHYSICAL AND
PHYSIOLOGICAL PROPERTIES OF TOBACCO SEEDS (*Nicotiana tabacum* L.)
FROM DIFFERENT YEARS**

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ABSTRACT

Tobacco is a pleasure plant that has been used for various purposes throughout human history. Turkey has gained an economically important place in the world with its oriental tobaccos. This study was carried out in Bingol University laboratories in 2021. Some physical (length, width, surface area, average arithmetic diameter, average geometric diameter, sphericity, thousand grain weight) and physiological (germination rate and germination time) characteristics of tobacco seeds harvested in different years (2017-2018-2019) were examined. The obtained data with the improvement studies, aimed to create an infrastructure for the stages of production, harvest and even product processing. According to the results of the research, it was found that tobacco seeds generally have a short and oval structure, an average length of 0.751 mm, a width of 0.565 mm, a surface area of 0.342 mm² and a grain weight of 0.096 g; it was determined to have a germination rate of 80-98%.

Keywords: Tobacco, *Nicotiana tabacum* L., Arbitrary plant, Seed characteristics, Seed sizes



INTRODUCTION

Tobacco has been used for various purposes since it was known by human beings. While it attracted the attention of people as a curing plant in the beginning, today it is known as an agricultural product that causes increasing controversy in terms of health. It still has a distinct place in agricultural products, as it creates added value in economic terms in our country as well as in many countries in the world and has become an important source of income for countries (Ekren et al., 2021).

Turkey is a country known for its oriental tobacco, and it meets 30% of the world's total oriental tobacco production (Kurt et al., 2021). In the 2019 tobacco production season, a total of 57.296 producers and 82.791 tons of tobacco were produced on an area of 950.622 hectares. When the shares of the region are evaluated according to the data of 2019; 57.1% Aegean, 11.4% Black Sea, 1.9% Marmara, 50.9% Mediterranean, 2.3% East Anatolia and 26.3% Southeastern Anatolia Regions (Anonymous, 2021). Although we rank the first in the world in oriental tobacco production, there has been a decrease in terms of production amount and yield values in recent years compared to previous years. Among the reasons for this decrease, the average age of the producer is 45 years and above, price policies, agricultural practices and seed characteristics are the main reasons (Ekren & İlker, 2017). This reduction poses an important problem in terms of the sustainability of production. In tobacco agriculture, obtaining efficient, uniform and quality products is very important for both domestic and foreign markets. Some seed characteristics such as germination and emergency power are the most important factors affecting the price of the product in terms of the amount of leaf tobacco to be obtained in an efficient and quality production.

Tobacco seeds are contained in tobacco capsules formed by the development of the ovary. 40-200 capsules and 2500-8000 brown seeds were detected in one plant. The seeds are very small, the thousand grain weight is 0.07-0.09 g and the amount of seed taken from a plant is around 20 g (Sekin, 1987). Many factors affect the amount of seed obtained, seed quality and leaf tobacco production. The number of flowers in the plant is one of the most important factors that increase and decrease the number of capsules and therefore the seed yield. However, this does not have any effect on germination. (Tso, 1990). Seed size, seed storage conditions (temperature, humidity, exposure, etc.) can also cause a decrease in seedling quality and seedling retention rate in planting, as it affects the germination rate and emergence rate. (Kasperbauer & Sutton, 1977; Papp & Vali, 1984; Sisler & Wood, 1986; Mohapatra et al., 1987, Mohammad & Tahir, 2014). If tobacco seed is stored under appropriate storage conditions, it can maintain its viability for a long time. When stored in paper bags or cloth bags for a long time under laboratory conditions, it loses its vitality. When stored under appropriate conditions, the seed can survive for up to 25 years (Tso, 1990).

The amount of oil in the tobacco seeds was determined as 32-42%. Its oil is in the group of semi-drying oils and has the same quality as sunflower, safflower and soybean oil. In the chemical composition of the oil, 20% protein, 54-43 ether extract, 3-4% carbohydrate, palmitic acid 21.3-25.7%, oleic acid 17.0-26.7% and 10% others were detected. Saturated fatty acids content was higher than unsaturated fatty acids (Tso, 1972; Frago et al., 1991; Abbas et al., 2008; Muhammad & Tahir, 2014). In the light of this mentioned information, it is seen that tobacco seeds have a content that can be the raw material of different industrial branches such as paint, cosmetics and oil.

In the tobacco market in the world, especially the oriental tobaccos produced in Turkey find an economic response, and the researches on this subject continue to diversify. Producing high quality and in accordance with the determined standards also enables Turkey to get a larger



share in the tobacco market. Therefore, it is aimed to minimize the problems encountered in tobacco production and to eliminate the existing problems. It is extremely important to determine the characteristics of the existing cultivars in order to develop disease and pest resistant genotypes. These basic properties of seeds are evaluated in the product processing steps from sowing to harvest and even afterwards.

In this study, the seeds of the tobacco plant harvested in different years (2017-2018-2019), which are valuable in the economic field, were examined. It is aimed that the obtained data will provide an infrastructure for current and future agricultural production, product processing and improvement studies.

MATERIAL and METHOD

This study was carried out in the laboratories of Bingöl University Faculty of Agriculture Biosystem Engineering Department and Ege University Field Crops Departments in 2020-2021. In this research, tobacco (*Nicotiana tabacum* L.) seeds belonging to different years (1-2-3 years) between 15 August-15 September 2019 (1 year), 2018 (2 years) and 2017 (3 years) tobacco production area in Ege Region. Some physical (shape-size, surface area, average arithmetic and geometric diameter, sphericity and thousand grain weight) and physiological (germination rate and time) characteristics of the seeds obtained from here were determined. The data obtained were evaluated by using SPSS V.22 program at $p < 0.05$ significance level statistically with DUNCAN grouping.

SOME PHYSICAL PROPERTIES OF TOBACCO SEEDS

Plants can vary depending on the environment in which they are grown (climate, geography, soil characteristics, etc.) and this situation directly or indirectly affects the seeds which produce (Dumanoğlu et al., 2021). The length (mm), width (mm) and thickness (mm) data, which are considered as the basis for seeds, are therefore of particular importance. According to the researchers conducted over the years, using these data, the geometric properties of the seeds (long-medium-short) and shape characteristics (round-oval-long) are classified (Yağcıoğlu, 2015) (Table 1). Appropriate tools, machinery and systems are used to use these data especially for seed breeding and for agricultural activities (Dumanoğlu, 2021).

Tobacco seeds belonging to different years were randomly sampled (100 seeds were selected) and basic characteristics were determined with a stereo microscope with its own software (Nikon SMZ 745T) (Dumanoğlu & Geren, 2020). After determining the shape-size characteristics (length, width, surface area) of the tobacco seeds, the mean geometric (mm) and average arithmetic diameter (mm) values of the seeds and the sphericity values are determined using the following equations (Alayunt, 2000, Kara, 2012, Mohsenin, 1970). The grain weight of the tobacco seeds (g); we have completed the weighing process on the Denver Instrument analytical balance (to 0.0001 g sensitivity), which was counted randomly and in triplicate (Dumanoğlu & Mokhtarzadeh, 2020).

Table 1. Classification of seeds according to their geometric characteristics and shapes

Seeds according to their geometric characteristics	Grain width/Grain length (b/a) (mm)	Seeds according to their shapes	Length (a), Width (b), Thickness (c) (mm)
Long	0.6	Round	$a \approx b \approx c$
Medium	0.6 – 0.7	Oval	$a/3 < b \approx c$
Short	> 0.7	Long	$c < b < a/3$



Mean Arithmetic Diameter:

$$D: (L + W)/2 \quad (1)$$

D: Mean arithmetic diameter of the seed (mm)

L: Length of the seed (mm)

W: Width of the seed (mm)

Mean Geometric Diameter:

$$D_0: (L * D^2)^{1/3} \quad (2)$$

D₀: Average geometric diameter of the seed (mm)

L: Seed length value (mm)

D: Average arithmetic diameter of the seed (mm)

Sphericity :

$$\Phi: D_0/L \quad (3)$$

Φ: Sphericity Value of the Seed

D₀: Average geometric diameter of the (mm)

L: Seed length value (mm)

SOME PHYSIOLOGICAL PROPERTIES OF TOBACCO SEEDS

It has been determined that the tobacco seeds of different years examined in this study have the germination ability of approximately 98-99% during the harvest period. After harvest, it was stored in glass jars in a closed, dry and dark (~ 24 °C, moisture-free environment). No diseases or pests were observed in the seeds during this period.

According to the ISTA (2007) rules, tobacco seeds belonging to different years were germinated in glass petri dishes (in four repetitions) for 16 days in a dark environment at approximately 20-30°C, 60% humidity and under controlled conditions in the BINDER brand incubator. Seed emergence was observed daily.

RESULTS AND DISCUSSION

SOME PHYSICAL PROPERTIES OF TOBACCO SEEDS

The tobacco seeds obtained from harvested in different years (2017-2018-2019) were examined and the data obtained were statistically significant at the level of $p < 0.05$. It has been determined that the tobacco seeds generally have an average length of 0.751 mm, width of 0.565 mm, a surface area of 0.342 mm², an average arithmetic diameter of 0.658 mm, a geometric diameter of 0.110 mm and a sphericity value of 0.145. According to DUNCAN grouping; 1 year and 2 year seeds are generally in the same group, and in terms of surface area (mm²), seeds were evaluated by grouping each separately (Table 2). According to the classification stated by Yağcıoğlu (2015), it was determined that tobacco seeds generally have a short and oval seed structure.

Er et al. (2014) and Geçit et al. (2018) stated that tobacco seeds generally have a grain weight of 0.07-0.09 g. It was determined that the tobacco seeds of different years examined in this study had an average weight of 0.096 g thousand grain weight and the results were consistent with the previous studies.



Table 2. Some physical properties of Tobacco Seeds

Seed Features	1 year		2 year		3 year		Avg.
	Avg.	Stdv.	Avg.	Stdv.	Avg.	Stdv.	
Length (mm)	0.770 ^a	0.067	0.761 ^a	0.062	0.721 ^b	0.065	0.751
Width (mm)	0.583 ^a	0.057	0.579 ^a	0.047	0.532 ^b	0.051	0.565
Surface area (mm²)	0.365 ^a	0.056	0.351 ^b	0.045	0.309 ^c	0.041	0.342
Average arithmetic diameter of the seed (mm)	0.677 ^a	0.053	0.670 ^a	0.043	0.626 ^b	0.050	0.658
Average geometric diameter of the seed (mm)	0.120 ^a	0.030	0.115 ^a	0.023	0.096 ^b	0.022	0.110
Sphericity of the seed	0.153 ^a	0.025	0.150 ^a	0.019	0.132 ^b	0.020	0.145
Thousand grain weight (g)	0.098 ^b	0.003	0.100 ^a	0.001	0.090 ^c	0.002	0.096

SOME PHYSIOLOGICAL PROPERTIES OF TOBACCO SEEDS

Some physiological characteristics such as germination rate and germination time of tobacco seeds harvested in different years (1-2-3 years) under controlled conditions were determined in the study. It has been determined that tobacco seeds have a germination rate of 80-98% and the ability to germinate within 2.825-2.951 days (Table 3). The high germination rates are predicted based on the results obtained that tobacco seeds can be utilized by producers for 3 years or more depending on the appropriate storage conditions.

Table 3. Some physiological characteristics of Tobacco Seeds

Seed Features	1 year	2 year	3 year
Germination Percentage (%)	98	80	91
Average Germination Time (day)	2.875	2.951	2.825

Tobacco is a pleasure plant that has been used for many purposes throughout human history. Turkey has gained an economically important place in the world with its oriental tobaccos. At the same time, tobacco, which has a market value in the country, can maintain its vitality for many years under appropriate storage conditions. In this research, some physical and physiological properties of seeds obtained from tobacco plants harvested in different years were examined. It was determined that the values obtained were statistically significant. According to the research, it was determined that tobacco seeds generally have a short and oval structure. Besides, it has an average length of 0.751 mm, a width of 0.565 mm, a surface area of 0.342 mm², an arithmetic diameter of 0.658 mm, a geometric diameter of 0.110 mm, a sphericity value of 0.145 and a grain weight of 0.096 g. It has been determined that it has a germination rate of 80-98% and the ability to germinate within an average of 3 days.



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19-20 June, Izmir-TURKEY



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GIDA AMBALAJLARINDA GÜNCEL NANOTEKNOLOJİ UYGULAMALARI

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ÖZET

Nanoteknoloji, yaklaşık olarak 1-100 nm uzunluğunda en az bir boyuta sahip olan yapıların, cihazların veya malzemelerin karakterizasyonu, imalatı ve/veya manipülasyonu ile ilgilenmektedir. Nanoteknolojilerin gıdalardaki uygulamaları, gıda işleme için gıda bileşenlerinde kullanılan nanomalzemeler, nano sensörler ve nano özellikli ambalajlamadır. Nano özellikli gıda ambalajlarında nanopartiküller kullanılabilir gibi, nano lifler, nano plakalar ve nanokompozitler de kullanılmaktadır. Bu amaçla kullanılan başlıca nanopartiküller gümüş (Ag), çinko oksit (ZnO), silikon dioksit (SiO₂), titanyum dioksit (TiO₂), magnezyum oksit (MgO), bakır oksit (Cu₂O), altın (Au), alüminyum oksit (Al₂O₃), zirkonyum dioksit (ZrO₂), antimon pentoksit (Sb₂O₅), kalay oksit (SnO₂), kalsiyum karbonat (CaCO₃) ve silisyum karbürdür (SiC). Ag nanopartiküller, bazı enfeksiyöz ajanlara ve kommensal suşlara karşı antibakteriyel aktiviteleri nedeniyle güçlü bir antibakteriyel ajan olarak kullanım potansiyeline sahiptirler. ZnO nanopartikülleri gıda ambalajlarında zararlı bakterilerle kontaminasyonunu önlemek amacıyla kullanılabilir gibi, ultraviyole (UV) ışığına hassas olan besinleri korumak için UV ışık emicileri olarak da kullanılmaktadırlar. TiO₂ hem antibakteriyel hem de antifungal özelliklere sahiptir. SiO₂ nanopartiküller, çeşitli polimer matrislerin mekanik ve/veya bariyer özelliklerini (mukavemet, uzama vb.) geliştirme potansiyeline sahiptir. Nanopartiküller, mekanik sürtünme, elektrodepozisyon ve kimyasal çöktürme yöntemleriyle elde edilmektedirler. Günümüzde nanoteknolojik sistemlerle iyileştirilmiş, aktif ve akıllı gıda ambalajları üretilebilmektedir. İyileştirilmiş ambalajlama, ambalaj malzemelerinin gaz bariyeri özelliklerinin yanı sıra sıcaklık ve nem direncini iyileştirmek için ambalaj malzemelerinin polimer matrisine nano malzemelerin karıştırılmasıyla elde edilmektedir. Aktif gıda ambalajları, gıda ürünlerini kontamine edebilecek patojen mikroorganizmaları öldürmek ve onların çoğalmalarını önlemek için geliştirilmiştir. Akıllı ambalajlar ise, gıdalardaki biyokimyasal veya mikrobiyal değişiklikleri renk değişiklikleri yoluyla algılamayı amaçlamaktadır. Nanoteknolojik ambalajlama, gıdaların raf ömrünün uzatılmasına yardımcı olabilmekte, gıda güvenliğini artırabilmekte, ambalaj atıklarını azaltabilmekte, besinlerin lezzetini ve tazeliğini korumaya yardımcı olabilmektedir. Bu nedenle yakın bir gelecekte geleneksel gıda ambalajlarının yerini tamamen yenilikçi ve özgün nanoteknolojik ambalajların alacağı öngörülmektedir.

Anahtar Kelimeler: Nanoteknoloji, gıda ambalajı, nanopartikül, nanokompozit



CURRENT NANOTECHNOLOGY APPLICATIONS IN FOOD PACKAGING

ABSTRACT

Nanotechnology includes the characterization, fabrication and / or manipulation of structures, devices or materials that have at least one dimension approximately 1-100 nm in length. Applications of nanotechnologies in food are nanomaterials used in food ingredients for food processing, nano sensors and nano-featured packaging. As well as nanoparticles can be used in nano-featured food packaging, nanofibers, nano plates and nanocomposites are also used. The main nanoparticles used for this purpose are silver (Ag), zinc oxide (ZnO), silicon dioxide (SiO₂), titanium dioxide (TiO₂), magnesium oxide (MgO), copper oxide (Cu₂O), gold (Au), aluminum oxide (Al₂O₃), zirconium dioxide (ZrO₂), antimony pentoxide (Sb₂O₅), tin oxide (SnO₂), calcium carbonate (CaCO₃) and silicon carbide (SiC). Ag nanoparticles have the potential to be used as a potent antibacterial agent due to their antibacterial activity against some infectious agents and commensal strains. ZnO nanoparticles can be used in food packaging to prevent contamination with harmful bacteria, as well as as ultraviolet (UV) light absorbers to protect foods that are sensitive to UV light. TiO₂ has both antibacterial and antifungal properties. SiO₂ nanoparticles have the potential to improve the mechanical and/or barrier properties (strength, elongation, etc.) of various polymer matrices. Nanoparticles are obtained by mechanical friction, electrodeposition and chemical precipitation methods. Today, improved, active and smart food packages can be produced with nanotechnological systems. Improved packaging is achieved by mixing nanomaterials into the polymer matrix of packaging materials to improve the temperature and humidity resistance as well as the gas barrier properties of the packaging materials. Active food packaging has been developed to kill pathogenic microorganisms that can contaminate food products and to prevent their proliferation. Smart packaging aims to detect biochemical or microbial changes in foods through color changes. Nanotechnological packaging can help to extend the shelf life of foods, increase food safety, reduce packaging waste, and help preserve the flavor and freshness of foods. Therefore, it is predicted that in the near future, traditional food packaging will be completely replaced by innovative and unique nanotechnological packaging.

Keywords: Nanotechnology, food packaging, nanoparticle, nanocomposite



GİRİŞ

Nanoteknoloji kavramını ilk defa 1959'da Richard Feynman kullanmıştır (Sharma ve ark., 2017). Nanoteknoloji, yaklaşık olarak 1-100 nm uzunluğunda en az bir boyuta sahip olan (veya en az bir boyutlu bileşenler içeren) yapıların, cihazların veya malzemelerin karakterizasyonu, imalatı ve/veya manipülasyonu ile ilgilenmektedir (Safraz ve ark., 2021). Daha büyük ölçekte olanlara kıyasla malzemelerin özelliklerinin ilginç bir şekilde değişebilmesi nedeniyle, nanoteknolojide tercih edilen boyut aralığı 100 nm'nin altında olmaktadır (Hernandez-Munoz ve ark., 2019). Bir nanometre, metrenin milyonda biridir (10^{-9} m). Bir nanometre, çap olarak bir insanın saç telinden yaklaşık 60.000 kat daha küçüktür. Tipik bir kağıt yaprağı yaklaşık 100.000 nm kalınlığındadır. Bir kırmızı kan hücresinin boyutu yaklaşık 2.000-5.000 nm, DNA'nın çapı ise yaklaşık 2.5 nm kadardır. Bu nedenle nanoteknoloji, DNA çapının yarısından kırmızı kan hücresinin 1/20'sine kadar değişen büyüklükteki maddelerle ilgilenmektedir (Sekhon, 2010).

Nanoteknolojilerin gıdalardaki uygulamaları, gıda işleme için gıda bileşenlerinde kullanılan nanomalzemeler, nano sensörler ve nano özellikli ambalajlama şeklinde üç gruba ayrılmaktadır. Nanomalzemeler, gıda ambalajlarında besin taşıyıcıları, katkı maddeleri veya antimikrobiyal ajanlar olarak kullanılabilirler (Mustafa ve Andreescu, 2020). Nanomalzemeler makro ölçekte malzemelerden farklı olarak spesifik ve gelişmiş fizikokimyasal özellikler sergilemektedirler. Bu malzemeler küçük boyutları sayesinde büyük bir yüzey-hacim oranına ve yüzey aktivitesine sahip oldukları için bazı polimerlere yapıştırıldıklarında, polimerin mekanik mukavemet, elektriksel iletkenlik ve termal stabilitesini artırmaktadırlar. Söz konusu malzemeler bu şekilde hem gıda paketlerinin mekanik ve bariyer özelliklerini iyileştirmekte hem de aktif ve akıllı paketleme sistemleri sunmaktadırlar (Sharma ve ark., 2017).

Gıdaların nano paketlenmesi için nanopartiküller, nano lifler, nanoplakalar ve nanokompozitler kullanılmaktadır (Adeyeye, 2019). Bu tür nanomalzemeler optoelektronik özellikleri sayesinde, gıdanın kalitesini değerlendirmek için sensörler ve dönüştürücüler olarak da kullanılmaktadırlar. Tüketici ürünlerinde kullanılan ana nanomateryaller gümüş nanopartiküller ($AgNp$ 'ler) ve SiO_2-Np 'lerdir. İşlenmiş, üretilmiş veya paketlenmiş nanoteknoloji araçları içeren gıdalar nano-gıda olarak adlandırılmaktadır. Nanomalzemelerin gıdaya entegrasyonu farklı amaçlara hizmet etmektedir: a) Faydalı bileşenlerin, besin maddelerinin veya nutrasötiklerin stabilitesini korumak ve iyileştirmek için nano kapsülleme (örneğin, kazein miselinde kapsüllenmiş D vitamini), gıda ürünlerini güçlendirmek için (örneğin, nano içinde kapsüllenmiş balık yağı-yoğurdun formasyonu için lipozomlar), b) Koruyucu özellikler kazandırmak için yüzeyleri aktif nanomateryallerle kaplamak (örneğin, antibakteriyel paketleme için $AgNp$ 'ler), c) Ambalajın mekanik özelliklerini iyileştirmek için kullanılan dolgu maddeleri (örneğin, nanokil), d) Gıda kalitesi ve güvenliğinin yerinde izlenmesi için ambalaja eklenen veya pakete dahil edilen materyalleri algılama (örneğin, O_2 algılanması için TiO_2) (Mustafa ve Andreescu, 2020).

Son yirmi yılda gıda paketleme uygulamaları için nanokompozitlere, özellikle de biyanokompozitlere olan ilgi gittikçe artmaktadır (Safraz ve ark., 2021). Gıdaların paketlenmesinde biyanokompozit kullanılımasının en önemli avantajları, gıdayı korumaları, raf ömrünü uzatmaları ve ambalaj için plastik tüketimini azaltmaları nedeniyle çevre dostu olmalarıdır. Biyanokompozitler, gaz, termal ve mekanik bariyer özelliklerini daha iyi kontrol eden nanoyapılı malzemelerin hibrit formlarıdır (Wahab ve ark., 2021).



Bu çalışmada, gıda ambalajlarında kullanılan nanomalzemeler, nanopartikül elde etme yöntemleri ve gıda ambalajlarında pratik nanoteknoloji uygulamaları ele alınmıştır.

GIDA AMBALAJLARINDA KULLANILAN NANOMALZEMELER: NANOPARTİKÜLLER VE NANOKOMPOZİTLER

Gıda ambalaj materyalinde kullanılan nanopartiküller, genellikle düzensiz / kristal şekillerdeki doğal mineraller ile bazı özel amaçları gerçekleştirmek için bilinçli olarak tasarlanmış düzenli ve geometrik şekillerdeki yapay ürünlerdir (Naffakh ve ark., 2013). Her iki tür nanopartikül de gıda paketlenme uygulamaları için amaçlanan polimer nanokompozitlerin üretiminde kullanılmaktadır. Ayrıca bu nanopartiküller, aktif ve akıllı paketler için tasarlanmış yeni materyallerin geliştirilmesinde özel olarak kullanılmaktadırlar. Gıda ambalajlarında kullanılmakta olan başlıca nanopartiküller Ag, ZnO, SiO₂, TiO₂, MgO, Cu₂O, Au, Al₂O₃, ZrO₂, Sb₂O₅, SnO₂, CaCO₃ ve SiC' dür (Hernandez-Munoz ve ark., 2019).

Nanokompozitler ise tipik olarak tüm katı fazların 1-20 nm aralığında olduğu, birden fazla katı fazın kompozitlerini ifade eder (Komarneni, 1992). Nanokompozit malzemeler gıda ambalaj malzemelerinin mukavemetinin, bariyer özelliklerinin, antimikrobiyal özelliklerinin ve ısıca/soğuğa karşı stabilitenin geliştirilmesinde kritik bir rol üstlenmişlerdir. Nanokompozitlerin gıda ambalajı için kullanımını 1990'larda başlamış ve nano bileşen olarak montmorillonit kili polietilen, naylon, polivinil klorür ve nişasta gibi çok çeşitli polimerlerde kullanılmıştır (Majid ve ark., 2018).

Nanomalzemelerin çeşitli gıda ambalajlarında uygulanabilirliği birçok araştırmada ortaya konulmuştur (Tablo 1)

GÜMÜŞ

AgNp'ler, bazı enfeksiyöz ajanlara ve kommensal suşlara karşı antibakteriyel aktiviteleri nedeniyle güçlü bir antibakteriyel ajan olarak kullanım potansiyeline sahiptirler. (Kumar ve Munstedt, 2005). Söz konusu antibakteriyel etki, AgNp'lerin bakteriyel enzimler, DNA ve proteinlere bağlanarak organizmanın metabolizmasının bozulmasına neden olması şeklinde ifade edilebilir (Cavaliere ve ark., 2015). AgNp'ler enfeksiyöz mikroskobik suşlar dışında, bazı mantarlar ile maymun çiçeği ve HIV gibi farklı virüslere karşı da etkilidir (Duncan, 2011).

AgNp'ler ile yapılan araştırmaların sonuçları ilgi çekicidir. Sığır eti, AgNp'ler ile selüloz pedler kullanılarak kaplanmış ve bu sayede mikroorganizma yükü önemli derecede düşürülmüştür (Smolkova ve ark., 2015). Başka bir çalışmada, AgNp'ler çok katmanlı doğrusal düşük yoğunluklu polietilene (LLDPE'ye) eklendiğinde *Aspergillus niger* yükünün %70'e düştüğü bildirilmiştir (Sánchez-Valdes ve ark., 2009). Rhim ve ark. (2014), *Listeria monocytogenes* ve *E. coli O157: H7*'ye karşı agar filmleri içeren AgNp'lerin güçlü antimikrobiyal aktiviteye sahip olduğunu rapor etmişlerdir. Ayrıca AgNp'lerin, *Enterococcus faecalis*, *Vibrio cholera*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Pseudomonas putida*, *Pseudomonas fluorescens*, *Pseudomonas oleovorans*, *Shigella flexneri*, *Bacillus anthracis*, *Bacillus subtilis*, *Bacillus cereus*, *Proteus mirabilis*, *Salmonella enterica typhmurium*, *Micrococcus luteus*, *Listeria monocytogenes*, *Klebsiella pneumonia* ve *Candida albicans* üzerinde de etkili olduğu bir çok farklı araştırmada ortaya konulmuştur (Duncan, 2011; Gaillet ve Rouanet, 2015; Hannon ve ark., 2015).



Mevcut arařtırmalar, nano gümüşün antimikrobiyal etkisinin, gümüş iyonlarının parçacıkların yüzeyinden salınması ile gerçekleştiğini göstermektedir (Cushen ve ark., 2013; de Azeredo, 2013). Ancak, doğal gümüşün etkili olabilmesi için gıdalla temas eden malzemelerden göç etmesi gerekmektedir (Hannon ve ark., 2015). Avrupa Birliđi, gümüşün gümüş içeren malzemelerden gıdalara taşınma limitini 0.05 mg/kg gıda veya gıda uyarıcısı şeklinde düzenlemiştir (EFSA, 2004; EFSA, 2005).

Gıda ambalajlarında AgNP bazlı nanokompozitler de ambalaj materyali olarak kullanılmaktadır. Zira bu tip nanokompozitler stabildir ve paketlenen/muhafaza edilen gıdalara gümüş iyonunun yavaşça göç etmesini sağlamaktadır. Böylece bahse konu gıdada kalıcı antimikrobiyal aktivite sağlamaktadır. Nanokompozit bazlı gümüş nanopartiküllerin, daha uzun nakliye veya depolama süresi gerektiren gıda ambalajlarında kullanılmasının iyi bir tercih olabileceđi bildirilmiştir (Sharma ve ark., 2017). An ve ark. (2008), taze kuşkonmaz mızraklarının AgNP/polivinil pirolidon nanokompozit filmlerle kaplanmasının, sođuk depolamada kuşkonmazların raf ömrünü 25 gün uzattığını belgelemiřlerdir. Gıdaların raf ömrü ile ilgili yapılan diđer bir çalışmada, P105 (TiO₂ ve 10 nm nano gümüş karışımı) içeren LDPE filmlerle 4 °C'de depolanan portakal suyu 112 gün boyunca depolanmış ve depolama süresi boyunca portakal suyunda *Lactobacillus plantarum* çođalmasının önemli ölçüde durdurulduđu rapor edilmiştir (Emamifar ve ark., 2011).

ZnO-Np'leri gıda ambalajlarında anti-mikrobiyal ajan olarak kullanılabilir. Gıdaların zararlı bakterilerle kontaminasyonunu önlemek amacıyla (Mizielinska ve ark., 2018) kullanılabilir gibi, UV ışığına hassas olan besinleri korumak için UV ışık emicileri olarak (Babaei-Ghazvini ve ark., 2018) da kullanılmaktadır. ZnO-Np'leri, UV ışığını ısı olarak yeniden yaymadan etkili bir şekilde emdiği için polimer kompozitlerin stabilitesini artırmaktadır (Enescu ve ark., 2019). Öte yandan ZnO nanopartikülleri, besin takviyelerinde, nutrasotiklerde ve fonksiyonel gıdalarda çinko kaynađı olarak da deđerlendirilebilmektedir.

ZnO partiküllerinin partikül boyutları küçüldükçe antibakteriyel aktiviteleri artmaktadır (Yamamoto, 2001). Çinkonun mikroorganizma hücre duvarı ile doğrudan teması, bakteri hücre bütünlüğünün bozulmasına sağlayabilmektedir (Sirelkhatim ve ark., 2015). Li ve ark. (2009), ZnO tozu ve ZnO-Np'lerinin gıda kaynaklı patojenlere (*Bacillus cereus*, *E. coli*, *S. aureus*, *S. enteridis*) karşı antimikrobiyal aktivitesini karşılařtırmışlar ve ZnO-Np'lerinin, test edilen tüm ürünlere karşı nano olmayan tozdan daha iyi antibakteriyel aktivite gösterdiğini gözlemlemiřlerdir. Jin ve ark. (2009), gıda sistemlerinde nano-ZnO'nun sıvı yumurta beyazında ve kültür ortamında *L. monocytogenes* ve *Salmonella enteritidis*'e karşı antibakteriyel etkisini rapor etmişlerdir. Sevinç ve Hanley (2010) ise, ZnO'nun dental materyallerde bakteriyel biyofilmlerin (*Streptococcus sobrinus*) yaklaşık %80 oranında büyümesini azalttığını ortaya koymuşlardır. Çinkonun yukarıda bahsedildiđi gibi güçlü antibakteriyel etkileri olsa da gıdalara göçünün belirli sınırlarda tutulması gerekmektedir. Bu bağlamda, 2016'da çıkarılan EFSA Yönetmeliđine (2016/1416 sayılı) göre, iyonik çinko için geçerli göç limiti 5 mg çinko/ kg gıda olarak belirlenmiştir (Enescu ve ark., 2019).



ÇİNKO OKSİT (ZnO)

Gıda Sınıfı	Nanomateriyal Aktivitesi	Kullanılan Nanomateriyaller	Ürünler	Kaynak
Sıvı	Antimikrobiyal	Ag ve ZnO-Np'ler ile çökeltilmiş düşük yoğunluklu polietilen (LDPE) filmler, Ag ve TiO ₂ -Np'ler içeren polietilen	Portakal suyu	Emamifar ve ark., 2010 Metak ve Ajaal, 2013
		AgNp'li polietilen	Elma suyu	Noble ve ark., 2004
		Ag, ZnO ve LDPE	Portakal suyu	Emamifar ve ark., 2011
		Selüloz AgNp'ler	Kivi ve kavun suyu	Lloret ve ark., 2012
Et	Antimikrobiyal	AgNp ile Pullulan	Hindi eti	Khalaf ve ark., 2013
		Ag ve ZnO ile düşük yoğunluklu polietilen	Kırmızı et	Panea ve ark., 2014
		AgNp'li etilen-vinil alkol kopolimeri	Tavuk	Martinez-Abad ve ark., 2012
		Alil izotiyosiyanat ve selüloz içeren karbon nanotüpler	Rendelenmiş pişmiş tavuk	Dias ve ark., 2013
		Selüloz AgNp'ler	Kümes hayvanları ve sığır eti	Lloret ve ark., 2012
		AgNp'leri içeren emici pedler	Kümes hayvanlarına ait etler	Fernandez ve ark., 2009
Meyve ve sebzeler	Antimikrobiyal	AgNp'li Polivinilpirrolidone	Kuşkonmaz	An ve ark., 2008
		Ag ve TiO ₂ nanopartiküllü polietilen	Taze elma	Metak ve Ajaal, 2013
		AgNp'leri içeren selüloz ped	Taze kesilmiş kavun	Fernandez ve ark., 2010
		Ag ve TiO ₂ içeren polietilen	Taze havuç	Metak, 2015
		ZnO kaplı polivinilklorid	Fuji elma dilimleri	Li ve ark., 2010
		TiO ₂ kaplı yönlendirilmiş polipropilen	Marul	Chawengkijwanich ve Hayata, 2008
		AgNp'li düşük yoğunluklu polietilen	Diken üzümü	Valipoor Motlagh ve ark., 2013
		Ag, TiO ₂ ve Kaolin içeren polietilen	Çin hünnabı	Li ve ark., 2009
		AgNp'li etilen vinil alkol	Meyve ve sebzelerin kabuk kısmı	Martinez-Abad ve ark., 2012
		ZnO- Np'li polivinil klorür	Bölünmüş elmalar	Li ve ark., 2011
Ag montmorillonit nanopartiküller	Taze meyve salatası	Costa ve ark., 2011		
Fırında pişirilmiş ürünler	Antimikrobiyal	Ag ve titanyum oksitli polietilen (PE)	Beyaz ekmek parçaları	Metak ve Ajaal, 2013
Et	Nanosensörler	Oksijen konsantrasyonu değişikliği işaretleri	Çiğ pastırma	Mills, 2005
Deniz ürünleri	Nanosensörler	Hipoksantin ve Ksantin gibi kimyasal işaretçi ve ksantin amper-metrik benzeri sensörler	Konserve ton balığı ve balık	Çubukçu ve ark., 2007 Yang ve ark., 2008



ZnO' in kompozit olarak kullanılması önemli avantajlar sağlamaktadır. Örneğin, poli bütilen süksinat (PBS) / ZnO kompozit filmleri kullanmanın *E. coli* ve *S. aureus*'a karşı önemli antibakteriyel aktiviteye sahip olduğu bildirilmiştir (Petchwattana ve ark., 2016). Karvakrol yağının *S. aureus* ve *E. coli*'ye karşı inhibe edici etkisi bulunduğu için bu tip uçucu yağlar PBS filmde antimikrobiyal ajan olarak kullanılmaktadır. Söz konusu uçucu yağın hoş olmayan kokusunu gidermek amacıyla PBS' ye ZnO eklenmekte, bu şekilde hem kokusuz hem de antibakteriyel bir ürün elde edilmiş olmaktadır (Murariu ve ark., 2011; Zaman ve ark., 2012)

TİTANYUM DİOKSİT (TiO₂, TİTANYA)

TiO₂ doğal olarak oluşur ve az çözünür. TiO₂ tüketici ürünlerinde kullanılan ilk beş nanopartikülden biridir (Shukla ve ark., 2011). TiO₂, yıllardan beri parlatma ve beyazlatma gibi karakteristik optik özellikler sağlamak amacıyla gıda boyasında pigment olarak veya granül / toz halindeki gıdalarda topaklanmayı önleyici ajan olarak kullanılmaktadır (Lomer ve ark., 2011; Shukla ve ark., 2011). ABD Gıda ve İlaç Dairesi (FDA) ve FAO/WHO Codex Alimentarius, katkı maddesinin ağırlıkça %1'i geçmemesi gerektiği ve içerik etiketinde yer almasına gerek kalmadan Avrupa ve ABD'de TiO₂'yi gıda renk katkı maddesi (E 171) olarak onaylamıştır (Enescu ve ark., 2019; FDA, 2020).

TiO₂ doğal olarak, anataz, rutil ve brookit şeklinde farklı boyutlara sahip üç ana faz halinde bulunur. TiO₂-Np'lerinin yüzey enerjisi boyutla birlikte büyür ve bu durum polimer / dolgu maddesi etkileşiminde önemli bir faktördür (Naicker vd., 2005). Rutil partiküllerin yüzey enerjileri, benzer büyüklükteki anataz partiküllerinden daha yüksektir (Macwan ve ark., 2011). TiO₂ hem antibakteriyel hem de antifungal özelliklere sahiptir. Farklı meyve ve sebzelerde (limon, elma ve domates) TiO₂ ile kaplanmış plastik filmlerin kullanılması, TiO₂' in ışıkla temas ettiğinde fotokatalitik özellik göstermesi nedeniyle bozunmaya neden olan *Penicillium expansum* mantarının çoğalmasını engellediği rapor edilmiştir (Maneerat ve Hayata, 2006). Başka bir çalışmada 3 saatlik aydınlatmadan sonra TiO₂ nanopartiküllerle kaplı yönlendirilmiş-polipropilen (OPP) film ile taze marulda *E. coli* sayısında 3 log/kob azalma görüldüğü; TiO₂ ile kaplanmamış filmlerin, benzer koşullar altında *E. coli* sayısını yalnızca 1 log/kob azaltabileceği bildirilmiştir (Chawengkijwanich ve Hayata, 2008). TiO₂ nanopartikül bazlı bazlı EVOH filmlerinin foto-aktif biyosidal özelliklerinin incelendiği bir çalışmada, TiO₂/EVOH varlığında 30 dakika ışınlamadan sonra *B. stearothermophilus*, *Bacillus sp.*, *L. plantarum* ve *P. jadinii* bakterilerinde 5 log/kob'un üzerinde azalma olduğu bildirilmiştir (Cerrada ve ark., 2008). Diğer taraftan, TiO₂-Np'lerinin gümüş ile kombine edilmesinin antimikrobiyal özellikleri önemli derecede artırdığı gösterilmiştir (Li ve ark., 2009; Wu vd., 2010).

2.4. SİLİSYUM DİOKSİT (SiO₂, SİLİKA)

SiO₂'nin geleneksel formu gıda katkı maddesi "E 551" olarak bilinmektedir. Gıdaların bileşiminde yer alan SiO₂ partiküllerin çoğunluğu 100-1000 nm aralığındadır. Ancak daha küçük boyutlardaki partiküller de bulunabilmektedir (Enescu ve ark., 2019).

SiO₂-Np'ler hafif, güçlü ve ısıya dayanıklı plastik (Durethan) geliştirmek için kullanılmaktadırlar (Mustafa ve Andreescu, 2020). SiO₂-Np'ler çeşitli polimer matrislerin mekanik ve/veya bariyer özelliklerini (mukavemet, uzama vb.) geliştirme potansiyeline sahiptir (Vladimirov ve ark., 2006). Salami-Kalajahi ve ark. (2012), %5 SiO₂-Np içeren nanokompozitlerin, mekanik ve fiziksel özelliklerinin iyileştiğini bildirmişlerdir. Jia ve ark.



(2007), vinil silika nanopartiküllerin ve vinil asetatın radikal kopolimerizasyonu yoluyla ürettiği polivinil alkol ve SiO₂ nanokompozitlerin, saf polivinil alkole kıyasla gelişmiş termal ve mekanik özellikler sergilediğini ortaya koymuşlardır. Tang ve Liu (2008) ise, nişasta/PVOH/SiO₂-Np ile biyolojik parçalanabilir filmler üretmişler ve bu filmlerdeki SiO₂-Np miktarındaki artışla filmlerin gerilme ve suya dayanıklılık özelliklerinin arttığını tespit etmişlerdir. Diğer taraftan nişasta matrisine SiO₂-Np eklenmesi, nişastanın su emilimini azaltabildiği gibi, nişastanın çekme özelliklerini de iyileştirebilmektedir (Xiong ve ark., 2008). Farhoodi (2016), SiO₂-Np'lerin gıda ambalaj malzemelerinde dolgu maddesi olarak uygulanmasının gazlar için kıvrımlı bir yol bıraktığını rapor etmiştir. Diğer taraftan, kağıda lotus benzeri süper hidrofobik özellik kazandırılması amacıyla SiO₂-Np ve polidimetilsiloksan silikon yağı ile kaplamanın, kağıdın su itici özelliğini güçlendirdiği bildirilmiştir (Chen ve ark., 2013).

MAGNEZYUM OKSİT (MgO)

MgO, yüksek erime noktasına ve sertliğe sahip, renksiz, kokusuz, toksik olmayan ve kristal yapıda nanopartiküllerdir. Gıda endüstrisinde topaklanmayı önleme (örneğin, kakao ürünleri; konserve bezelye vb.) ajanı, sıkılaştırma ajanı, pH kontrol ajanı, renk koruma, besin takviyesi, potansiyel güvenlik artırıcı olarak kullanılmaktadır. Ayrıca antibakteriyel aktivitesi nedeniyle gıdalardaki patojen bakterilerin çoğalmasını önemli ölçüde sınırlandırabilir (Swaroop ve Shuckla, 2018; Enescu ve ark., 2019).

NANO KİL

En yaygın kullanılan nano kil, genellikle volkanik kül/kayalardan elde edilen montmorillonittir (bentonit) (Hannon ve ark., 2015; Enescu ve ark., 2019). Montmorillonit, hidratlanmış magnezyum alüminyum silikat katmanlı bir kildir. Kristal yapısı, iki silika tetrahedral katman arasında, magnezyum veya alüminyum-hidroksitin kenar paylaşımli oktahedral tabakalarından oluşur. Nanokil katmanlarındaki izomorf ikame, kil trombositlerinin (galerilerinin) düzlemi içinde dağıtılan net bir negatif yüzey yükü oluşturmaktadır. Yüzeydeki negatif yüklerin dengesizliği, trombositler arasında bulunan değiştirilebilir katyonlarla (tipik olarak alkali veya alkali toprak katyonları) telafi edilmektedir. Paralel katmanlar, zayıf elektrostatik kuvvetlerle birbirine bağlanır. Montmorillonit bir polimer matrikse eklendiğinde, nano filtrenin geçirgen olmayan inorganik kristal yapısının, daha uzun ve daha kıvrımlı bir yol nedeniyle gaz geçirgenliğinde bir azalmaya neden olabilmektedir (Enescu ve ark., 2019).

NANOPARTİKÜL ELDE ETME YÖNTEMLERİ KİMYASAL ÇÖKELTME

Bu yöntemle, boyut kontrolü, tutuklanmış çökeltme tekniği ile yapılır. Kimyasal çökeltmede, aynı sıvı içinde, fiziksel değişiklikler ve küçük kristallerin agregasyonu göz ardı edilerek nanomateryal sentezlenir (Rajput, 2015). Sentez, uygun çözücü içinde bileşen malzeme arasındaki reaksiyonu içermektedir. Çökeltme reaksiyonundan önce, yüzey aktif maddeden oluşan partiküller arasındaki ayrımı korumak için ana çözeltiye katkı maddesi ilave edilir. Oluşan nanokristal santrifüj ile ayrılır, yıkanır ve kurutulur. Ancak kurutulmuş materyal, gerçek kuantum tutulmasını iletmek için nanoküme yüzeyindeki yüzey aktif madde kapatma filminin polimerizasyonu için UV kürlemesine de maruz bırakılmaktadır (Wahab ve ark., 2021).



MEKANİK YIPRANMA/SÜRTÜNME

Nanoyapılar sadece kütle birleştirme yoluyla üretilmez, aynı zamanda plastik deformasyonun bir sonucu olarak kaba partikül yapısının temel parçalanması yoluyla da üretilebilir. Söz konusu üretimler mekanik sürtünme işleminin kullanılmasıyla mümkün kılınmıştır. Bu amaçla bilyalı frezeleme ve çubuk frezeleme teknikleri, birçok gelişmiş malzemenin imalatı için güçlü bir araç olarak büyük ilgi gören mekanik alaşımlama teknikleridir. Mekanik alaşımlama, oda sıcaklığında gerçekleştirilebilen benzersiz bir işlemdir. İşlem hem yüksek enerjili santrifüj tipi değirmenler ve titreşimli tip değirmenlerde hem de düşük enerjili tamburlu değirmenlerde gerçekleştirilebilir (Rajput, 2015).

ELEKTRODEPOZİSYON

Elektrodepozisyon yardımı ile çeşitli nanoyapılı parçaların oluşumu gerçekleştirilebilir. Elde edilen bu filmler tekdüze durur ve mekanik olarak dayanıklıdır (Wahab ve ark., 2021). Metalik nanoyapıların elektrodepozisyonu ilgi çekicidir. Çünkü biriktirme potansiyeli, zaman ve çözelti bileşimi gibi parametrelerin, büyüme oranını, partikül boyutunu ve sayı yoğunluğunu kontrol etmek için değiştirilebileceği bildirilmektedir (Day ve ark., 2007).

GIDA AMBALAJLARINDA PRATİK NANOTEKNOLOJİ UYGULAMALARI İYİLEŞTİRİLMİŞ AMBALAJLAMA

İyileştirilmiş ambalajlama, ambalaj malzemelerinin gaz bariyeri özelliklerinin yanı sıra sıcaklık ve nem direncini iyileştirmek için ambalaj malzemelerinin polimer matrisine nano malzemelerin karıştırılmasıyla elde edilmektedir. Bunların gıda ile temas halinde güvenli olduğu ABD Gıda ve İlaç Dairesi tarafından onaylanmıştır (Adeyeye, 2019).

Gıda ambalaj malzemelerinin mekanik özelliklerini iyileştirmek için kullanılan nano yapılar Tablo 2' de gösterilmiştir.

AKTİF AMBALAJLAMA

Antimikrobiyal özelliklere sahip bu gıda ambalajları, gıda ürünlerini kontamine edebilecek patojen mikroorganizmaları öldürmek ve onların çoğalmalarını önlemek için geliştirilmiştir. Gıda güvenliğini artırmak ve gıda ürünlerinin raf ömrünü uzatmak için ambalaj malzemelerine farklı antimikrobiyal ajanlar eklenebilir. Ambalaj materyallerinde kullanılan antimikrobiyal ajanlar arasında doğal olarak üretilmiş antimikrobiyal ajanlar (örn., uçucu yağlar, antikorlar ve enzimler), sentetik inorganik materyaller (örn., ZnO, TiO₂ ve Ag) ve organik bileşikler (örn., grafen) bulunmaktadır (Mei ve Wang, 2020).

AKILLI AMBALAJLAMA

Akıllı ambalajlama, özellikle gıdalardaki biyokimyasal veya mikrobiyal değişiklikleri algılamayı amaçlayan bir nanotekniktir. Ambalajdaki bazı akıllı ambalaj nano sensörleri, renk değişikliklerinin tespiti için geliştirilmiştir (Wahab ve ark., 2021). Bu yeni ambalaj malzemelerinde, hedefleri tespit eden reseptörler ve sinyal değişikliklerini bildiren raporlayıcılar bulunur. Başlıca reseptörler biyomakromoleküller (örn., Antikorlar, DNA enzimleri, RNA'lar, aptamerler ve enzimler) ve küçük kimyasal moleküllerdir (örn., oligotiyofen-benzotiyazol bazlı siyanür sensörü). Raporlayıcılar ise, çeşitli nanopartiküller ve enzimlerdir. Raporlayıcılar, moleküler sinyalleri, çıplak gözle veya ekipmanla



gözlemlenebilen/ölçülebilen renk ve elektronik sinyaller gibi algılanabilir bilgilere dönüştürmektedirler (Mei ve Wang, 2020).

Tablo 2. Gıda ambalaj malzemelerinin mekanik özelliklerini iyileştirmek için birden fazla nano yapının kombinasyonu

Materyal	Değişen özellik	Kaynak
İrmik içinde ZnO nanorodlar ve nanokaolin	-İyileştirilmiş gerilme mukavemeti ve antimikrobiyal aktivite -Azalan su buharı geçirgenliği	Jafarzadeh ve ark., 2017
Nanokaolin gömülü ırmik filmi	-Azalan su buharı, oksijen ve nem geçirgenliği -Suda çözünürlük	Jafarzadeh ve ark., 2016
ZnO-NP'ler / CuO-NP'ler/ Karragenan hidrojel	-Artan su tutma kapasitesi ve termal stabilite -Gelişmiş antibakteriyel aktivite	Oun ve Rhim, 2017
Lizozim / halloysit nanotüpler / Poli laktikasit	-Güçlendirilmiş su buharı geçirgenliği ve mekanik özellikler -Kopma sırasında azalan uzama	Bugatti ve ark., 2017
Uçucu yağ / sodyum bentonit nanokil / zein	-İyileştirilmiş su buharı geçirgenliği, suda çözünürlük ve mekanik özellikler -Mükemmel antimikrobiyal aktivite	Kashiri ve ark., 2017
Lizozim / halloysit nanotüpler / poliamid 11	-Gelişmiş mekanik özellikler ve elastik modül -Mükemmel antimikrobiyal aktivite	Bugatti ve ark., 2018
Selüloz asetat / AgNP'ler-organokil / timol	-Azaltılmış optik netlik ve termal stabilite ile geliştirilmiş UV bariyer özellikleri -Üstün antioksidan aktivite ve antimikrobiyal aktivite -Artan gerilme ve oksijen bariyer özellikleri	Dairi ve ark., 2019
TiO ₂ -NP'ler / zein / kitosan	-Geliştirilmiş mekanik özellikler, termal stabilite ve hidrofobiklik -Antibakteriyel özellik	Qu ve ark., 2019
Nişasta / kefiran / TiO ₂	Geliştirilmiş karışabilirlik ve uyumluluk	Goudarzi ve Shahabi-Ghahfarrokhi, 2018
ZnO-NP'ler/ nişasta / yağ / karboksimetil selüloz	İyileştirilmiş gerilme, mekanik ve su buharı geçirgenliği	Mirjalili ve Ardekani, 2017
Selüloz nanokristaller / AgNP'ler / Poli laktikasit	Filminden yoğunlaştırılmış bariyer özellikleri ve Ag göçü	Fortunati ve ark., 2013
Selüloz/lignin NP'ler/Poli laktikasit	-Arttırılmış UV ışığı engelleme özelliği, gerilme mukavemeti ve elastik modül -Etkili biyosidal aktivite	Yang ve ark., 2016
Karvakrol / timol / halloysit nanotüpler / LDPE	Geliştirilmiş termal stabilite ve üstün antimikrobiyal aktivite	Krepker ve ark., 2017
Kitosan NP'ler / tarçın esansiyel yağı / zein	-Azalan su buharı geçirgenliği ile kopma sırasında uzama -Geliştirilmiş gerilme mukavemeti ve antimikrobiyal aktivite	Vahedikia ve ark., 2019

Gıda ambalajlarında özellikle nanosensörler oldukça işlevsel özelliklere sahiptir. Nanosensörler, gıdaların tazeliğini (bozulmasını) kontrol etmek için gıda tedarik zinciri boyunca gıda ürünlerinin, peletlerin ve kapların dış veya iç koşullarını izlemek için kullanılmaktadır (Farhoodi, 2016; He ve Hwang, 2016). Bu nanosensörlerden başlıcaları,



nanopartikül tabanlı sensörler, elektronik burunlar, dizi biyosensörler, nanokonsollar, çözelti içindeki nanopartiküller ve nano test şeritleridir.

Ambalajlanmış gıdalardaki patojenlerin tespit edilebilmesi için kullanılan bazı nanomateryaller ve nanobiyosensörler Tablo 3' te gösterilmiştir.

Tablo 3. Gıdalarda bulunan patojenlerin tespiti için kullanılan farklı nanomateryaller ve nanobiyosensörler (Girigoswami ve ark., 2021)

	Kullanılan nanomateryaller ve biyosensörler
1	Karbon nanomateryaller - Karbon nanotüpler, Fullerenler, Grafen, indirgenmiş Grafen Oksit ve Grafen Oksit türevleri
2	Soy metal tabanlı nanomalzemeler - Altın, gümüş ve bimetallik nanomalzemeler
3	Aflatoksin B1'in rekabetçi manyetik immünoteksiyonu (cMID) için manyetik nanopartiküller

SONUÇ

Nanoteknoloji, gıdaların üretimi, işlenmesi ve dağıtımındaki çeşitli uygulamaları nedeniyle algılarımızı değiştirebilir ve gıda endüstrisinde köklü değişikliklere yol açabilir (Wesley ve ark., 2014). Nanoteknoloji, gıdaların raf ömrünün uzatılmasına yardımcı olabilmekte, gıda güvenliğini artırabilmekte ve ambalaj atıklarını azaltabilmektedir. Öte yandan besinlerin lezzetini ve tazeliğini korumaya da yardımcı olabilmektedir (Adeyeye, 2019).

Nanoteknolojinin gıdaların ambalajlamasında etkili bir şekilde kullanılabilmesi için, nanomalzemeler ve nanokompozitlerin özellikleri, nanomalzemelerin gıdaya göçü ve nanomalzemelerin biyolojik etkileri hakkında detaylı bilgilere ihtiyaç vardır. Bu nedenle, nanomalzemeler için kapsamlı karakterizasyon yöntemleri geliştirilmelidir (Rossi ve ark., 2017).

Nanoteknoloji dikkatli bir şekilde uygulanırsa, gıda ambalajlarında büyük yararlar sağlayabilir. Nano esaslı ambalajların söz konusu yararlarının yanında, ambalajlarda kullanılan nanomalzemelerin potansiyel olarak gıdaya geçerek, tüketiciler için sağlık risklerine yol açabileceğinden endişe edilmektedir (Carlson ve ark., 2008). Zira farklı araştırmacıların titanya, gümüş ve karbon nanotüplerin nano parçacıkları üzerinde yaptıkları araştırmalar, bu nanomalzemelerin kan dolaşımına girdiğini ve çözünmez özelliklerinden dolayı vücut organlarında aşırı miktarlarda birikebileceğini göstermiştir (Wang ve ark., 2007; Rhim ve ark., 2013). Ülkelerin gıda otoriteleri, ambalajlarda uygulanan nanomalzemelerin insan sağlığı üzerindeki etkilerini değerlendirmeli, söz konusu sağlığı korumaya hizmet eden bilgilendirici rehberler ve standartlaştırılmış prosedürler geliştirmelidirler.

Yakın bir gelecekte nanoteknolojinin gelişmiş ambalajlama sistemlerini yönlendirmesiyle, gıda endüstrisinde geleneksel ambalajların yerini tamamen yenilikçi ve özgün gıda ambalajlarının alacağı öngörülmektedir.



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**EFFECT OF SOWING DATES AND NITROGEN LEVELS ON YIELD AND
QUALITY OF BLACK CUMIN (*Nigella sativa* L.)**

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ABSTRACT

This study was carried out to determine the effects of different sowing date and nitrogen levels on yield and quality characteristics in black cumin. Field experiment was setup in the experimental fields of Siirt University Faculty of Agriculture in 2017-2018 vegetation period. Four different sowing times (29 October, 05 November, 12 November, 19 November) and five different nitrogen levels (0, 30, 60, 90 and 120 kg ha⁻¹) were tried in this study. Plant height, number of branche, number of capsule, thousand seed weight, seed yield, fixed oil ratio and fixed oil yield were examined. As a result, the effects of nitrogen levels on the yield and quality characteristics were statistically significant. According to variance analysis showed that there weren't significant difference between the sowing dates except for the number of branches. The highest seed yield (1893.2 kg ha⁻¹) and fixed oil (42.42%) were obtained from 90 kg N ha⁻¹ application..

Keywords: Black cumin, *Nigella sativa*, yield, fixed oil, nitrogen, sowing date



INTRODUCTION

Nigella sativa belongs to the Ranunculaceae family, which has been used in Southern Europe, Southwest Asia and North Africa and it is cultured in many countries in the world, such as the Mediterranean region, Middle East, Pakistan, India, South Europe, Turkey, Saudi Arabia and Syria (Al-Ameedy and Omran, 2019). The seeds of the blackcumin plant are used for various purposes. The height of black cumin plant ranges from 30 to 60 cm and its seed is of black color. It is one of the most important medicinal plants because it has multifarious uses (Ashraf et al. 2006). For example, its seed has been widely used in folk medicine for the treatment of a number of diseases, including diarrhea, jaundice, amenorrhea, helminthiasis, ophthalmia, paralysis and asthma. Analysis of black cumin seeds shows a composition of 39.7-52.5% oil and 0.5-1.5% essential oil (Takruri and Dameh, 1998). Fixed oil of *Nigella* seeds is rich in linoleic, oleic and palmitic acids. The dominating fatty acid is linoleic acid, which is an essential fatty acid and accounts for more than 50% of the total fatty acids (Gilani et al. 2001). The crude extract from the blackcumin seed was found to have spasmolytic and bronchodilator activities. The essential oil of black cumin seed contains a variety of active compounds, of which thymoquinone, α -thujene and p-cymene are the major ones. The essential oil of black cumin was found to possess antioxidant activity (Burits and Bucar, 2000), antibacterial properties (Ferdous et al. 1992; Moukaweh et al. 2018; Sultana et al. 2018), anticancer, antihypertensive and anti-inflammatory activities (Al-Ameedy and Omran, 2019). In this study, it was aimed to reveal the effect of sowing date and nitrogen levels on seed yield and some quality parameters of black cumin.

Therefore, proper sowing time and improving crop management are crucial to crop success. The studies have reported that sowing time has an effect on yield, yield elements and quality characteristics of black cumin (Kizil et al. 2008; Sultana et al. 2018; Beyzi and Karer, 2020). Nitrogen has an important role in product yield, its deficiency causes serious reductions in yield. It was reported that nitrogen doses in black cumin plant had positive effects on plant height, the number of branches, the number of capsules, seed yield (Tuncur et al. 2012). Ashraf et al. (2006) reported that the ratio of fixed oil increased with the increase of nitrogen doses. In this study, it was aimed to reveal the effect of sowing date and nitrogen levels on seed yield and some quality parameters of black cumin.

MATERIAL and METHODS

The study was carried out in 2017-2018 vegetation period under the ecological conditions of Siirt province located in the Southeastern Anatolia Region of Turkey, which has a semi-arid climate. Climatic values for experimental area in the research year were 574.2 mm rainfall, 58.5% humidity and 11.2 °C mean temperature. While the most precipitation occurred in December, March and April, there was no precipitation in June. It rained less than the average for many years in the trial year (Table 1).



Table 1. Climate characteristics of trial area (Anonymous, 2020).

Climate parameters	Research year and long term	Months								
		Nov.	Dec.	Jan.	Feb.	March	April	May	June	Mean/Sum.
Average temperature (°C)	2017-2018	10.4	3.3	3.0	2.7	9.6	14.0	19.5	26.9	11.2
	Long term*	10.6	5.1	3.2	4.7	9.2	14.2	19.8	25.9	11.6
Average humidity (%)	2017-2018	50.2	75.0	72.7	73.0	63.1	60.2	47.1	26.6	58.5
	Long term*	62.7	72.5	72.5	67.5	61.3	58.4	50.1	33.9	59.9
Monthly precipitation (mm)	2017-2018	55.4	116.6	46.4	29.2	119.2	132.8	74.6	0.0	574.2
	Long term*	74.3	90.6	81.0	98.4	112.5	103.5	63.1	9.1	632.5

*: 1980-2018

In the study, some physical and chemical analysis results of the soils taken 0-20 cm depth before establishing the field trial were presented in Table 2. The trial area soil was clay-loam textured, slightly alkaline, salt-free, their lime content was "medium calcareous," the organic matter content was "low" and the available potassium (K) content was "sufficient". The available P content of the soils was determined to be "low" (Table 2).

Table 2. Some physical and chemical properties of the study area soils (0-20 cm)*

Properties	Value
Clay, %	34.16
Silt, %	26.00
Sand, %	39.84
pH	7.53
Electrical conductivity (EC), mS cm ⁻¹	0.150
Lime (CaCO ₃), %	8.2
Organic matter, %	1.78
Available phosphorus, kg P ₂ O ₅ ha ⁻¹	49
Available potassium, kg K ₂ O ha ⁻¹	1250

In the research, "Çameli" black cummin variety registered by Transitional Zone Agricultural Research Institute was used as plant material. "TSP" (Triple süper phosphate-42% P₂O₅) was used as the source of phosphorus, and urea (46% N) was used as the source of nitrogen fertilizer. The experiment was established as split plots of randomized blocks design with three replications. In the study, 4 sowing date (29 October, 05 November, 12 November and 19 November) and 5 different nitrogen levels (N₀= 0, N₁= 30, N₂= 60, N₃= 90 and N₄= 120 kg N ha⁻¹) constituted the subject of the study. The sowing process was done manually in the opened rows with the help of a marker. Sowing norm is 30 kg ha⁻¹. Each plot sizes were 3 x 1.2 = 3.6 m² and row spacing was 30 cm in 4 rows. Area harvested was 1.2 m² and plants were harvested by hand when seeds were ripened. Weed control was performed mechanically by hand several times. It has not been irrigated and has been grown depending on natural precipitation. In the study, some agricultural traits such as plant height (cm), the number of branch (branch/plant), the number of capsule (capsule/plant), thousand-seed weight (g), seed yield (kg ha⁻¹), fixed oil ratio (%) and fixed oil yield (L ha⁻¹) were investigated. The data obtained from the research



were subjected to analysis of variance in the JMP statistical program according to the split plots of randomized blocks. Tukey test was used to group the features with statistically significant differences.

RESULT and DISCUSSION

According to variance analysis showed that there were not significant difference between the sowing dates except for the number of branches. All the features investigated in this study were positively affected by different nitrogen levels. The interaction of sowing date x nitrogen level was found to be insignificant in all properties.

There was a statistically significant difference at $p < 0.05$ level between nitrogen levels in terms of plant height. Although the highest plant height was determined for N_3 , there was no statistical difference between them except for the control subject. In this study, plant height values were found between 23.95 cm and 40.95 cm according to the sowing times (Table 3). Plant height of black cumin in different studies varied in a wide range from 23.95 cm to 78.90 cm (Kızıllı et al. 2008; Tuncurk et al. 2012; Tulukcu, 2015; Kılıç and Arabacı, 2016; Beyzi and Karer, 2020). Plant height is a feature which related to plant genotype and affected by ecological variations in growing conditions and cultural applications. Therefore, differences in plant height among the different ecological and soil conditions with different genotypes could be expected.

Table 3. Means of plant height at sowing date and nitrogen levels in black cumin

Sowing date	Nitrogen levels					Mean
	N ₀	N ₁	N ₂	N ₃	N ₄	
29 October	63.26	66.46	74.07	74.97	64.43	68.64
05 November	59.83	62.30	64.07	66.70	64.50	63.48
12 November	57.90	62.63	60.57	63.03	62.70	61.37
19 November	60.56	59.80	62.10	62.23	64.80	61.90
Mean	60.39 b	62.80 ab	65.20 ab	66.73 a	64.11 ab	
CV (%)	6.97					

A statistically significant difference was found between sowing date ($p < 0.05$) and nitrogen levels in terms of number of branches ($p < 0.01$). The number of branches decreased with the delay of sowing dates, and the highest number of branches was determined at the first sowing date. Although the highest number of branches among nitrogen levels was determined in N_3 , there was no statistical difference between N_2 and N_4 levels (Table 4). The number of branch increased by increasing nitrogen levels up to 90 kg ha^{-1} , there was a amount decrease in further nitrogen level. Some researchers reported that the highest the number of branches was obtained form higher nitrogen doses (90 kg N ha^{-1}) (Özgülven and Şekeroğlu, 2007; Tuncurk et al. 2012; Özyazıcı, 2020). Branches values determined our study are in harmony with the researchers' findings.



Table 4. Means of number of branch at sowing date and nitrogen levels in black cumin

Sowing date	Nitrogen levels					Mean
	N ₀	N ₁	N ₂	N ₃	N ₄	
29 October	5.27	5.57	5.90	6.93	7.30	6.19 a
05 November	4.83	5.40	6.03	7.06	6.00	5.87 ab
12 November	4.50	4.87	5.37	5.93	5.40	5.21 ab
19 November	4.43	4.67	4.73	5.40	4.90	4.83 b
Mean	4.75 c	5.13 bc	5.51 abc	6.33 a	5.90 ab	
CV (%)	15.80					

There was no statistical difference between sowing dates in terms of number of capsule. However, numerically the highest number of capsule was observed at the second sowing date (Table 5). There was a statistically significant difference at $p < 0.01$ level between nitrogen levels. The highest number of capsule was obtained N₃ level, and the lowest in the control (no nitrogen fertilizer). In different studies, researchers found that the number of capsule for black cumin were in the range of 22.2 Özgüven and Şekeroğlu (2007), 5.30-7.60 (Tuncturk et al. 2012) and 2.20-3.60 (Beyzi and Karer, 2020).

Table 5. Means of number of capsule at sowing date and nitrogen levels in black cumin

Sowing date	Nitrogen levels					Mean
	N ₀	N ₁	N ₂	N ₃	N ₄	
29 October	7.70	10.33	10.87	16.60	12.77	11.65
05 November	11.23	13.47	15.40	19.03	14.60	14.75
12 November	7.83	11.80	10.63	15.47	12.26	11.60
19 November	10.67	13.43	13.80	11.67	14.13	12.74
Mean	9.36 c	12.26 b	12.68 b	15.69 a	13.44 ab	11.65
CV (%)	16.01					

Between sowing dates wasn't statistical difference in terms of thousand-seed weight. The thousand-seed weight changed between 2.23-2.33 g. There was a statistically significant difference at $p < 0.05$ level between nitrogen levels. Although the highest thousand-seed weight was determined for N₂ and N₃ levels, there wasn't statistical difference between them except for the control (Table 6). Some researchers reported that nitrogen doses didn't affect the thousand grain weight (Özgüven and Şekeroğlu, 2007; Mollafilabi et al. 2010; Tuncturk et al. 2012), while others reported that increasing nitrogen doses increased the thousand grain weight (Tulukcu, 2015). Other studies, thousand seed weight of black cumin was reported as 2.35 g (Özgüven and Şekeroğlu, 2007), 2.20-2.33 g (Tuncturk et al. 2012), 2.46-2.70 g (Beyzi and Karer, 2020) and 2.92-3.24 g (Moradzadeh et al. 2021).



Table 6. Means of thousand-seed weight at sowing date and nitrogen levels in black cumin

Sowing date	Nitrogen levels					Mean
	N ₀	N ₁	N ₂	N ₃	N ₄	
29 October	2.09	2.29	2.33	2.31	2.18	2.24
05 November	2.20	2.30	2.38	2.44	2.31	2.33
12 November	2.21	2.34	2.40	2.41	2.26	2.32
19 November	2.00	2.07	2.45	2.48	2.17	2.23
Mean	2.13 b	2.25 ab	2.39 a	2.41 a	2.23 ab	
CV (%)	7.05					

The effect of sowing time on seed yield was not found statistically significant. There was a statistically significant difference at $p < 0.01$ level between nitrogen levels. Although the highest seed yield was determined for N₃ level, there wasn't statistical difference between N₄ level (Table 7). 90 kg nitrogen application per hectare increased the seed yield by 42% compared to the control. Seed yield of black cumin in different studies varied in a wide range from 198 to 1037.3 kg ha⁻¹ (Tuncturk et al. 2012; Tulukcu, 2015; Sultana et al. 2018; Beyzi and Karer, 2020). Our findings are more than the researchers' results. This can be explained by the difference in genotype, climate and soil conditions, and sowing dates.

Table 7. Means of seed yield (kg ha⁻¹) at sowing date and nitrogen levels in black cumin

Sowing date	Nitrogen levels					Mean
	N ₀	N ₁	N ₂	N ₃	N ₄	
29 October	1385.7	1499.7	1729.3	1918.0	1762.7	1659.1
05 November	1399.0	1567.7	1733.3	1946.0	1668.7	1662.9
12 November	1186.0	1487.3	1684.7	1821.7	1736.0	1583.1
19 November	1369.3	1453.0	1603.3	1887.0	1786.7	1619.8
Mean	1335.0 d	1501.9 c	1687.7 b	1893.2 a	1738.5 ab	
CV (%)	8.29					

One of the most important factors determining the seed quality of black cumin is the fixed oil rate. With respect to fixed oil ratio, the effects of N levels were found to be statistically significant ($p < 0.01$), while the effects of sowing dates were found to be insignificant (Table 8).

Table 8. Means of fixed oil ratio at sowing date and nitrogen levels in black cumin

Sowing date	Nitrogen levels					Mean
	N ₀	N ₁	N ₂	N ₃	N ₄	
29 October	38.40	40.08	41.63	42.76	40.73	40.72
05 November	38.06	39.51	41.29	42.60	39.70	40.23
12 November	35.81	39.39	41.70	42.14	40.48	39.91
19 November	37.17	39.68	40.43	42.19	40.80	40.05
Mean	37.36 d	39.67 c	41.26 b	42.42 a	40.43 bc	
CV (%)	2.18					



The highest fixed oil ratio was obtained N₃ level, and the lowest in the control (no nitrogen fertilizer). In other studies reported that the fixed fat ratio varied between 11.94-42.10% (Ashraf et al. 2006; Ertaş, 2016; Gülhan and Taner, 2020; Beyzi and Karer, 2020). Fixed oil ratio values determined in the present study are in conformity with the researchers' findings.

Table 9. Means of fixed oil yield (L ha⁻¹) at sowing date and nitrogen levels in black cumin

Sowing date	Nitrogen levels					Mean
	N ₀	N ₁	N ₂	N ₃	N ₄	
29 October	531.3	601.3	720.3	819.6	716.7	677.8
05 November	532.7	619.0	716.0	829.6	662.7	672.0
12 November	427.0	586.0	702.3	768.0	703.3	637.3
19 November	507.7	577.0	649.3	796.0	729.0	651.8
Mean	499.7 d	595.8 c	697.0 b	803.4 a	702.9 b	
CV (%)	8.39					

Fixed oil yield is a feature that occurs with the direct effect of oil rate and seed yield. Statistically similar results were found in terms of fixed oil yield and fixed oil ratio. The highest fixed oil yield was obtained N₃ level, and the lowest in the control (Table 9). There is a positive relationship between seed yield and oil yield. In the study, nitrogen levels with high seed yields also had high oil yields.

CONCLUSION

In semi-arid climate conditions, 90 kg nitrogen application per hectare can be recommended for seed and oil yield in black cumin cultivation. Since there isn't difference between the sowing times in terms of the examined characteristics, November can be recommended as the sowing time under Siirt ecological conditions.



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DOMATESTE SALİSİLİK ASİT UYGULAMASININ TUZA TOLERANS ÜZERİNDEKİ ETKİSİ

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ÖZET

Tuzluluk bitki büyüme ve gelişimi ile üretimi sınırlandıran en önemli çevresel faktörlerden biridir. Bu çalışmada; salisilik asit (SA) uygulamasının (0.5 mM), daha önce yapılan çalışmalarımızda tolerant ve hassas olarak belirlenen iki genotip ve Tuğba F1 domates çeşidinde tuza tolerans üzerindeki etkisi morfolojik, fizyolojik ve biyokimyasal bakımdan incelenmiştir. Tohumlar 2:1 oranında torf:perlit karışımı içeren viyollere ekilmiş, bitkiler iki gerçek yapraklı aşamada yine 2:1 oranında torf:perlit karışımı içeren plastik saksılara şaşırtılmış ve dört gerçek yapraklı aşamada tuz (150 mM NaCl) stresine başlanmıştır. Stres sonunda bitkiler yeşil aksam yaş ve kuru ağırlığı, yaprak alanı, yaprak oransal su içeriği (YOSİ), sodyum (Na), klor (Cl), potasyum (K) ve kalsiyum (Ca), klorofil, malondialdehit (MDA) içeriği, antioksidatif enzim [süperoksit dismutaz (SOD), katalaz (CAT), glutatyon redüktaz (GR) ve askorbat peroksidaz (APX)] aktiviteleri bakımından değerlendirilmiştir. Tuz stresi bitki büyüme parametreleri, K, Ca ve klorofil içeriğinde azalmaya yol açarken; Na, Cl ve MDA içeriği ile antioksidatif enzim aktivitelerinde artışa yol açmıştır. Bununla birlikte SA uygulamaları tuza toleransı değişen oranlarda artırmıştır. Özellikle hassas genotipte büyüme parametrelerinde %46 düzeyinde iyileşme sağlanmış; MDA içeriğinde ise %20 oranında azalma belirlenmiştir. Bununla birlikte SA uygulaması antioksidatif enzim aktivitelerinde de artışa neden olmuştur. Çalışma sonucunda; domateste 0.5 mM SA uygulamasının tuza toleransın sağlanmasında etkin olabileceği tespit edilmiştir.

Anahtar Kelimeler: CAT, salisilik asit, SOD, *Solanum lycopersicum*, tuzluluk



THE EFFECTS OF SALISILIC ACID TREATMENT ON SALT TOLERANCE IN TOMATO

ABSTRACT

Salinity is a significant environmental factor that inhibits plant growth, development, and production. In this study, the effect of salicylic acid (SA) application (0.5 mM) on salt tolerance in two genotypes, which were previously classified as tolerant or sensitive and the Tugba F1 tomato cultivar was evaluated in terms of morphological, physiological, and biochemical characteristics. The seeds were sown in viols containing a 2:1 peat: perlite mixture, and the plants were transplanted into plastic pots containing a 2:1 peat: perlite mixture at two true leaf stages and then salt (150 mM NaCl) stress was initiated at the four true leaf stage. At the end of the stress, plants shoot fresh and dry weight, leaf area, leaf water content (YOSI), sodium (Na), chlorine (Cl), potassium (K) and calcium (Ca), chlorophyll, malondialdehyde (MDA) content, antioxidant enzyme activities [superoxide dismutase (SOD), catalase (CAT), glutathione reductase (GR) and ascorbate peroxidase (APX)] were evaluated for their activities. While salt stress causes a decrease in plant growth parameters, K, Ca and chlorophyll content; Na, Cl and MDA contents and antioxidant enzyme activities increased. However, SA applications increased salt tolerance to varying degrees. Especially in sensitive genotypes, 46% improvement was achieved in growth parameters; a 20% reduction in MDA content was determined. In addition, SA application also allowed an increase in antioxidant enzyme activities. As a result of the study, it was determined that 0.5 mM SA application could be effective in providing salt tolerance in tomatoes.

Keywords: CAT, salicylic acid, salinity, SOD, *Solanum lycopersicum*,



GİRİŞ

Tuz stresi; özellikle kurak ve yarı kurak bölgelerde bitkisel üretimi sınırlandıran en önemli abiyotik stres faktörlerinden biri olarak değerlendirilmektedir. İklimsel değişikliklerin beraberinde getirdiği kalitesiz ve kontrolsüz su kullanımı nedeniyle, dünya genelinde 1.5 milyar ha tarım alanının yaklaşık olarak %5'inin (77 milyon ha) tuzluluktan etkilendiğini ayrıca bu alanların dünya yiyecek ihtiyacının üçte birini karşıladığını belirtmektedirler. Türkiye ise 1.5 milyon ha alanda tuzluluk problemi ile savaştaktadır. Bu alanların %60'ı tuzlu, %19.6'sı orta derecede tuzlu, %0.4'ü orta derecede alkali, %12'si hafif tuzlu-alkali, %8'i ise orta derecede tuzlu-alkali olarak sınıflandırılmaktadır (Kuşvuran, 2010; Karaoğlu ve Yalçın 2018).

Tuz stresinde bitkinin kök bölgesinde iyon dengesinin bozulduğu, artan miktardaki sodyum alımının, diğer mineral maddelerin alımı ile rekabete girerek beslenme noksanlığına yol açtığı bildirilmekte (Sobhani ve Mohammadzadeh 2017), iyon dengesizliğinin ve köklerde hücre zarı geçirgenliği bozulmasının bitkinin beslenme rejimini etkileyerek, metabolik olaylarda kullanılan temel bazı elementlerin alımını önlediği, bunun da fizyolojik sorunların ortaya çıkmasına neden olduğu ileri sürülmektedir (Villora ve ark. 1997). Bununla birlikte farklı türlerde gerçekleştirilen çalışmalarda, tuz stresinin su eksikliği (su stresi), Na^+ ve Cl^- iyonlarının fazla miktarda alınması nedeniyle oluşan iyon toksisitesi, iyon taşınımında ortaya çıkan dengesizlik nedeniyle hücre içindeki sıvının mineral yapısının ve Ca^{++} dengesinin bozulması şeklinde bitki büyümesi üzerindeki sınırlayıcı etkisi olduğu vurgulanmıştır (Marschner 1995, Kuşvuran, 2012; Kuşvuran ve Kaya, 2019).

Tuza tolerant genotiplerde ve/veya çeşitlerde, stresin yarattığı zararlanmalardan korunma, bitkilerde hücresel ve moleküler düzeyde meydana gelen biyokimyasal değişimler sonucunda gerçekleşir ve hücrelerin zarar görmesi engellenir. Bu bağlamda hücrelerdeki ozmolit sentezleri ve birikimleri son derecede önem kazanmaktadır. Benzer durumlar yine bir ozmotik stres olan kuraklığa karşı tolerans bakımından da geçerli olabilir. Diğer birçok stres faktöründe olduğu gibi tuz stresi altındaki bitkiler su kaybını azaltmak için stomalarını kapatmakta böylece CO_2 gazının girişi de engellenmektedir. Karbondioksit fiksasyonunda kullanılmayan elektronlar ile absorbe edilen ışık enerjisi O_2 aktivasyonunda kullanılmaktadır. Stres altındaki bitkilerde artan reaktif oksijen türleri (ROS) hücrelere zarar vermekte, protein membran lipitleri, nükleik asitler ve klorofil gibi hücre bileşenlerinde zararlar meydana getirmektedir. Tuz stresi sonucunda ROS'u zararsız bileşiklere dönüştüren antioksidan miktarları ve antioksidan enzim aktiviteleri bitkilerin oksidatif strese karşı en önemli dayanım mekanizmalarıdır. Bitkideki kloroplastlar, toksik oksijen türevlerine karşı antioksidan savunma sistemlerine sahip olup bunların başında vitamin E, vitamin C, glutatyon ve karotenoidler gelirken; süper oksit dismutaz (SOD), askorbat peroksidaz (APX), glutatyon redüktaz (GR), katalaz (CAT) gibi enzimler en etkin antioksidatif enzimler arasındadır (Kusvuran ve ark., 2016).

Bitki büyüme düzenleyicileri doğal ve sentetik olmak üzere iki şekildedir. Doğal hormonlar bitki tarafından sentezlenirken, sentetik hormonlar kimya endüstrisi tarafından geliştirilen değişik yapıdaki maddelerdir. Sentetik hormonlar doğal hormonlarla benzer etki göstermekte, bazı durumlarda da daha fazla etkilere sahip olabilmektedir (Algül ve ark., 2016).. Büyüme ve gelişme üzerine etki eden başlıca beş hormon grubuna (oksinler, sitokininler, giberellinler, absizik asit) ek olarak brassinostreoidler, josmonatlar, salisilik asit ve poliaminlerde bitki büyüme düzenleyicileri arasında yer almaktadır. Bitki büyüme düzenleyicisi olarak değerlendirilen salisilik asidin bitkiler üzerindeki etkisine yönelik yapılan çalışmalarda, bitki büyümesinin düzenlenmesinde ve gelişiminde oldukça etkili olduğu ortaya konmuştur. Salisilik asit (SA) bitkinin tüm organlarında bulunmakta ve dışarıdan uygulandığı yerden floem yoluyla farklı organlara taşınmaktadır (Baktır, 2010; Algül ve ark., 2016).. SA'nın en etkin kullanım



alanlarından bazıları da kuraklık, tuzluluk, yüksek ve düşük sıcaklık, ağır metal ve don stresi gibi olumsuz koşullara dayanıklılık kazandırmak olarak rapor edilmektedir. Ayrıca SA'nın bitkilerde çevresel stres koşullarına dayanım açısından önemli bir içsel işaret molekülü olduğu; biyotik veya abiyotik stres koşulları altındaki bitkilerde protein sentezlenmesi ve üretilen bu proteinlerin çoğunda (Absisik asit) ABA ve SA gibi fitohormonların etkili olduğu ifade edilmektedir (Kök, 2012).

Gerçekleştirilen bu çalışmada, domateste SA uygulamasının tuz stresine tolerans üzerindeki etkileri morfolojik, fizyolojik ve biyokimyasal parametreler açısından değerlendirilmiştir.

MATERYAL ve YÖNTEM

Çalışmada, önceki çalışmalarımız doğrultusunda tuza hassas (H) ve tolerant (T) olduğu belirlenen 2 adet domates genotipi ile Tuğba F1 domates çeşidi kullanılmıştır. Tohumlar 2:1 oranında torf:perlit içeren ortama ekilmiş, bitkiler 2 gerçek yapraklı aşamaya ulaştıklarında aynı oranda substratın bulunduğu 2 litre kapasitedeki plastik saksılara her saksıda 3 bitki olacak şekilde transfer edilmiştir. Bitkiler 4 gerçek yapraklı aşamaya gelinceye kadar standart besin çözeltisi ile sulanmıştır. Tuz uygulamalarında 50 mM NaCl konsantrasyonundan başlanarak kademeli olarak tuz konsantrasyonu artırılmış ve 3. gün sonunda 150 mM NaCl değerine ulaşılmıştır. Salisilik asit (SA) uygulamasında ise 0.50 mM SA dozu kullanılmıştır. Uygulama tuz stresi ile birlikte başlanmış, yapraktan püskürtme şeklinde haftada 1 kez gerçekleştirilmiştir. Stres uygulamaları sonucunda hasat edilen bitkilerden tesadüfi olarak seçilen 4'er bitki hassas terazide tartılarak yaş ağırlıkları belirlenmiş; daha sonra aynı örnekler 65 °C etüvde 48 saat süreyle kurutulduktan sonra kuru ağırlıkları da alınmıştır. Yaprak alanı C1d B10 Science Marka, CI 202 Model yaprak alan ölçer aleti ile ölçülerek cm²/bitki olarak belirlenmiştir.

Lipid Peroksidasyon Miktarının Belirlenmesi (MDA): Lipid peroksidasyonunun ölçümü Lutts ve ark. (1996) tarafından anlatılan yöntem izlenerek gerçekleştirilmiştir. Yaprak örneklerinden 200 mg tartılmış ve üzerine 5 ml % 0.1'lik trikloro asetik asit (TCA) ilave edilmiştir. Bu karışım 12500 rpm devir hızında 20 dakika süre ile santrifüj edilmiştir. 5 ml'lik ekstrakttan 3 ml süpernatant alınmış, süpernatantın üzerine, içinde % 20 TCA bulunan % 0.1'lik tiobarbütirik asit (TBA)'den 3 ml ilave edilmiştir. Karışım 95°C'deki sıcak su banyosunda 30 dakika süreyle bekletilmiştir. Bunun ardından spektrofotometrede A532 ve A600 nm'de absorbans değerleri okunmuştur.

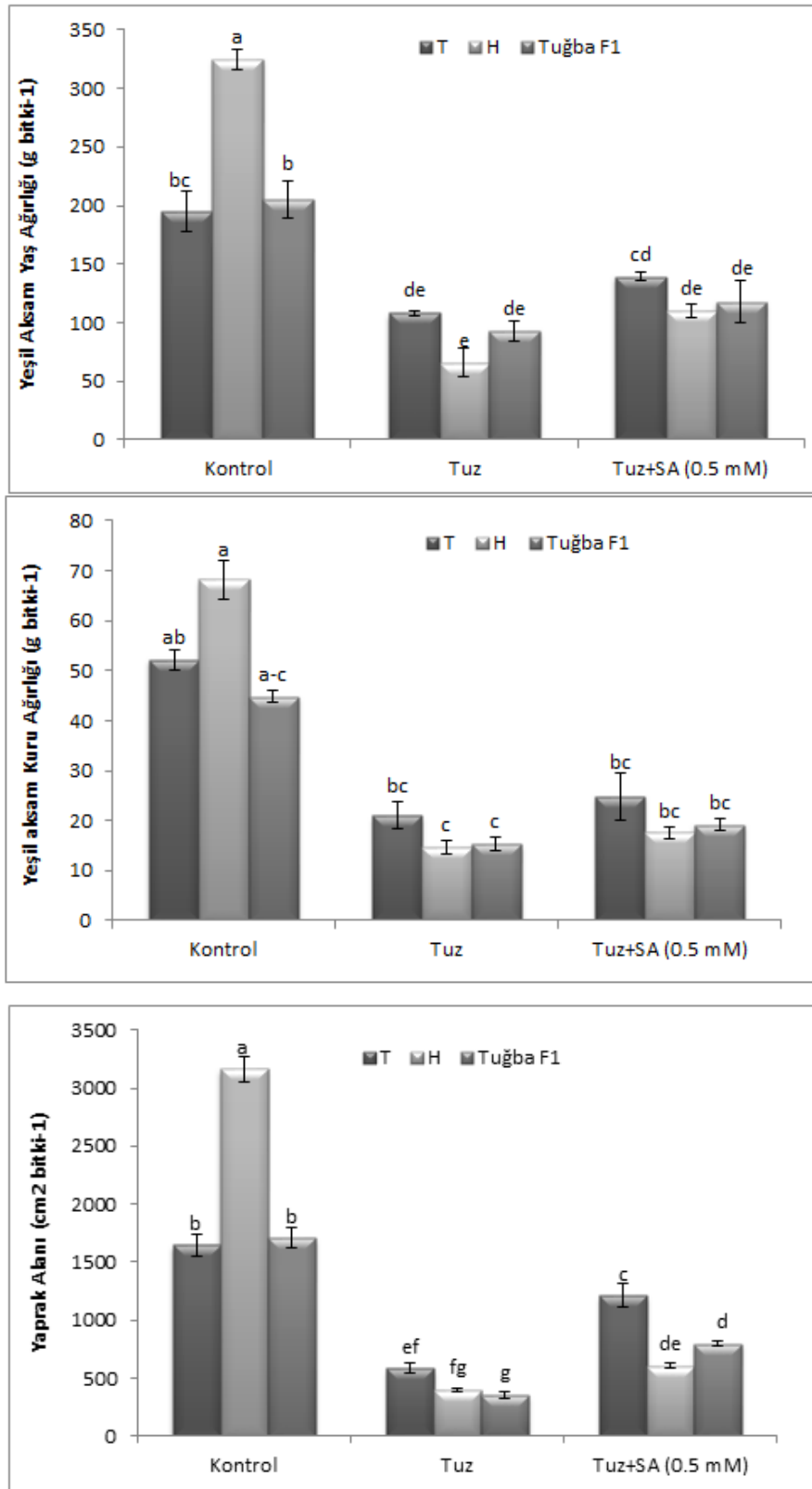
Antioksidatif Enzim Aktiviteleri: Enzim analizleri için 1 g taze yaprak ve doku örnekleri sıvı azot içerisinde porselen havanlarda ezildikten sonra, içinde 0.1 mMNa-EDTA bulunan 50 mM'lık 10 ml'lik fosfor tampon çözeltisi (pH:7.6) ile homojenize edilmiş, 15 dk 15000 g'de santrifüj edildikten sonra ölçüm yapılıncaya kadar +4°C sıcaklıkta tutulmuştur. Enzim ölçümünde son hacimler, tampon çözeltisiyle tamamlanmıştır. Superoksid dismutaz aktivitesi (SOD) Çakmak ve Marschner (1992) tarafından önerilen, NBT'nin (nitro blue tetrazolium kloridin) ışık altında O₂- tarafından indirgenmesi yöntemine göre ölçülmüştür. Katalaz aktivitesi (CAT), H₂O₂'nin 240 nm'de (E=39.4mM cm⁻¹) parçalanma oranı esas alınarak ölçülmüştür (Çakmak ve Marschner, 1992). Askorbatperoksidaz (APX), Çakmak ve Marschner (1992)'e göre, 290 nm'de (E=2.8mM cm⁻¹) askorbatın oksidasyonu ölçülerek, glutatyon redüktaz (GR) Çakmak ve Marschner (1992)'e göre 340 nm'de (E=6.2 mM cm⁻¹) NADPH'nin oksidasyonu esas alınarak ölçülmüştür.

Verilerin değerlendirilmesi: Çalışma tesadüf parselleri deneme desenine göre 3 tekrarlamalı olarak yürütülmüştür. Denemeden elde edilen veriler JMP (versiyon 5.0.1) istatistik paket programı kullanılarak varyans analizine tabi tutulmuş, ortalamaları arasındaki farklılıklar Tukey testine (p≤0.05) göre gruplandırılmıştır.



BULGULAR ve TARTIŞMA

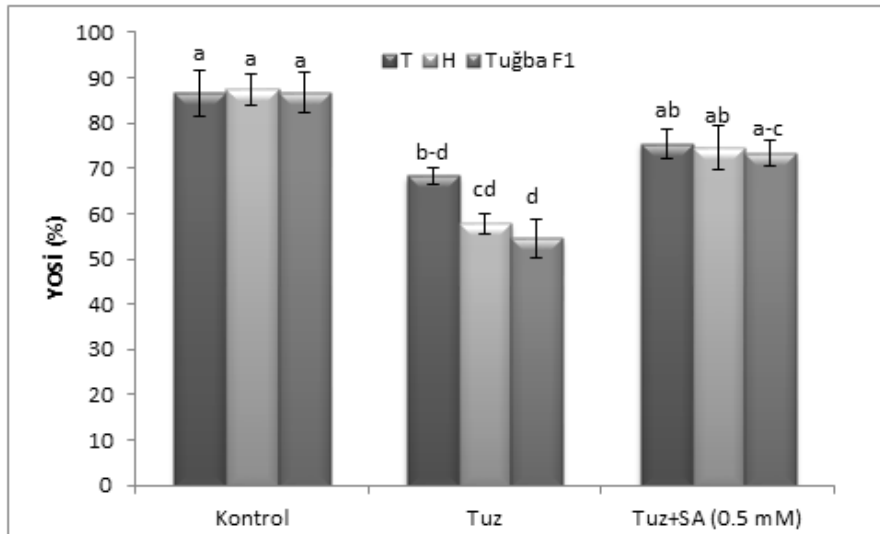
Domateste SA uygulamasının tuz stresine tolerans üzerindeki etkisinin incelendiği çalışmada; uygulamalar arasında farklılıkların olduğu belirlenmiştir. En yüksek yaş ve kuru ağırlık değerleri kontrol uygulamasında belirlenmiş; tuz stresine bağlı olarak ortalama olarak %60 ve %68 düzeyinde azalma meydana gelmiştir (Şekil 1). Ancak bu oran T ve H genotipleri ile Tuğba F1 çeşidinde sırasıyla %44-59, %79-78 ve %54-65 oranlarında gerçekleşmiştir. Yaş ve kuru ağırlık değerleri SA uygulamasında sadece tuz stresi uygulamasına oranla bitkilerde %41 ve %21 düzeyinde iyileşme sağlamıştır. Yaprak alanı da stres koşullarında (ortalama %70 azalma) kontrol bitkilerine oranla azalma göstermiştir (Şekil 1). Ancak SA uygulaması, tuz stresinin olumsuz etkisini %97 düzeyinde azaltmayı başarmış ve kontrol bitkilerine oranla %53 düzeyinde azalma meydana gelmiştir. Tuzluluğun bitki gelişimi üzerinde olumsuz etkileri; 1) kök bölgesinde oluşacak olan düşük su potansiyelinden dolayı kökler tarafından suyun alınmaması, 2) Na, Cl ve SO₄ gibi iyonların yüksek konsantrasyonlarda olması halinde bitkide toksik etkilerin ortaya çıkması 3) bitki besin elementlerinin alımının ve taşımının bozulması şeklinde sıralanabilir. Bitkilerde NaCl konsantrasyonlarına bağlı olarak bitki yaş ve kuru ağırlığında meydana gelen azalma; tuzun bitkilerde yaratmış olduğu ozmotik strese bağlı olarak ortaya çıkan ozmotik dehidrasyondan veya transpirasyondaki artıştan dolayı olabileceği ifade edilmektedir. Ozmotik dehidrasyonun meydana gelmesi, hücrenin su ve ozmotik potansiyelini düşürmekte, hücre hacminin ve genişleme oranının azalmasına neden olmaktadır. Artan transpirasyon sonucunda ise; bitkinin sürgün ve yapraklarında meydana gelen kurumalar ağırlık kaybına neden olmaktadır (Kuşvuran ve Kaya, 2019). Penalla ve ark. (2016) bitki büyüme ve gelişmesindeki asıl olan faktörün fotosentetik kapasite olduğunu vurgulamıştır. Tuz stresi karşısında NaCl'ün neden olduğu toksitise ve su potansiyelinde meydana gelen azalma, bitki hücrelerinin ozmotik potansiyelinin düşmesine ve bitki gelişiminde azalmaya neden olmaktadır. Özellikle stomaların kapanması bitkinin fotosentez hızının azalmasına ve ilerleyen dönemlerde bitkinin ölümüne yol açmaktadır. Bu değişim süreci içerisinde tuz stresine en duyarlı olan bitki organlarının yapraklar olduğu düşünülmektedir (Kıran ve ark. 2014). Shakirova ve ark. (2003), salisilik asidi (SA), bitkilerde fizyolojik olayların düzenlenmesinde yardımcı olan, fenolik bileşiklere ait içsel bir büyüme düzenleyicisi olarak ifade ederken; Senaratna ve ark. (2000), hidroksil (-OH) grubu taşıyan aromatik halkalı bitki fenoller grubunda yer alan sekonder bir metabolit olan SA'in birçok çevresel strese bitki tepkilerinin düzenlenmesinde büyük bir rol oynadığını rapor etmiştir. Mimouni ve ark. (2016) domateste gerçekleştirmiş oldukları çalışmalarında, tuz stresinin gövde ve kök kuru ağırlıklarında azalmaya neden olduğunu, SA uygulamasının bu olumsuz etkiyi azalttığını ifade etmişlerdir.



Şekil 1. Domateste tuz ve SA uygulamalarının yeşil aksam yaş ve kuru ağırlığı ile yaprak alanı bakımından ortaya koyduğu değişimler



Tuz stresinin ortaya koyduğu etkilerin belirlenmesinde önemli bir parametre olarak değerlendirilen yaprak oransal su içeriği (YOSİ) en yüksek kontrol bitkilerinde %87 olarak tespit edilmiştir (Şekil 2). Tuz stresi ile birlikte YOSİ değeri azalma göstermiş T ve H genotipleri ile Tuğba F1 çeşidinde sırasıyla %21, %33 ve %36 oranlarında gerçekleşmiştir Genel olarak SA uygulaması kontrol bitkilerine en yakın oranları ortaya koymuş ve azalma ortalama olarak %14 düzeyinde meydana gelmiştir. Tuz stresi, bitkinin su alımını engelleyerek, ozmotik etki nedeniyle bitki gelişiminin azalmasına, iyon toksisitesi nedeniyle de yapraklarda su taşınımını sağlayan hücrelerde zararlanmalara neden olmaktadır. Özellikle Na iyon toksisitesi ile bitkiye su girişi arasında negatif bir korelasyon bulunmaktadır (Munns 2005). Farooq ve Azam (2006) buğdayda artan tuz stresinin YOSİ değerlerinde azalmaya yol açtığını, ancak hassas genotiplerde bu değişimin daha belirgin olabileceğini; Ghars ve ark. (2008) ise, *Arabidopsis thaliana* ve *Thellungiella halophila* bitkilerinde Na iyonunun bitki gelişimini olumsuz etkilediğini ve yaprak su içeriğinin artan tuz konsantrasyonuna bağlı olarak azaldığını bildirmişlerdir. Goreta ve ark. (2008), karpuzda tuz stresinin bitki gelişimini olumsuz etkilemesi yanında yaprak su içeriğinin de azaldığını ifade etmişlerdir. Hand ve ark. (2017) biberde gerçekleştirmiş oldukları çalışmalarında yaprak oransal su içeriğinin artan tuz dozuna bağlı olarak azaldığını; bu etkinin tolerant genotiplerde daha az oranda gerçekleştiğini ifade etmiştir. Tahjib-Ul-Arif ve ark. (2018) mısırdaki tuz stresinin YOSİ değerini %11 düzeyinde azaltırken; SA uygulamasının olumlu etki ortaya koyduğu ve stres koşullarında YOSİ değerindeki azalmanın %5 düzeyinde kaldığını bildirmiştir.

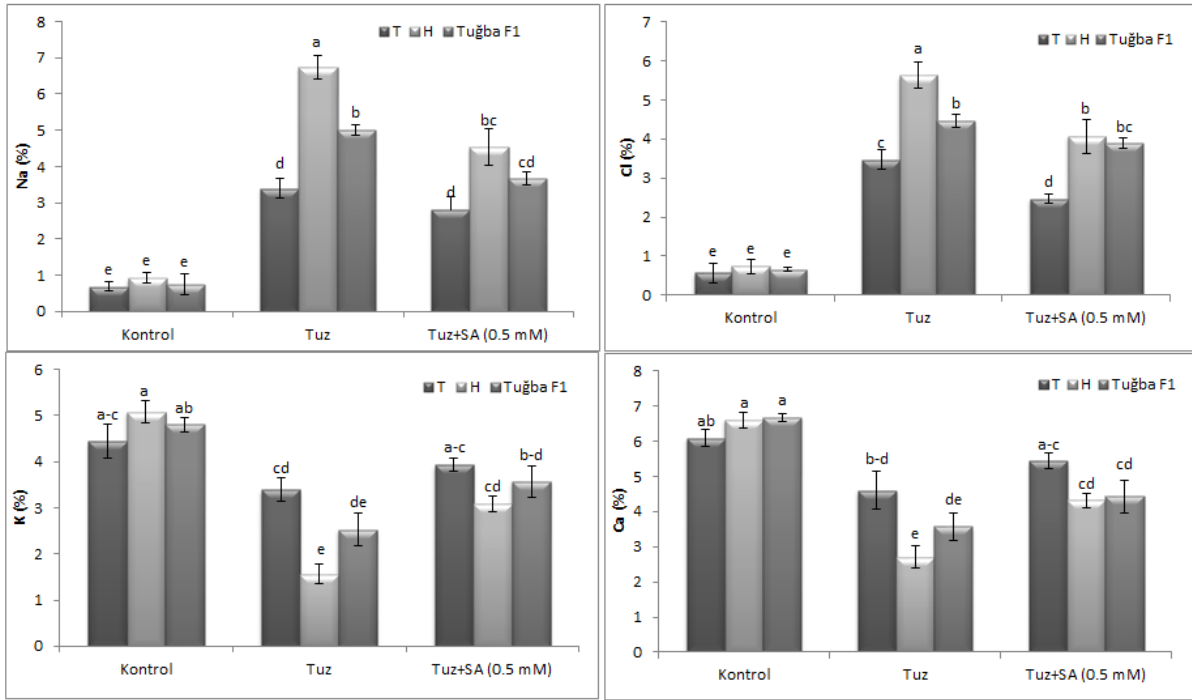


Şekil 2. Domateste tuz ve SA uygulamalarının yaprak oransal su içeriği (YOSİ) bakımından ortaya koyduğu değişimler

Tuz stresi her 3 domates türünde Na ve Cl iyonlarında farklı oranlarda artışa neden olmuştur. Kontrol bitkilerine oranla sodyum iyonunda ortalama olarak %487 ve klor iyonu bakımından %582 artış biçiminde belirlenmiştir (Şekil 3). Bununla birlikte SA uygulaması domateste Na ve Cl alımını sınırlandırmış ve ortaya çıkan artış %364 ve %422 düzeyinde tespit edilmiştir. Diğer taraftan tuz stresi K ve Ca iyon içeriğinde azalmaya neden olmuştur. Kontrol bitkilerine oranla %44 düzeyinde azalma meydana gelirken 0.5 mM SA uygulaması ile bu oran %26 düzeyine gerilemiş ve SA uygulaması ile %33-37 düzeyinde bir iyileşme belirlenmiştir. Yüksek tuz konsantrasyonlarının hücrede meydana getirdiği olumsuzlukların nedenleri arasında Na ve Cl iyonlarının yüksek konsantrasyonu ile oluşan iyon toksisitesi yer almaktadır (Zhu ve ark., 2008; Zhang ve ark., 2018). Tuz stresinden kaynaklanan iyon toksisitesinin birincil derecede



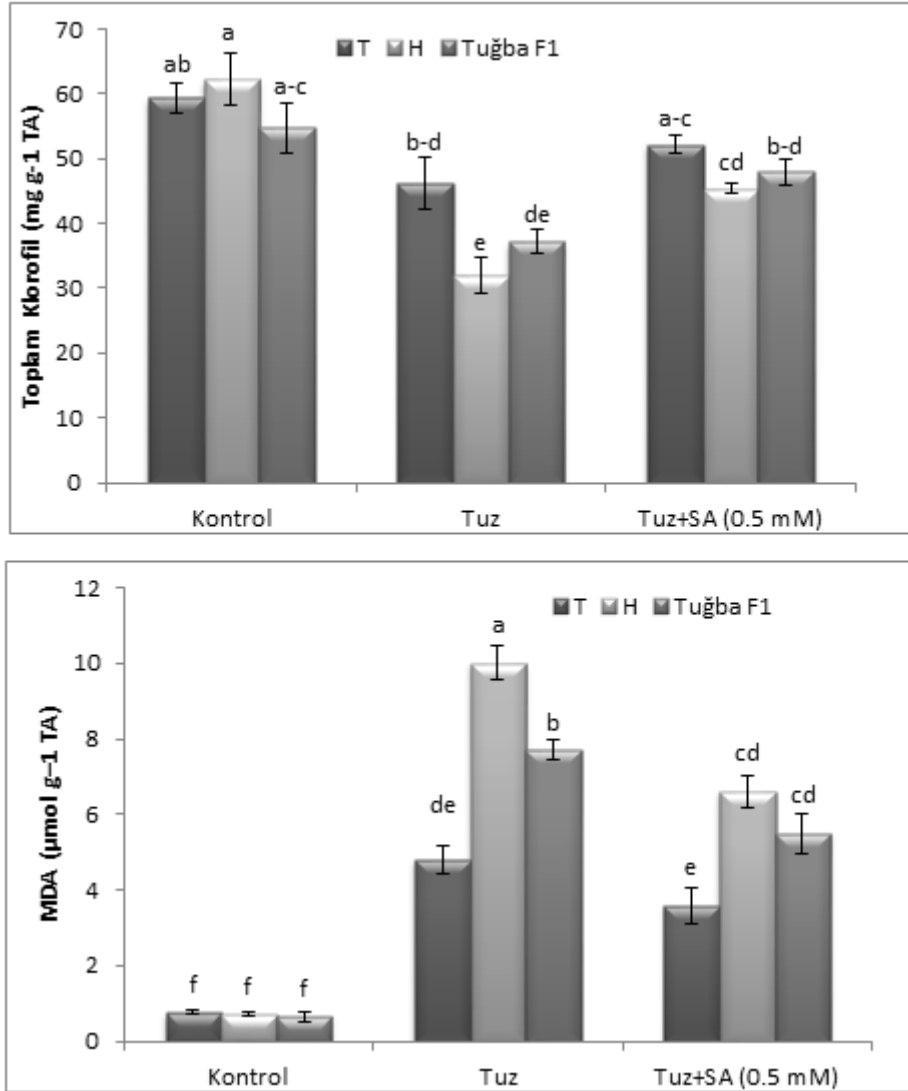
etkili stres faktörü olduğu, bunun ardından oluşan su alımının azalması yani su stresi ve mineral maddedeki dengesizlikler ve beslenmedeki bozulma ikincil stres faktörleri olarak yorumlanmaktadır (Levitt, 1980). Yüksek düzeyde Na iyon alımı osmotik potansiyel dengesinin bozularak oksidatif zarara yol açmakta, hücresel ve bitki düzeyinde zarar oluşturduğu gibi moleküler anlamda da zararlanmalara neden olmaktadır (Yang ve ark., 2015; Yang ve ark., 2018). Tuz stresi koşullarında büyümesindeki azalmanın en önemli kritik nedenlerinden birisi de bitki bünyesine gereğinden fazla biriken klor iyonu konsantrasyonu olduğunu vurgulayan Kıran ve ark. (2015), patlıcanda 100 mM NaCl uygulaması sonucu yeşil aksamda Cl⁻ iyon içeriğinde artışı olduğunu, bu artışın çeşit ve gneoipler arasında değişim gösterdiğini belirtmişlerdir. Soyada ve hıyarda tuz stresi koşullarında SA uygulamalarının Na alımını azaltmada etkili olduğu vurgulanmıştır (yıldırım ve ark., 2008; Farhangi-Abriz ve ark., 2018). Çilekte tuz stresi karşısında Na alımının artış gösterdiği buna karşılık SA ve JA uygulamalarının Na alımında sınırlayıcı bir rol oynadığı bildirilmiştir (Faghieh ve ark., 2017). Hücre içerisinde ozmotik dengenin korunmasında K konsantrasyonunun önemi büyüktür. Tuz stresinin en önemli olumsuz etkilerinden biri de bitki bünyesinde meydana gelen, büyüme ve gelişmeyi de olumsuz etkileyen iyon dengesinde oluşan aksaklıklardır. Na miktarında meydana gelen artış, genellikle ozmotik regülasyonu ve besin dengesini bozarak spesifik iyon toksisitesine girmekte, iyonik çaplarının ve elektriksel yüklerinin benzerliği nedeniyle K iyonu ile rekabete girerek bu iyonun alımını da engellemektedir (Levitt, 1980). Tuz stresi nedeniyle ortaya çıkan su eksikliği dokularda Ca konsantrasyonunun azalmasına neden olmaktadır. Ca iyonun ksilemde taşınması ve floemdeki hareketliliğinin sınırlı olması, suyun kısıtlı olduğu durumlarda taşınımının da sınırlanmasına neden olmaktadır (Kiegle ve ark., 2000). Bu azalma respirasyon ve fotosentez gibi metabolik olaylar dışında enzim aktivitelerinde meydana gelen aksaklıklar nedeniyle membran geçirgenliğinin azalmasına, ozmotik dengenin bozulmasına ve sonuçta bitki büyüme ve gelişmesinde olumsuzluklara neden olmaktadır (Kıran ve ark., 2018). Faghieh ve ark. (2017) çilekte gerçekleştirmiş oldukları çalışmalarında tuz stresi koşullarında bitki bünyesinde daha yüksek Na içeriğine karşılık K alımının azaldığı ve dolayısı ile Na/K oranı dikkate alındığında tuz stresi koşullarında yetiştirilen bitkilerde daha yüksek bir oran ortaya çıktığını bildirmişlerdir. Araştırmacılar yapraktan 0.5 ve 0.75 mM SA ile 0.25 mM JA ve kökten 0.1 mM SA ve 0.25 mM JA uygulamalarında en düşük Na/K oranlarının belirlendiğini bildirmişlerdir. Benzer biçimde soyada, tuz stresine bağlı olarak K ve Ca içeriğinde azalma meydana geldiği SA uygulamasının K ve Ca alımını teşvik ederken, JA asit uygulamalarının etkili bulunmadığı ifade edilmiştir (Farhangi-Abriz ve ark., 2018).



Şekil 3. Domateste tuz ve SA uygulamalarının sodyum (Na), klor (Cl), potasyum (K) ve kalsiyum (Ca) içeriği bakımından ortaya koyduğu değişimler

Toplam klorofil içeriği 150 mM NaCl uygulamasına bağlı olarak %22-48 düzeyinde azalma göstermiş, en büyük etki H domates genotipinde %48 olarak kaydedilmiştir. SA uygulaması bu azalmayı %27 düzeyinde koruyarak, tuz stresi koşullarında ortalama değişimin %17 düzeyinde kalmasına olanak sağlamıştır. Yüksek tuzluluk klorofillerin moleküler yapısını bozmakta ve miktarını azaltmaktadır. Klorofil içeriğindeki azalma, klorofil sentezinin azalmasından ya da klorofil pigmentlerinin parçalanmasının artmasından kaynaklanabilmektedir. Özellikle klorofil parçalanması, klorofilaz enzim aktivitesindeki artış sonucunda ortaya çıkmaktadır (Yıldız ve ark., 2010). Tayyab ve ark. (2020) mısırdaki tuz stresi ile birlikte klorofil-a, klorofil-b ve toplam karotenoid içeriğinde azalma meydana gelirken SA uygulamalarının bu olumsuzluğu önemli düzeyde iyileştirdiğini bildirmişlerdir.

Tuz stresi bitkilerde serbest radikallerin oluşmasına neden olmaktadır. Ortaya çıkan bu radikaller lipid ve proteinlerin geri dönüşümsüz olarak hasara uğramasına yol açmaktadır. Lipid peroksidasyonu, hücre zarlarında membran bütünlüğünün yok olmasına sebep olmakta ve sonuçta hücre bütünlüğünün bozulması ve ölümü gerçekleşmektedir. Çalışmada domates bitkilerinde tuz stresi karşısında %891 düzeyinde MDA içeriğinde artış meydana gelmiştir (Şekil 4). Pagaria ve ark. (2012) ise membran lipidlerinin peroksidasyonun, membran hasarı için bir belirteç olduğunu. MDA konsantrasyonunun ölçülmesi ile oksidatif hasarın belirlenebileceğini stres altındaki bitkilerde MDA içeriğinin önemli derecede arttığını bildirmişlerdir. Eroğlu (2016) biberde ve Özdamar (2018) patlıcanda tuz stresi koşullarında; Kuşvuran ve Daşgan (2017a, 2017b) domates ve fasulyede, Alzahrani ve ark. (2018) buğdayda kuraklık stresi karşısında MDA miktarında artış meydana geldiği ifade etmişlerdir. SA uygulamaları sonucunda MDA içeriğinde meydana gelen artış önemli oranda sınırlandırılmış ve bu artış %621 düzeyinde kalmıştır. Heidarian ve Roshandel (2021) tuz stresi koşullarında SA uygulamasının MDA içeriğinde %39 düzeyinde azalmaya imkan sağladığını ifade etmişlerdir.

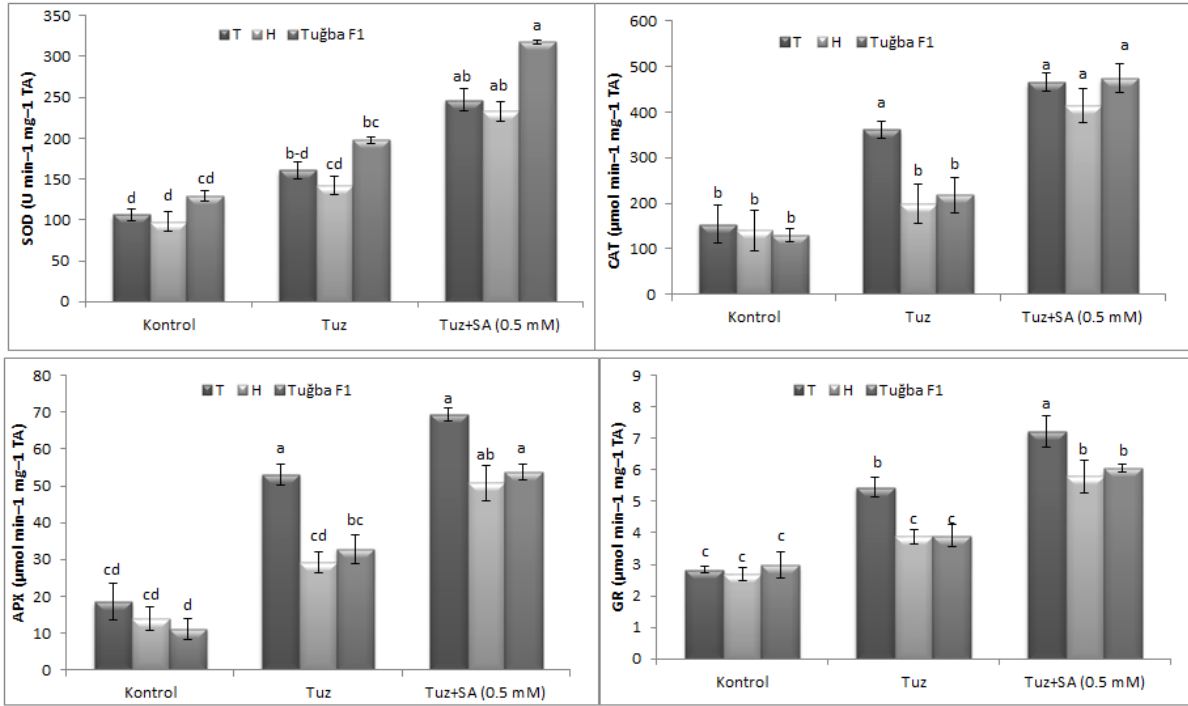


Şekil 4. Domateste tuz ve SA uygulamalarının toplam klorofil ve MDA içeriği bakımından ortaya koyduğu değişimler

Antioksidatif enzim aktivitelerinde (SOD, CAT, GR, APX) meydana gelen değişimlerin de incelendiği çalışmada, tuz stresi karşısında enzim aktiviteleri değişen oranlarda artış göstermiştir. Bu artış ortalama olarak %49 (SOD), %82 (CAT), %581 (GR) ve %164 (APX) düzeyinde gerçekleşmiştir. SA uygulamaları tüm domates türlerinde enzim aktivitelerinde artışa olanak sağlamış ve bu artış %45-84 oranlarında meydana gelmiştir (Şekil 5). Bitkilerdeki abiyotik ve biyotik stres, kloroplast ve mitokondride elektron taşıma zincirlerinin (ETC) fazla aktifleşmesine, serbestleşmesine ve bozulmasına neden olmaktadır. Yüksek oranda reaktif olan ROS'lar, lipid, protein, DNA ve diğer bazı metabolitlerde önemli hasara neden olmaktadır (Ashraf, 2009). Tuzluluktan kaynaklanan oksidatif hasarın giderilmesi, antioksidan enzim (CAT, SOD, APX, GR) sentezinin teşvik edilmesi ile gerçekleşmektedir. Nitekim benzer sonuçlar Kuşvuran ve Daşgan (2017a, 2017b) domates ve fasulyede; Rady ve ark. (2018) fasulye ve buğdayda gerçekleştirmiş oldukları çalışmalarında, stresi koşullarında bitkilerde antioksidatif savunma mekanizmasının aktif hale geçtiğini bu savunma mekanizmalarını etkin kullanabilen genotiplerin stres koşullarına tolerans düzeylerinin de arttığını ifade etmişlerdir.



Tayyab ve ark. (2020) mısırdaki kuraklık stresi karşısında dışsal SA uygulamalarının, uygulama yapılmayan bitkilere oranla CAT, POD ve SOD enzim aktivitelerinde artış sağladığını ifade etmişlerdir. Benzer sonuçlar *Panax ginseng* (Ali ve ark., 2017), ayçiçeği (Golkar ve ark., 2019) ve çilek (Faghih ve ark., 2017) bitkilerinde de elde edilmiş ve SA uygulamalarının antioksidatif enzim aktivitelerinde artış sağlayarak bitkilerin ROS nedeniyle ortaya çıkan zararlanmadan kendilerini koruyabildikleri ifade edilmiştir.



Şekil 5. Domateste tuz ve SA uygulamalarının SOD, CAT, APX ve GR enzim aktiviteleri bakımından ortaya koyduğu değişimler

Tuzluluğun bitki gelişimi üzerindeki olumsuz etkisinin ortadan kaldırılması ve etkin bir bitkisel üretimin sağlanabilmesi amacı ile bazı önlemler alınabilmektedir. Tuzlu toprakların ıslah edilmesi, tuzlu sulama sularının iyileştirilmesi ve daha kaliteli su kullanımı alınabilecek önlemler olarak sayılabilir. Ancak sözü geçen bu yöntemlerin zaman alıcı ve yüksek maliyetli olması uygulanabilirliklerini oldukça sınırlandırmaktadır. Bu nedenle, problemlerin çözümüne ilişkin en akılcı ve ekonomik yöntemlerden birisi stres koşullarına karşı dayanıklı genotipler ve/veya çeşitler kullanmak ya da dayanıklı olmayan genotipler ve/veya çeşitlerde strese karşı dayanıklılığı artırmaya yönelik uygulamalardır. Bunlar arasında, bitki büyüme düzenleyicilerin strese toleransı sağlaması açısından kullanımını da yer almaktadır. Bu çalışma sonucunda elde edilen bulgular çerçevesinde domateste tuz stresinin olumsuz etkisini sınırlandırmak için 0.50 mM SA uygulamasının etkili olduğu tespit edilmiştir.



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THE EFFECTS OF LEMON AND LIME POWDERS USING ON THE QUALITY CHARACTERISTICS OF COOKIE

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ABSTRACT

Consumers increasingly take interest in health promoting attributes of foods. As a result of this awareness, bakery products such as cookies are fortified different nutritional ingredients. In this study, the effects of freeze-dried lime and lemon powders addition on the physical, chemical and sensory properties of cookies were investigated. When the highest L^* value was determined in control sample, the highest a^* values were observed in 10% lime and lemon powders fortified samples. The differences in b^* values of cookies which were between 30.64-34.44 were not significant statistically. The using of lime and lemon powders decreased whiteness index and occurred significant total color difference. The diameter measurements of the cookies were not significantly different from each other ($p>0.05$). Small differences were obtained among thickness and the spread ratio values of the samples and 10% lemon powder addition caused a significant ($p<0.05$) decrease in the hardness values when compared the control. The incorporation of the citrus powders did not statistically change the moisture, fat, protein and carbohydrate values and these values were between 3.41-3.53%, 15.97-17.03%, 7.15-8.52%, 71.17-72.32% respectively. Also the powders addition insignificantly affected ($p>0.05$) the energy values and it changed in the range of 464.59-468.89 kcal. In sensory analyzes, odour scores of lime added cookies were higher than other samples but the control samples received highest scores for taste and general acceptability evaluation. The negative sensorial effect was prominently perceived with 10% ratio for lime or lemon fortified cookies. The study showed that both lime and lemon powders can be used up to 5% in cookie production.

Keywords: Lemon, lime, cookie, quality



INTRODUCTION

Commercial, academic and governmental sectors increasingly take interest in functional food development recent years because of health promoting claims about functional foods are eagerly accepted by consumers (Jones and Jew 2007). As functional nutrient, citrus fruits display positive health effects with their chemical composition. (Sanofer 2014). In addition to being a good source of vitamin C, citrus fruits contain fiber, potassium, folate, calcium, thiamine, niacin, vitamin B6, phosphorus, magnesium, copper, riboflavin, pantothenic acid and various phytochemicals such as carotenoids and flavonoids. As some of flavonoids, erythrin and hesperidin are common in lemons and limes while hesperidin and hesperidin glycosides are found in oranges and tangerines; naringin, narirutin and naringin glycosides are mostly found in grapefruit. The amounts of these components may vary according to the citrus variety, maturity, storage conditions, processing methods (Turner and Burri 2013; Gattuso et. al 2007). Flavours of these fruits especially lime or lemon are generally used in beverage, confectionary, cookies and desserts (Guimarães et. al 2010). Cookies attract attention because of widely acception and consumption with their ready-to-eat form and relatively long shelf-life in many developing countries (Arshad et al 2007).

Drying is one of the most important food preserving methods. Nutritional substances of a product are concentrated by means of dehydration. For this purpose, freeze-drying method has been preferring rather than conventional drying (hot air) recently. Due to the absence of liquid water and the low temperatures required for the process, most of deterioration and microbiological reactions are stopped which gives a final product of excellent quality with freeze-drying (Ratti 2001). Sun et. al (2015) examined three different drying methods (sun-drying, hot air-drying and freeze-drying) for four un-matured citrus species and the results showed that freeze-drying is good for retaining phenolic compounds, synephrine, antioxidants and limonoids. Papoutsis et al. (2017) applied freeze-drying, hot air-drying and vacuum-drying on dried lemon pomace and investigated polyphenols and antioxidant capacity of samples. They reported that the total phenolic content and antioxidant capacity were higher in lemon pomace dried by hot air or under vacuum than those dried by freeze-drying. Ledesma-Escobar et al. (2016) examined the effect of freeze-drying and air-drying at 45 °C on the different compounds of whole lemons using 53% ethanol as a solvent for the extraction and showed that freeze-drying was more suitable for the extraction of flavanones or flavones of lemon.

In this context, the present research was undertaken to examine the effect of freeze-dried lime and lemon powders addition on the some physical, chemical and sensory attributes of cookies.

MATERIAL and METHODS

Materials

Cookie ingredients (wheat flour, butter, powder sugar and egg) were obtained from local markets in Karaman. The freeze dried lime and lemon powders were supplied by Freshbak Organic Natural Food Industry and Trade Incorporated Company (Turkey). The lime powder contains 3.52% ash, 4.8% protein, 1.4% fat, 71% carbohydrate and 19% total fibre while limon powder contains 3.25% ash, 7.7% protein, 1.9% fat, 69% carbohydrate and 30% total fibre.

Cookie Preparation

Control cookie samples were prepared using the following recipe: Wheat flour (100 g), butter (55 g), powder sugar (30 g) and whole eggs (12 g). To prepare doughs containing lime and lemon powders, flour was replaced with powders at 5 and 10% level (w/w) separately. The dough was prepared by means of a mixer (Kitchen Aid, Model K45SS Hobart Co., Troy, OH). The resulting dough was manually shaped into circular form (diameter: 48 mm). The cookies



were baked in an air oven at 175 °C for 14 min. The cookies were cooled down to room temperature prior to analysis (20 °C).

Colour measurements

Color measurements were implemented with L^* (white; black), a^* (red; green) and b^* (yellow; blue) values using a Hunter Lab Color QUEST II Minolta CR-400 (Minolta Camera, Co., Ltd., Osaka, Japan). The total color difference (ΔE^*) was calculated with Equation (1).

$$\Delta E^* = ((L_c - L_i)^2 + (a_c - a_i)^2 + (b_c - b_i)^2)^{1/2} \quad E(1)$$

where: L_c , a_c , b_c references are color parameters of the control sample, L_i , a_i , b_i references are color parameters of the enriched cookies. ΔE is usually classified as a trace level (0–0.5), slight (0.5–1.5), noticeable (1.5–3.0), appreciable (3.0–6.0), large (6.0–12.0), and obvious difference (>12.0) (Zarzycki et al. 2020).

The whiteness index (WI) of the cookie samples was also calculated according to the Equation (2) (Zarzycki et al. 2020).

$$WI = 100 - ((100 - L)^2 + a^2 + b^2)^{1/2} \quad E(2)$$

Physical analysis

The diameter and thickness of the cookie samples after baking were measured using a calliper. Spread ratio was estimated by calculating diameter/thickness values. Texture Analyser (TAPlus, Lloyd Instruments, UK) was used for hardness values and the maximum force required to break the cookie sample was determined. The span between the supports was 40 mm.

Chemical composition

Moisture, ash, protein and fat content were reported by the methods of AACC 44-19, 08-01, 46-12, 30-25 respectively (AACC, 2002). The proximate carbohydrate content and energy value were estimated according to Desai et al. (2018). Total fat, protein, ash and moisture contents were used for carbohydrate content calculation and energy value was calculated with Equation (3).

$$\text{Energy value (kcal/100 g)} = (4 \times \text{protein (\%)}) + (9 \times \text{lipid (\%)}) + (4 \times \text{carbohydrate (\%)}) \quad E(3)$$

Sensory evaluation

Sensory analyses were undertaken by 7 panellists in the age group of 26-48. Cookie samples were coded with different letters and served to the panelists in a random order. Different sensory attributes (appearance, odour, taste, fracturability and general acceptability) were evaluated using a seven point hedonic scaling system (Like extremely [7]; Acceptable [4]; Dislike extremely [1]).

Statistical analyses

The assessment of differences obtained from results was made by One Way Analysis of Variance (ANOVA) using SPSS statistics software (SPSS Inc., Chicago, IL, USA). Duncan's Multiple Range Test was conducted for comparing of the means that were statistically different from each other.

RESULTS and DISCUSSION

Colour measurements

Colour values of cookie samples prepared with lime and lemon powders were given in Table 1. When the colour measurements were evaluated, lightness (L^*) decreased with the use of the powders in the formulation. Also yellowness (b^*) generally decreased with the enrichment of the samples but this decreasing was not significant statistically. a^* values of cookies increased with addition of the powders, the highest a^* values were found in 10% lime and lemon added



cookie samples. Gül et. al (2013) studied effect of white cabbage powder on cookie quality and reported that with increasing level of cabbage powder addition, a values of cookies slightly increased while L and b values decreased. In this study, especially 10% lime and lemon powders addition caused the ΔE values higher than 12 which means that the color difference is obvious. On the other hand, WI values of the cookie samples varied between 37.74 and 57.72 and decreased as the concentration of both lime and lemon powders increased in cookie formulation. The observed these color differences can be based on brownish color of both lime and lemon powders compared to wheat flour.

Table 1. Color measurements of cookie samples

	L^*	a^*	b^*	ΔE	WI
Control	75.78±0.93 ^a	3.82±0.01 ^d	34.44±0.61 ^a	-	57.72±1.03 ^a
5% Lime	70.12±0.98 ^b	5.21±0.28 ^c	33.52±2.21 ^a	6.00±1.99 ^c	54.76±1.02 ^a
10% Lime	53.07±1.01 ^c	10.86±0.02 ^a	34.05±0.59 ^a	23.79±0.09 ^{ab}	41.00±0.46 ^c
5% Lemon	56.41±1.99 ^c	9.94±0.33 ^b	32.50±0.71 ^a	20.41±2.87 ^b	44.71±1.21 ^b
10% Lemon	47.05±0.49 ^d	11.52±0.18 ^a	30.64±0.60 ^a	29.99±1.32 ^a	37.74±0.09 ^c

Quality parameters

Some quality parameters of the cookie samples were demonstrated in Table 2. From the results, it was seen that the diameter measurements of the cookies were not significantly different from each other ($p>0.05$). However, thickness measurements of the samples varied from 8.41 to 9.93 mm and the highest measurements were obtained with 5% lime powder added samples. Spread ratio value is one of the most important properties in evaluating the quality of cookies. It is also known that high spread ratios are desirable and indicate a good cookie quality (Şeker et al. 2009). Small differences were obtained among the spread ratio values of the samples. The highest and lowest values were observed in 10% lemon and 5% lime added samples respectively. Uysal et al. (2007) used fibres from apple and lemon in wire-cut cookie production and they reported that increasing the amount of apple and lemon fibre decreased the spread ratio of the samples. The addition of the powders reduced the hardness values of all samples at all addition levels. Especially lemon powders added samples became softer and gave less resistance to the applied force during analyses compared to control and lime added samples. On the contrary, Demirel and Demir (2018) used albedos obtained from different citrus in cookie production and they observed that hardness increased in all samples due to the increase of albedo substitution.

Table 2. Physical properties of cookie samples

	Diameter (mm)	Thickness (mm)	Spread ratio	Hardness (kg)
Control	48.33±0.02 ^a	9.28±0.04 ^{ab}	5.21±0.03 ^{ab}	2.62±0.01 ^a
5% Lime	48.98±0.21 ^a	9.93±0.03 ^a	4.93±0.04 ^b	2.11±0.50 ^{ab}
10% Lime	48.51±0.69 ^a	8.84±0.32 ^b	5.50±0.28 ^{ab}	1.95±0.10 ^{ab}
5% Lemon	48.56±0.88 ^a	8.76±0.14 ^b	5.54±0.19 ^{ab}	1.76±0.21 ^{ab}
10% Lemon	49.09±0.47 ^a	8.41±0.39 ^b	5.85±0.33 ^a	1.45±0.17 ^b

Chemical Properties

Some chemical properties of cakes were depicted in Table 3. The moisture content of the cookie samples did not statistically change with the incorporation of the citrus powders. The lowest ash content was obtained with control sample (0.41%). The ash content of cookies increased



with both lime and lemon powders addition at all levels. 10% lime and lemon powder added samples had the same ash content (0.54%). On the other hand, the highest fat content was obtained with 10% lemon powder addition (17.03%) in cookie formulation but there was no statistically difference among samples. Similarly, protein content of samples was not affected statistically with changes in formulation and the values ranged from 7.15% to 8.52%. As a result of the above mentioned analysis, the carbohydrate content of cookie samples were close to each other. The carbohydrate values ranged from 71.17% to 72.32%. When the obtained energy values were evaluated, the values ranged from 464.59 kcal to 468.89 kcal and the incorporation of both lime and lemon powders did not exhibit significant ($p < 0.05$) effect. Uysal et al. (2007) showed that moisture, ash, protein, fat contents and energy values of 15% lemon fibre added cookies were 8.01%, 1.34%, 4.45%, 23.61% and 484.23 kcal respectively.

Table 3. Proximate analyses and energy value of cookie samples

	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Energy (kcal/100 g)
Control	3.41±0.25 ^a	0.41±0.04 ^b	15.97±0.16 ^a	8.52±0.19 ^a	71.71±0.64 ^a	464.59±0.32 ^a
5% Lime	3.50±0.11 ^a	0.48±0.02 ^{ab}	16.22±1.70 ^a	7.82±0.37 ^a	72.00±1.41 ^a	465.22±8.15 ^a
10% Lime	3.51±0.29 ^a	0.54±0.01 ^a	16.50±0.50 ^a	7.15±1.03 ^a	72.32±0.24 ^a	466.32±1.38 ^a
5% Lemon	3.49±0.42 ^a	0.49±0.01 ^{ab}	16.71±0.01 ^a	8.16±0.33 ^a	71.17±0.10 ^a	467.65±1.66 ^a
10% Lemon	3.53±0.42 ^a	0.54±0.02 ^a	17.03±0.07 ^a	7.64±0.46 ^a	71.27±0.13 ^a	468.89±1.97 ^a

Sensory evaluation

The sensory evaluations of samples were shown in Table 4. The appearance scores of 5 and 10% lime supplemented samples were greater than the others. Similarly, odour scores of lime added samples at both 5% and 10% levels were higher than others. On the other hand, the citrus powders addition caused unpalatable taste and especially this taste was prominently perceived with 10% ratio for both lime and lemon powders. Although the fracturability values of cookie samples decreased with lime and lemon powders addition, there was no statistically difference among all samples. When the results of general acceptability were examined, the addition of lime and lemon powders negatively influenced the sensorial parameters of cookies. The lowest acceptability scores was observed in 10% lime added cookie samples. Uysal et al. (2007) obtained similar sensory results for cookies with lemon fibres. They reported that fibre addition resulted in undesirable changes in sensory properties of cookies and increasing amount of fibre from lemon decreased the scores for the sensory properties of the samples.

Table 4. Sensory evaluation of cookie samples

	Appearance	Odour	Taste	Fracturability	General acceptability
Control	5.80±0.71 ^{ab}	6.00±0.00 ^{ab}	6.85±0.21 ^a	6.90±0.14 ^a	7.00±0.00 ^a
5% Lime	7.00±0.00 ^a	6.45±0.07 ^a	3.10±0.14 ^{ab}	5.25±1.06 ^a	4.40±1.27 ^{ab}
10% Lime	6.15±0.49 ^a	6.90±0.14 ^a	2.45±0.07 ^b	4.50±0.71 ^a	3.60±0.85 ^b
5% Lemon	4.90±0.14 ^{ab}	4.50±0.71 ^{ab}	5.25±2.47 ^{ab}	5.15±0.49 ^a	6.50±0.71 ^{ab}
10% Lemon	3.00±1.41 ^b	2.75±1.77 ^b	1.60±0.85 ^b	4.50±0.71 ^a	4.65±0.49 ^{ab}

CONCLUSION

In this study, supplementation of lime and lemon powders increased the total color differences and decreased whiteness index of cookie samples. However, the incorporation of the freeze-dried lime and lemon powders in cookie formulation did not negatively influence quality parameters. Only, when compared the control, 10% lemon powder addition caused a significant ($p < 0.05$)



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decrease in the hardness values. Except the ash content, other chemical analyses results and energy values of cookies were close to each other. But taste and general acceptability results showed that the powders addition had an unpalatable effect. Especially this effect was prominently perceived with 10% ratio for both lime and lemon fortified cookies. Thus, lime and lemon powders can be used as a constituent in functional cookie production lower than 10% addition level.



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MALTLIK ARPADA AZOTLU GÜBRELEMENİN ÖNEMİ

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ÖZET

Arpa (*Hordeum vulgare* L.), ülkemizde yaklaşık 26.1 milyon hektarlık ekim alanı ve 7.4 milyon tonluk yıllık üretimi ile tahıllar içerisinde buğdaydan sonra ikinci sırada yer alan önemli bir kültür bitkisidir (Anonim, 2020). Dünyada ve ülkemizde hayvan yemi ve maltlık olarak kullanılmaktadır. Arpa, kalite bakımından yemlik ve maltlık olmak üzere başlıca iki amaçla yetiştirilmekte ve ıslah edilmektedir ancak maltlık arpanın toplam arpa üretimi içerisindeki payı Türkiye’de oldukça düşüktür. Türkiye’de tüketilen arpa miktarı her geçen yıl artış göstermektedir. Hayvancılığın gelişmesiyle birlikte yemlik arpa ihtiyacı artmakta, malt sanayindeki gelişmeler ile de maltlık arpaya olan ihtiyaç artmaktadır. İyi özelliklere sahip maltlık arpanın da elde edilmesi oldukça önemlidir. Maltlık arpanın birim fiyatının yemlik arpadan % 70-80 daha yüksek oluşu ve maltın ihraç edilme potansiyelinin yüksek bulunması, maltlık arpa üretiminin artırılması gereğini de birlikte getirmektedir. Maltlık arpa kalite özelliklerinin içinde en önemlileri protein oranı ve malt ekstrakt oranıdır. Maltlık arpanın tane verimi ve kalitesini N oranı, çeşit ve iklim koşulları belirlemektedir. Bu nedenle arpa yetiştiriciliğinde azotlu gübrelemenin önemi büyüktür.

Anahtar Kelimeler: : Arpa, malt, azot, gübre



THE IMPORTANCE OF NITROGEN FERTILIZATION IN MALTING BARLEY

ABSTRACT

Barley (*Hordeum vulgare* L.), based on the production area (26.1 million ha) and total yield (7.4 mil. ton), is the second important cereal following wheat in Turkey (Anonim, 2020). It is used as animal feed and malting in the world and in our country. Barley is cultivated and improved for two main purposes, as forage and malting in terms of quality, but the share of malting barley in total barley production is quite low in Turkey. The amount of barley consumed in Turkey is shown an increasing every year. With the development of animal husbandry, the need for barley for feed increases, and the need for malting barley increases with the developments in the malting industry. It is very important to obtain malting barley with good features. The fact that the unit price of malting barley is 70-80% higher than that of forage barley and the malt has a high export potential brings the necessity of increasing malting barley production. Among the malting barley quality characteristics, the most important ones are protein ratio and malt extract ratio. The grain yield and quality of malting barley are determined by the N ratio, variety and climatic conditions. For this reason, nitrogen fertilization is of great importance in barley cultivation

Keywords: Barley, malting, nitrogen, fertilizier



GİRİŞ

Arpa (*Hordeum vulgare* L.) insanoğlu tarafından kültüre ilk alınan bitkiler arasındadır (Smith ve Nesbitt, 1995). Mısır ve Mezopotamya'da arpa fosilleri buğdaydan daha fazla bulunmuştur ve bu durum tarihte arpanın insan gıdası olarak buğdaydan daha fazla kullanıldığını göstermektedir (Ceccarelli ve ark., 2007). Ancak, zamanla arpanın yerini buğday ve pirinç almış ve arpanın kullanımı hayvan yemi olarak yaygınlaşmıştır (Baik and Ullrich, 2008). Ülkemizde de arpanın hayvan yemi olarak kullanımı oldukça yaygındır. Bununla birlikte arpa içeriğinde mevcut olan besinsel lifler, protein, β -glukan, selüloz ve arabinoksilan ve zengin nişasta miktarı fonksiyonel gıda üreticilerinin dikkatini çekmiştir (Köten ve ark., 2013). Maltlık arpa özellikle dünyada bir ihracat ürünü olarak yetiştirilmektedir. Maltlık arpanın en popüler kullanımı alkollü içecekler olsa da malt ve malt ürünlerinin son zamanlarda fırıncılık ve bebek maması üretiminde ve alkolsüz malt içeceklerinin de üretiminde artmasıyla kullanımı artmaktadır (Feiten et al., 2010). Ülkemizde tarım alanlarının %40'ı ekilmekte ve bu ekili alanların %81.9'ını tahıllar oluşturmaktadır. Bu ekili alanlardan elde edilen üretimin ise %58.9'ını tahıllar oluşturmaktadır. Arpa, 26.1 milyon ha ekim alanı, 7,4 milyon ton üretim miktarı ile ülkemizde buğdaydan sonra ikinci önemli tahıldır. Türkiye'nin güneydoğusunda 372.030,5 ha alanda üretimi yapılmış ve üretilen toplam tane verimi 556.876 tondur (Anonim 2020). Arpada kalite; yemlik ve maltlık oluşuna göre değişir. Maltlık arpada; homojen irilik, yuvarlak, kısa, dolgun ve yumuşak tane, ince kavuz, saflık, parlak renk, unsu görünüş, düşük olmayan hektolitre ve bin tane ağırlığı ile yüksek nişasta ve uygun düzeyde protein oranı önemlidir.



Şekil 1. Maltlık Arpa



Yemlik arpalarda ise proteinin fazla olması, kavuzun ise fazla olmaması istenir (Geçit ve ark., 2009). Maltlık arpanın borsa fiyatının belirlenmesinde ürün tanesinin dolgun olması ve dolgun tane oranının % 75'in üzerinde (homojen) olması, tane protein oranının % 9 ile 11,5 arasında, hektolitre ağırlığının 65 kg üzerinde ve tane nişasta oranının % 55 – 65 arasında olması sayılabilir. Azotlu gübrenin, tane verimi ve maltlık arpanın kalite kriterlerini etkilemesi, maltlık arpa yetiştiriciliğinde azotlu gübrelemeyi önemli kılmaktadır.



Şekil 2. Yemlik Arpa

Maltlık arpada kaliteyi belirleyen en önemli kriterlerin başında protein oranı gelmektedir. Azotlu gübrenin hem verilme zamanı hem de miktarı tane verimi ve protein oranı açısından önemlidir. Bu nedenle maltlık arpada azotlu gübrelemeyle ilgili çeşitli çalışmalar yapılmıştır.

ÖNCEKİ ÇALIŞMALAR

Kassie ve Tesfaye (2019), 2012—2014 yıllarında beş N seviyesi (0, 23, 46, 69 ve 92 kg ha⁻¹) ve iki maltlık arpa çeşidi kullanarak bir çalışma yürütmüşlerdir. N oranı arttıkça, maltlık arpada tane veriminin ve tane protein konsantrasyonunun ve tane iriliğinin arttığını ancak maltlık açıdan kabul edilebilir tane kalitesinin 48 kg N ha⁻¹ (protein içeriği < 11.5% ve tane iriliği > 85 g kg⁻¹) uygulamasından elde edildiğini bildirmişlerdir.

Öztürk ve ark., 2016, arpadaki tane protein oranının % 8-16 arasında değişmekle birlikte biralık arpalarda bu oranın % 9 - 11,5 arasında olmasının istendiğini (Anonim, 2019), arpadaki tane protein oranının tanenin yemlik ya da maltlık olarak değerlendirilmesinde belirleyici olan çok



önemli kalite kriterlerinden biri olduğunu, tanedeki protein oranının genotip, çevre şartları ve kültürel uygulamalara göre farklılık gösterdiğini bildirmişlerdir.

Gezahegn B. ve Kefale (2016), Güney Etyopya’da maltlık arpanın verim ve kalitesi üzerine azotlu gübrenin etkisini belirlemek amacıyla yaptıkları çalışmada, 52.5, 64, 75.5, 87 ve 98.5 kg/ha şeklinde beş doz azot uygulamışlardır. 75.5 kg/ha uygulamasında, optimum verim ve maltlık arpa için kabul edilebilir tane protein içeriği elde edildiğini bildirmişlerdir.

Fox 2003, protein ve karbonhidrat içeriği arasında güçlü ters bir korelasyon olduğundan dolayı maltlık arpada yüksek protein oranı istenmediğini, yüksek protein içeriğinin maltlık arpada düşük ekstrakt oranına sebep olacağını bildirmişlerdir. Maltlık arpa çeşitlerinden daha kaliteli ve daha yüksek verim elde edilmesi için ekonomik olarak uygulanabilir azot seviyelerinin belirlenmesinin önemli olduğunu vurgulamışlardır.

Biruk ve Demelash (2016), azotlu gübre düzeyinin maltlık arpa çeşitlerinin verim ve kalitesi üzerindeki etkilerini belirlemek amacıyla, 2013 sezonunda, Sidama bölgesinde (Etiyopya) tarla denemesi yürütmüşlerdir. Denemede üç farklı arpa çeşidi (Sabini, Bahat ve yerel) ve beş farklı azotlu gübre düzeyi (52.5, 64, 75.5, 87 ve 98.5 kg/ha) kullanılmıştır. Bahat çeşidinin kardeş sayısı, hasat indeksi, bin tane ağırlığı, hektolitreye ağırlığı ve tane proteini içeriği bakımından daha yüksek değerler gösterdiğini rapor etmişlerdir. Diğer taraftan, yerel çeşitlerin başak uzunluğu, bitki boyu ve saman verimi bakımından daha yüksek değerler gösterdiğini belirtmişlerdir.

Emebiri 2015, arpa tanelerinin malt için kabul edilebilir protein konsantrasyonları içinde olması gerektiğini, Avustralya’da bulunan maltçıların protein içeriği %10.5’e yakın olanları tercih ettiğini, protein içeriği %9.0-12.0 arasında olan arpaları maltlık kabul ettiklerini ve bunun dışındaki protein içeriğine sahip olanları maltlık olarak kabul etmediklerini bildirmiştir.

İlkay, (2015) iki biralık arpa çeşidinin agronomik, verim ve kalite özellikleri üzerinde azot dozunun etkisini incelemek amacıyla 2003-2004 yıllarında Adnan Menderes Üniversitesi Ziraat Fakültesi deneme alanlarında, tesadüf blokları deneme deseninde üç tekerrürlü olarak yürüttükleri çalışmada, azotlu gübrenin yarısını ekimle birlikte diğer yarısını ise kardeşlenme döneminde olmak üzere olmak üzere iki defada 0, 4, 8, 12 ve 16 kg/da uygulamışlardır. Denemede yer alan, çeşitler Şerife Hanım ve Kaya’dır. Bu denemenin sonucunda, her iki çeşit için de yüksek verim ve kaliteyi sağlayan en iyi azot dozlarının 4 ya da 8 kg/da azot uygulaması olduğu tespit edilmiştir. Üretimin ekonomik olmasını sağlamak amacıyla, gübre fiyatları da düşünüldüğünde, yüksek verim ve kaliteli ürün için 4 kg/da saf azot miktarının yeterli olabileceği sonucuna varılmıştır.

Wu ve ark., 2015, Yetersiz tahıl proteini içeriğinin, nişastayı parçalayan enzimlerde düşük aktivite veya düşük köpük oluşumuna sebep olduğu, bu durumun da protein içeriğinin malt kalitesi üzerinde ikili etki gösterdiğini bildirmişlerdir. Azot gübrelemesi yapılan alanlar ile yapılmayan alanlar karşılaştırıldığında, azot gübrelemesinin maltlık arpa verimini artırabildiğini (O’ Donovan et al, 2011, Sainju et al., 2013) ancak dolgun maltlık arpa tanelerinin düşük, protein konsantrasyonunun yüksek olmasının artan azot gübrelemesinden dolayı olduğunu bildirmişlerdir (Wade and Froment, 2003; O’ Donovan et al., 2011).

MBPM (2014), Protein seviyesinin direk olarak tanenin nitrojen içeriği ile ilişkili olduğunu, düşük tane protein seviyesinin bira endüstrisi tarafından arzu edildiğini; yüksek tane protein içeriğinin protein ve karbonhidrat içeriği arasındaki güçlü ters ilişki nedeniyle arzu edilmediğini bildirmiştir.

Sainju ve ark., (2013), Doğu Montana’da kuruda maltlık arpa verimi, tane özellikleri, azot alımı ve azot kullanım etkinliği üzerine azotlu gübrelemenin etkilerinin araştırıldığı beş yıllık çalışmada 0, 40, 80, 120 N ha⁻¹ uygulanmıştır. Azot oranı arttıkça tane verimi, protein



konsantrasyonu ve azot alımı arttığını, 40 ve 80 kg N ha⁻¹ arasındaki azot oranlarının maltlık arpanın verim ve kalitesini devam ettirmesi için kullanılabileceğini bildirmişlerdir.

McLelland et al. 2009; Thompson et al. 2004, Maltlık arpanın optimum tane verimi ve protein konsantrasyonu arasında bir denge olması için, uygun azot gübrelemesine ihtiyaç duyulduğunu bildirmişlerdir. Yüksek tane protein içeriği, malt ekstraktına dönüşüm için daha az nişastalı daha küçük taneyi gösterdiğini bildirmişlerdir (Smith et al. 2016).

Engin (2005), Adıyaman yöresinde 3 yıl süreyle yürüttüğü çalışmada on iki farklı arpa çeşidinin maltlık kalitesini tespit etmeyi amaçlamıştır. Tane verimi ve kalite kriteri olarak tane iriliği, protein içeriği, ekstrakt oranı, viskozite ve friablite oranları incelenmiştir. İncelenen özellikler bakımından sonuçlar arasında önemli farklar bulunmuştur. En yüksek tane verimi Prosa (417 kg/da), en yüksek tane iriliği Opal (% 94.8), en düşük protein içeriği Prosa (% 10.8), en yüksek ekstrakt içeriği ve friablite değeri Madras (% 77.4-92.3) çeşitlerinde elde edildiğini bildirmiştir. McKenzie, R.H., and G. Jackson. 2005, Toprağa yeterli su ve azotlu gübreleme uygulanması, maltlık arpanın verim ve kalitesi için yapılan en faydalı agronomik uygulamalar olacağını bildirmişlerdir.

Kandemir 2004, Tokat ili Kazova bölgesine uygun maltlık arpa çeşitlerinin belirlenmesi amacıyla 2001-02 ve 2002-03 yetiştirme döneminde yürütülen çalışmada yerli Tokak 157/37 ve Bülbül-89 çeşitleri yanında Efes Pilsen A.Ş.'nin Türkiye genelinde değerlendirmeye aldığı 15 yabancı orijinli çeşit ve Kanada'nın en önemli maltlık arpa çeşidi Harrington kullanılmıştır. Yağışın uzun yıllar bölge ortalamasına yakın olduğu 2001-02 döneminde çoğu çeşit hektara beş tonun üzerinde verime, 50 g üzerinde 1000-tane ağırlığına ve 68-70 kg civarında hektolitreye ağırlığına sahip olmuş, aralarında yerli çeşitlerin de bulunduğu bazı çeşitlerde ise ciddi oranlarda yatma görüldüğü yağışın oldukça az olduğu 2002-03 döneminde ise, tane verimlerinin 3,0-3,5 ton civarında gerçekleştiğini, 1000-tane ağırlıklarının 40-50 g, hektolitreye ağırlıklarının 67-69 kg civarında olduğunu, yerli çeşitlerden Tokak 157/37 yatmanın olmadığı durumda yüksek verimli çeşitlere yaklaşmış ve oldukça iyi kalitede tane ürünü verdiğini tespit etmişlerdir.

Thompson ve ark., 2004, optimum tane verimi, tane iriliği ve protein konsantrasyonu arasındaki dengeyi sağlamak için uygun azotlu gübreleme yapılması gerektiğini bildirmişlerdir.

Kartal ve ark., (2003), Azotun 0, 2, 4, 6 ve 8 kg /da dozlarına karşılık sırasıyla % 9.59, 10.29, 10.48, 11.07 ve 11.55 ham protein oranı elde edildiğini, ham protein oranının 8 kg N/da dozunda 0, 2 ve 4 kg N/da dozlarına göre önemli derecede arttığını, ancak azotlu gübrenin tamamının ekimle birlikte verildiği bu çalışmada, ham protein oranının en yüksek azot dozunda bile üst sınır olarak belirtilen % 12'yi aşmadığını bildirmişlerdir.

Marquez-Cedillo et al. (2000) ABD ve Kanada'da on üç farklı lokasyonda yürüttükleri çalışmada, Morex çeşidinin malt ekstrakt oranının %76-81 arasında, Harrington çeşidinin %79-82 arasında değiştiğini belirlemişlerdir. Elde edilen bu verilere göre Türkiye'de yetiştirilen maltlık arpalarda malt ekstrakt oranının pek yüksek olmadığı anlaşılmaktadır.

Engin ve ark. (1999) malt proteininin (%) malt kalitesine etki eden en önemli kriterlerden biri olduğunu bildirmişler ve bu değer %9,0 ile 11,5 arasında olmasını önermişlerdir. Maltlık arpa kalite özelliklerinin içinde en önemlisinin malt ekstrakt oranı olduğunu (Schwarz and Li 2011), malt ekstrakt oranının, enzimlerin etkisiyle eriyebilir hale gelen maddelerin toplamı olduğunu bildirmişlerdir.

Fox, 2008, kaliteli maltlık arpada bu oranın %80,0-83,0 arasında olması gerektiğini bildirmiştir. Erzurum koşullarında 15 arpa genotipinin maltlık özelliklerini araştıran Öztürk ve ark. (1997), genotiplerin 2.5 mm lik elek üstü, ekstrakt ve ham protein oranlarının sırasıyla % 78.3-89.6, % 76.3-78.1 ve % 11.2-13.4 arasında olduğunu saptamışlardır. Cytris, 1515, 1510, 1517, 1527 ve Afyon Kılıç genotiplerini üstün bulan araştırmacılar, malt kalitesini sınırlayan en önemli faktörün



yüksek protein oranı olduğuna, bu nedenle azotun tamamının ekimle birlikte verilmesi ve miktarının ayrıca belirlenmesi gerektiğine dikkat çekmişlerdir.

Tuğay (1995), ülkemizde nitelikli biralık arpa üretimi için yeni çeşitlerin geliştirilmesi, her yöre için uygun çeşit ve ekim zamanının belirlenmesi, azotlu gübrenin ekimle birlikte bir defada verilmesi ve azot miktarının 6 kg/da'ı aşmaması gerektiğini bildirmiştir.

Azot dozlarının (0, 2, 4, 8, 16 kg/da) malt kalitesine etkisini araştıran Eagles ve ark. (1995), azot dozlarına göre ham protein oranının % 9.82 (0 kg/da)- 16.6 (16 kg/da), malt ekstrakt oranının ise % 61.4 (16 kg/da)-76.3 (0 kg/da) arasında değişim gösterdiğini, en yüksek verimin 8 kg/ha N uygulamasından elde edildiğini saptamışlardır. Malt ekstraktının ise artan N dozuyla polinomial olarak azaldığını, azotlu gübre uygulamalarının arpa bitkisinde tane protein konsantrasyonlarını yükseltirken malt ekstraktını azalttığını belirlemişlerdir.

Maltlık arpa üzerine azot gübrelemesinin en önemli etkisinin, tane protein oranını artırması, tane büyüklüğünü azaltması olduğunu bildirmişlerdir (O'Donovan et al. 2011, 2015; Sainju et al. 2013).

Tanenin azot içeriğinin, malt kalitesini belirlemede önemli bir faktör olduğunu, tanedeki yüksek azot içeriğinin sadece daha düşük karbonhidrat içeriği ve malt ekstrakt seviyesi değil aynı zamanda maltçılar için problemlere sebep olduğunu, tercih edilen tane azot seviyesinin %1.6-1.8den daha fazla olmadığını bildirmişlerdir (Fox et al., 2003).

Maltlık arpanın gübre uygulamasına iyi cevap vererek, hem tane verimi hem de protein içeriğinde artış gösterdiğini ancak fazla miktarda azotun protein oranını artırabildiğini fakat fazla proteinin maltlık arpanın kalite özelliklerinde istenmeyen durumlar yaratabildiğini bildirmişlerdir (Johnston et al., 2007).

McLelland et al., 1999, Azotlu gübreleme ne kadar önemliyse belirli dönemlerde sulama da o kadar önemli olduğunu, bitkinin tane doldurma dönemindeki su stresinin protein oranının artmasına ancak tane iriliğinin azalmasına neden olduğunu dolayısıyla yağış zamanının da verim ve protein açısından önemli olduğunu bildirmişlerdir. Artan azot uygulaması ile birlikte protein içeriği ve verimin artacağı ancak protein içeriğinin daha az oranda olacağını örneğin azot uygulaması ile verimin ikiye katlanacağını, protein oranının ise %1-2 oranında artacağını belirtmişlerdir.

O'Donovan et al. (2011), Maltlık arpanın tane karakterleri ve malt kalitesi üzerine yüksek azot uygulamasının negatif etkiye sahip olduğunu bildirmişlerdir.

McLelland et al. 2009; Thompson et al. 2004, optimum tane verimi ve protein konsantrasyonu arasında dengeyi kurmak için maltlık arpaya uygulanması gereken azot oranının tespit edilmesi gerekliliğinin önemini vurgulamışlardır.

Arpa tanesinin malt ve bira için yeterli kaliteye sahip olup olmadığını tespit etmek için en önemli kriterlerden birisinin tane protein içeriği olduğunu bildirmişlerdir (Castro et al. 2008; Emebiri 2015; Smith et al. 2012).

Wade and Froment 2003, Birleşik krallıkta yürütülen denemede uygulanan tohum oranı, azotlu gübre oranı, çeşit ve diğer uygulamaların maltlık arpa kalitesini etkileyen temel faktörler olduğunu bildirmişlerdir.

SONUÇ

Ülkemizde farklı maltlık arpa ve yemlik arpa çeşitleri belirlenmiş ancak bu arpa çeşitlerinin yapılan çalışmalardan da anlaşılacağı üzere çevre koşullarından önemli derecede etkilendiği de tespit edilmiştir. Maltlık arpanın özellikle azot gübrelemesi ve diğer çevre koşullarından önemli derecede etkilendiği görülmektedir.

Özellikle kurak geçen yılların maltlık arpanın tanesindeki protein miktarını artırdığı, maltlık kalitesini bozduğu görülmüştür. Kuraklık da gözönüne alınarak hem tane verimi hem de maltlık



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kalitesi yüksek olan arpa çeşitlerinin uygun azot gübrelemesi yapılarak yetiştirilmesi kalite açısından önemlidir.

Malt sanayisinin aradığı kriterlere uygun ürünler borsada daha yüksek fiyatla alıcı bulmaktadır. Ülkemizde sanayiciler zaman zaman malt kalitesi yüksek ürün ihtiyacını yurt dışından ithalat yoluyla gidermek zorunda kalmaktadırlar. Ülkemizde kaliteli maltlık arpa yetiştirilirse bu ürünü dışarıdan ithal edeceğimize sanayimize gerekli olan hammaddeyi kendi ülkemizden karşılamış oluruz.



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GENERAL SITUATION OF TOBACCO PRODUCTION IN TURKEY

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ABSTRACT

Tobacco which still has a great economic importance in the world and Turkey provides extensive employment opportunities from growing to evaluation stage to a certain part of our people and is produced as a family enterprise for centuries in our various regions. Turkey has a production of 82.791 tons tobacco compared with the production of 6.6 million tons in the world. Besides is number one with the 32% of high quality oriental tobacco production in Turkey in the world. According to 2020 statistics, 47.298 ton tobacco which is more than that of 50% of total production of Turkey, has been obtained from Aegean Region of Anatolia. Furthermore, the region has sufficient agricultural land to meet requirement of the World's total oriental tobacco. However there is a significant decrease in tobacco production the Aegean region as Turkey's total tobacco production. There are many factors causing the decline in tobacco production in Turkey. Such as reduction in the number of families producing tobacco, farmers usually be over the age of us 45 years and older consists of farmers, price policy, anti-smoking policy and the challenges of the agricultural practices. As well as, to grow tobacco in the same field every year and to use low purity seed are among the main factors in the decrease of the yield. Tobacco production and industrial facilities provide livelihood to nearly 3 million people. Production of tobacco in Turkey, from 1969 until 2002, was organized by the Law No. 1177. Since January 9, 2002, contract production method has been taken over with the Law No 4733 shortly known as 'Tobacco Act'. Tobacco has an important role in Turkey's economy and social life of producers. A large part of tobacco production is exported and it provides approximately 200-300 million dollars to Turkey's economy in every year. In addition to this, Aegean Region has an important role in terms of foreign sales and more than 79.60% of exported tobacco is provided from the Aegean Region.

Keywords: Tobacco, production, Turkey, export



INTRODUCTION

In spite of being a matter of increasing debate by reason of its adverse effects on health, tobacco is a crucial plant in terms of both the contributions it makes to our national economy and the employment opportunities it creates.

In our country, tobacco is produced in a total of 5000 villages, 68 % of which are located in Aegean Region, and 400.000 households are mainly dependent for their living on tobacco production (Anonim, 2021, Koseoglu et. al., 2014). Tobacco, which is very suitable for the ecological and social structure of Turkey, has been widely grown in several regions of Turkey for centuries as the family agriculture. Tobacco provides for both the employment opportunities and the value added to the economy (Guler Gumus and Akbulut, 2002). It still maintains significance as an agricultural product for Turkey. Oriental tobacco, which is in the third place the Turkish economy after nut and grape, provides an export income of \$267 million. So, this is important for Turkey.

This study focuses on World's oriental tobacco production, production in Turkey and foreign trade policies.

MAIN ORIENTAL TOBACCO PRODUCING COUNTRIES in the WORLD

Despite the decline in tobacco production in recent years, Turkey oriental tobacco market still appears to be leading the world in the country. When we compare our country with competing countries in oriental tobacco production, there are yield changes over the years . however, approximately 32 percent of the world belongs to Turkey oriental tobacco market.

Table 1. Oriental tobacco producing countries and their production

Country	Oriental tobacco production (kg)	Oriental tobacco production (%)
Turkey	60.000.000	32,3
CIS	30.000.000	16,0
Greece	22.000.000	11,8
Macedonia	21.000.000	11,3
China	18.500.000	10,0
Bulgaria	9.000.000	4,9
Lebanon	5.000.000	2,7
Albania	3.000.000	1,6
Other	17.000.000	9,4
Total	185.500.000	100

Source: Anonymous, 2018. (CIS:Commonwealth of independent states)

TOBACCO PRODUCTION in TURKEY

The tobacco production in Turkey was directed by the tobacco monopoly law and regulations number 1177 for years from 1969 to January 9, 2002. Since January 9, 2002, contract production method has been taken over with the Law No 4733 shortly known as 'Tobacco Act'. Tobacco has an important role in Turkey's economy and social life of producers. There has been decrease in the number of producers (%87) but increased tobacco planted areas (%116), and the amount of production (%154) from year to year (Table 2). (Anonymous, 2020).



Table 2. Tobacco production in Turkey (2011-2020)

Year	Number of producer	Index	Area planted (000 ha)	Index	Production (000 ha ⁻¹)	Index
2011	65.152	100	814	100	53.667	100
2012	50.881	78	828	101	45.613	84
2013	71.026	109	1076	132	73.284	136
2014	87.685	134	1330	163	93.158	173
2015	73.074	112	992	121	74.695	139
2016	62.144	95	919	112	67.989	126
2017	64.464	98	925	113	74.238	138
2018	64.541	99	995	122	93.665	174
2019	55.871	85	935	114	75.276	140
2020	57.296	87	950	116	82.791	154

Source: www.tarimorman.gov.tr

Turkey produced 82.791 tons tobacco of the world's total production 6.6 million tones. According to 2020 statistics, 47.298 ton tobacco which is more than 50% of total production of Turkey, were obtain from Aegean Region of Anatolia. In Turkey, 82 metric tons of oriental tobacco has been produced in an area of 950 ha. In addition, oriental tobaccos is grown in six regions in Turkey. Considering the tobacco production properties in these regions, approximately Aegean (57.1%), Black Sea (11.4%), South East Anatolia (26.4%), Marmara (1.9%), Mediterrean (0.9%), East Anatolia (2.3%) (Figure 1). (Anonymous, 2020).

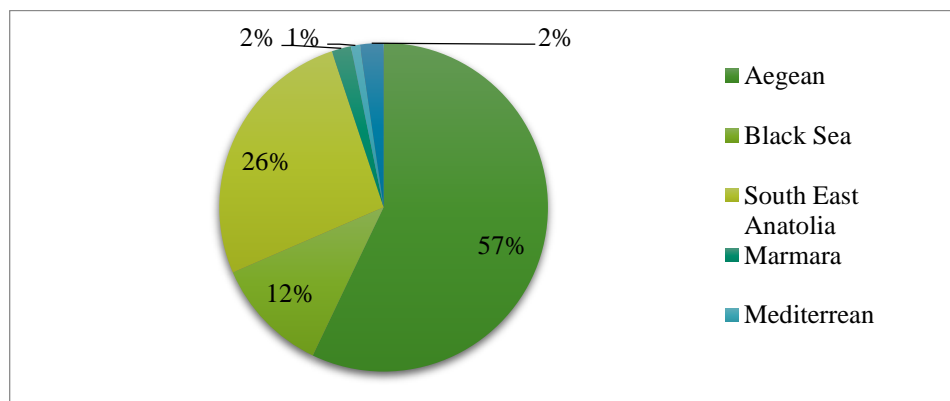


Figure1. Regional shares of tobacco production in Turkey

In addition to this, Aegean Region has an important place in terms of foreign sales and 79.6% of the total tobacco exported was covered by the Aegean Region. Aegean tobaccos are grown in the region with the local name of Aegean Region tobaccos. The type has been cultivated in this region for more than 150 year (Wolf, 1962). The region has sufficient agricultural land to meet requirement of the world's total oriental tobacco. However, there is a significance decrease in the Aegean Region in parallel with the total tobacco production of Turkey.



There are many factors causing the decline in production. Some of them are reduction in the number of families producing tobacco, 45 years of age and older consists of farmers, price policy, anti-smoking policy and the challenges of the agricultural practices. As well as, to grow tobacco in the same field every year and to use of low seed purity is among the main factors in the decrease of the yield (Ekren and İlker, 2017).

So, decreasing the tobacco production is the most important in terms of sustainability of the production. Ekren et al. (2015) studied on different planting methods on tobacco quality and yield on Izmir type tobacco. They found that double cross planting method was better than the traditional method in terms of yield and visual quality.

FOREIGN TRADE POLICIES

While Turkey is one of the leading tobacco exporting countries in the world, it has become one of the important purchaser countries in the world tobacco trade with the import it started in 1988. Tobacco imports have gradually increased due to changes in the demands of smokers in the domestic market. With the increase in cigarette consumption, the rapid increase in the share of American Blend cigarettes in the domestic market and the supply of Expanded Tobacco, reconstituted tobacco, as well as Flue-cured and Burley tobaccos, which are needed for the production of these cigarettes, have made Turkey an important tobacco importer country (Gumus, 2000).

Since 1988, Flue-cured and Burley type tobacco has been used in cigarette blends in Turkey. Since then, the consumption of blended cigarettes has increased, while the consumption of cigarettes made entirely of oriental type tobacco has followed a decreasing trend (Ozguven et al., 2005; Gumus et al., 2010).

THE IMPORT and EXPORT of TOBACCO in TURKEY

In Turkey, tobacco production and industrial facilities provide livelihood to nearly 3 million people. A large part of tobacco production is exported and it provides approximately 200-300 million dollars to Turkey's economy in every year (Anonymous, 2021). When we look at the change in the last 10 years, it is seen that imports increased at a high rate and exports decreased (Figure 2). Parallel to this, the income from exports is about half of the amount paid for imports (Figure 3).

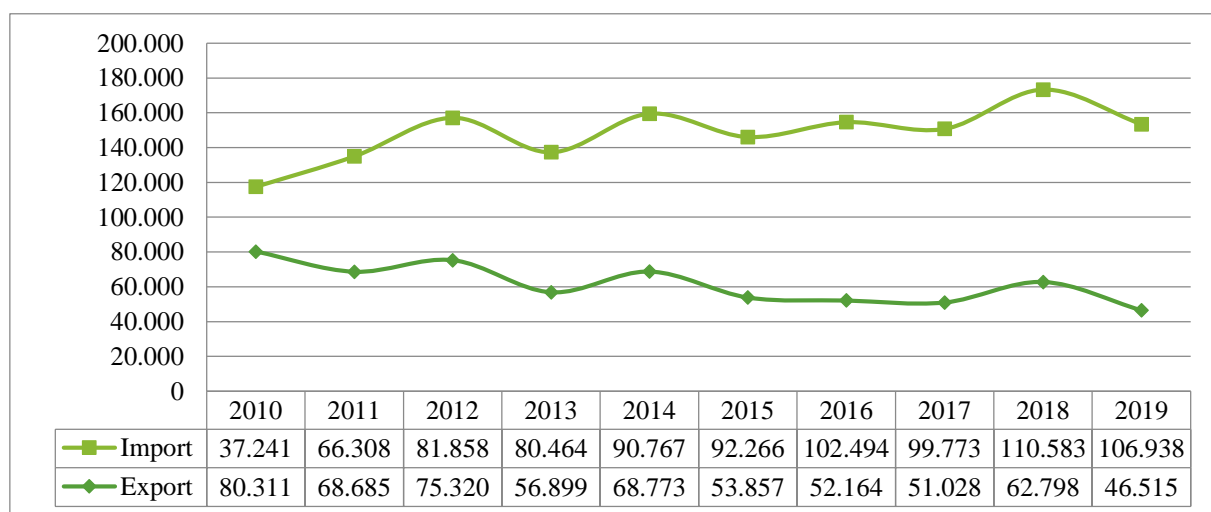


Figure2. Turkey tobacco imports and exports (2010-2019) (ton) Source: www.tarimorman.gov.tr

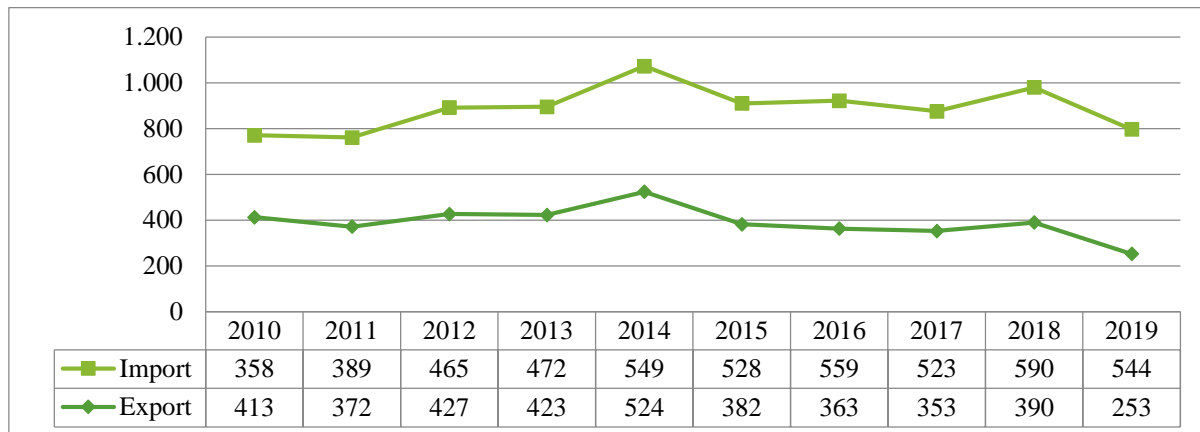


Figure3. Turkey tobacco imports and exports (2010-2019) (Million USD) Source: www.tarimorman.gov.tr

CONCLUSION

Major changes have been experienced in the tobacco industry in Turkey since the early 2000s. Especially the developments within the scope of tobacco marketing have affected the producers closely and many farmers have moved away from tobacco production.

If tobacco farming is not supported, it is inevitable that over time, especially the villages that have been producing tobacco for 400 years will migrate to the cities. What to do in Turkey; It should be determined the villages that have no alternative other than tobacco, not with political effects, but according to objective criteria, to shift our tobacco business to these regions in the medium and long term and to support the producers from the income obtained from tobacco.

The need for Oriental tobaccos used in the making of Blend cigarettes will continue in the future as it is today. However, while creating national tobacco policies, it is necessary to consider some realities and to produce alternatives accordingly. The primary and determining factor is that the price of the product is not attractive to the producers.

The necessity of producing cigarettes without additives will cause an increase in the market shares of natural blend cigarettes. The richness of oriental type tobacco produced in Turkey in terms of taste and smell is considered as a chance for some tobacco products such as İzmir and Samsun in the medium and long term and it is thought that new market opportunities may emerge.

It is thought that the production of İzmir type tobaccos will increase in other tobacco production regions, including the East and Southeast, and that those with superior performance from foreign varieties such as Katarini, Virginia, etc. that have been put into trial production will be put into widespread production in the near future.

Despite the information mentioned above, the feasibility of tobacco production in arid and barren agricultural lands, its potential to increase the amount of production and Turkey's leadership in oriental tobacco production are the strengths of the sector.

Tobacco will preserve its identity as a product of Turkey's export and brand values, even at a certain production level in barren areas where there is no alternative in our country today and in the future.



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REGENERATION OF EXPLANTS OF THE SPECIES *GLYCYRRHIZA GLABRGA* L.

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ABSTRACT

The medicinal plant *Glycyrrhiza glabrga* L. is under the protection of the Protected Areas Act and the Biodiversity Act. Application of *in vitro* methods makes it possible to study the reaction of the species under controlled conditions. With the development of a callus induction protocol, the extraction of valuable chemical compounds can be achieved. The experiment included four nutrient media, developed depending on the purpose of the study. The main nutrient medium was Quorin & Lepoivre (1977) and Murashige & Skoog (1962) with added TDZ and BAP in a concentration of 1mg /l, 0.05 mg / l IBA and 0.03 mg / l GA. Leaves from the whole part of the plant growing on the main nutrient medium Murashige & Skoog (1962) were used, without growth regulators included. In all variants, regenerations of leaf segments are reported after 25 days of betting experience. Comparing the effect of different cytokinin and auxin supplements, it was found that the combination of TDZ and IBA in the nutrient medium Quorin & Lepoivre (1977) has a stimulating effect on regeneration. A maximum of regenerated from one leaf explant is reported. Examination of the difference in the age of the leaves revealed that the young leaves are susceptible to callus formation. 3 to 5 leaves have the best regenerative ability.

Keywords: *in vitro*, medical species, auxins, cytokines, regeneration, *Glycyrrhiza glabrga* L



INTRODUCTION

The Bulgarian flora is an invaluable source of plant species that are in limited populations, but rich in a large set of chemical components - specific substances or groups of compounds (Atanasova, M. and N. Nedkov, 2004). The medicinal plant *Glycyrrhiza glabra* L. is under the protection of the Protected Areas Act and the Biodiversity Act. In the Red Book of Bulgaria the species is assessed according to the criteria of IUCN - category "endangered" / EN /. The study, conservation and conservation of medicinal plants is an opportunity to preserve biodiversity.

The species is widely used in the cosmetics, food and pharmaceutical industries (Fu, 2013). The roots are used, containing mainly polysaccharides, flavonoids and saponins. Also glucose, sucrose, mannitol, starch (25-30%), essential oil, asparagine, sterols (beta-sitosterol), etc., and in the aboveground parts - a large amount of crude protein (up to 14.3%), fat %) and carbohydrates (Honda G. 2003, Sabbioni et al., 2006).

Application of in vitro methods to *Glycyrrhiza glabra* L makes it possible to study the reaction of the species under controlled conditions. With the development of a callus induction protocol, the extraction of valuable chemical compounds can be achieved. Their successful application in laboratory conditions is a prerequisite for industrial production of useful products (Yordanowa, 2016).

The most commonly used culture media in *Glycyrrhiza glabra* L. in vitro are Murashige & Skoog, Quoirin & Lepoivre, Linsmaier & Skoog, Nitsch and Gamborg. From the studies performed, the species shows a very good development in the nutrient medium Murashige & Skoog, which contains inorganic nitrogen, stimulating the process of organogenesis and somatic embryogenesis (Skirvin, 1981; Henry et al., 1991, Zirinov, 2003). The interaction between auxins and cytokines and the use of the right concentration to the requirements of plant species is important for the growth and differentiation of plant cells (Durkovic, 2003; Kyozyuka, 2007).

A study on growth regulators, photoperiod, explant collection season was conducted by Kulder Yadav in *Glycyrrhiza glabra* L. It was found that maximum root growth was found in MS medium enriched with 1.0 mg / l IAA.

The aim of the present experiment is the possibility to study the regeneration potential of in vitro explants of the species *Glycyrrhiza glabra* L. by applying four types of modified nutrient media.

MATERIAL and METHODS

To examine the regeneration capacity of in vitro grown plants of *G. glabra* L. , leaf explants developed on MS basic media without growth regulators included. The leaves are used throughout the plant. They are injured at 2-3 sites, across the central nerve, and laid down with their adaxial surface to the nutrient medium. The experiment included four nutrient media developed according to the purpose of the study by Assoc. Prof. Dr. Violeta Kondakova (Table 1). The addition of the TDZ cytokinin was performed after autoclaving of the culture medium in laminar box.



Table 1. Nutritional media for adventitious organogenesis

Variant	Basic nutrient medium	Type and quantity of growth regulators		
G1	Quorin & Lepoivre (1977)	TDZ 1mg/l	IBA 0.05 mg/l	GA 0.03 mg/l
G2	Murashige & Skoog (1962)	BAP 1 mg/l	IBA 0.05 mg/l	GA 0.03 mg/l
G3	Quorin & Lepoivre (1977)	BAP 1 mg/l	IBA 0.05 mg/l	GA 0.03 mg/l
G4	Murashige & Skoog (1962)	TDZ 1mg/l	IBA 0.05 mg/l	GA 0.03 mg/l

The explants are placed in petri dishes and then closed with a colorless adhesive foil to prevent infection. Each petri dish contains 10 ml of culture medium. The nutrient media used for regeneration contained 30 g/l sucrose, 7 g/l agar and 5.6 pH. The prepared media are stored in cool and dark rooms for up to 30 days prior to use. Exploitation of the explants in the test steps was carried out in a chamber with a temperature of $24 \pm 2^\circ\text{C}$ and a photoperiod of 16 hours of light and 8 hours of darkness with 3000 lx of light. The reported ratios are the number of regenerated explants and regenerants obtained from one explant.

CONCLUSIONS

The development of a regeneration system is determined by the genotype requirement of the species. The factors that influence the regenerative potential of the species are different: genotype of the explant, composition of the nutrient media.

From the observations made, the regeneration from the leaf segment showed that *G. glabra* has a satisfactory regenerative ability, as a result of cultivation on the studied combinations of growth regulators (photo 1). Regeneration is also associated with the induction of white callus. Callus tissues are located on the surface of the explant. In all variants, regenerations of leaf segments are reported after 25 days of betting experience. A factor influencing the regeneration process and suitable for studying the genotype is the combination of cytokinin with auxin.



Picture1. Regeneration from *G. glabra* L.



The best result stands out in variant G1 with a maximum of 3 regenerants obtained on the 35th day of betting on the experience. Comparing the effect of different cytokinin and auxin supplements, it was found that the combination of TDZ and IBA (with the addition of GA 0.03 mg / l) has a stimulating effect on regeneration. A maximum of regenerated from one leaf

explant with $\bar{X} = 2$ pieces is reported. The reason for these results is due to the basic nutrient medium Quorin & Lepoivre (1977) with added 1mg / l TDZ. Compared to natural purine cytokinins, TDZ shows stronger action and high regeneration efficiency because it does not contain the purine ring so characteristic of other cytokinins.

In the case of *G. glabra*, different requirements of the explants to the modified medium G2 are taken into account. On the 25th day after betting on the experiment, the formation of a white callus is observed. Culture medium G2 differs from G1 in terms of results obtained with the

largest number of single realized regenerants with $\bar{X} = 0.9$ pieces. The reason for these results is due to the basic nutrient medium Murashige & Skoog (1962) with added optimal concentrations of IBA, BAP and GA3, which allow for maximum realization of the species (photo 2). This is a confirmation that the concentration of growth regulators can strongly affect the ability to regenerate.

Summarizing the obtained data, lower values of regeneration in variant G3 stand out in comparison with modified nutrient media G1 and G2. At 26 days from the start of the experiment, the least newly formed regenerants were reported $\bar{X} = 0.6$ leaf explants with 1 regenerant each (Table 1). The resulting callus is white with a granular, medium density. No regeneration process was observed in *G. glabra* in more than half of the leaf segments embedded in G3 medium.



Picture 2. Regeneration from *G. glabra* L. leaf segment in G1 medium

The results obtained are probably influenced by the basic nutrient medium Quorin & Lepoivre (1977) and the combination of growth regulators.

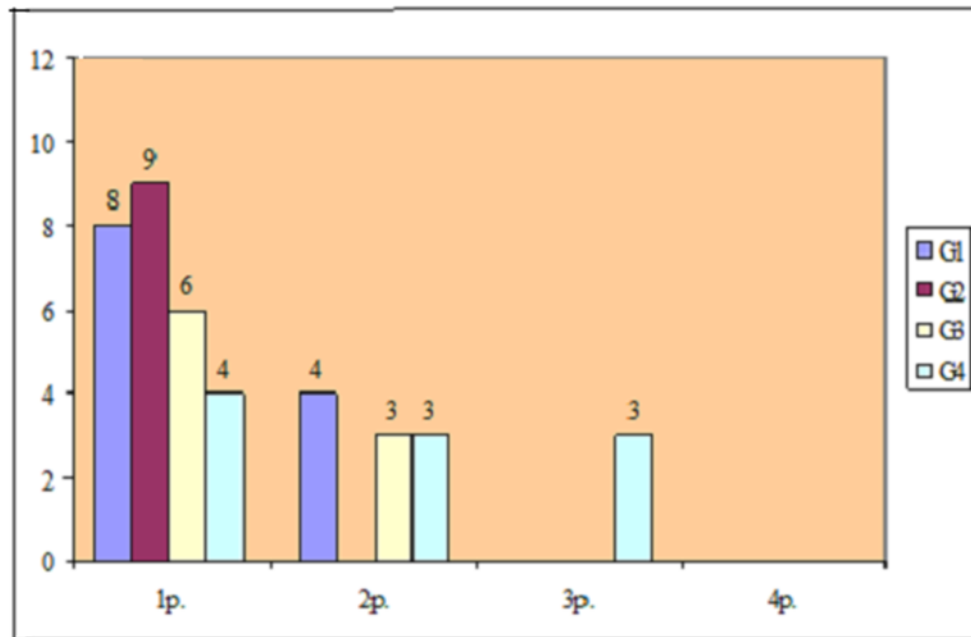


Table 2. Regeneration in *Glycyrrhiza glabra* L. in modified broth G1, G2, G3 and G4 with 1, 2, 3 and 4 leaf regeneration

The modified G4 culture medium does not allow for maximum realization of the species *G. glabra*. The formation of a maximum of up to $\bar{X} = 0.4$ regenerant from a laid leaf explant is observed.

Examination of the difference in the age of the leaves revealed that the young leaves are susceptible to callus formation. 3 to 5 leaves have the best regenerative ability.

CONCLUSIONS

In the species *Glycyrrhiza glabra* L., successful regeneration from leaf explant was reported in a modified nutrient medium test involving Quorin & Lepoivre (1977) with added 1mg / l TDZ, 0.05 mg / l IBA and 0.03 mg / l GA.



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DÜNYADA ve TÜRKİYE'DE KÜÇÜKBAŞ HAYVAN VARLIĞININ MEVCUT DURUMU, SAĞIM UYGULAMALARI VE SÜTÜN ÖNEMİ

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ÖZET

Koyun ve keçi, Dünyada yaygın yetiştiriciliği yapılan türlerdir. Yayla ve meraların yoğun olduğu bölgelerde koyun yetiştiriciliği yapılmakta olup dağlık, makilik alanlarda ise daha çok keçi yetiştiriciliği yapılmaktadır. Koyun ve keçiden elde edilen ürünler insan beslenmesi açısından önemlidir. Özellikle koyun ve keçi sütü değerli bir üründür. Sütün sağılarak işlenmiş veya çiğ olarak pazarlanması önem arz etmektedir. Bu sebeple bu araştırmada küçükbaş hayvan varlığının Dünyada ve Türkiye’de mevcut durumu değerlendirilmiş, koyun ve keçi sütünün özellikleri, faydaları, sağım yapılması ve sağım sistemlerinin yaygınlaştırılması ile ilgili sorunlar incelenmiştir. Ülkemizde küçükbaş hayvan yetiştiriciliği diğer çiftlik hayvanlarına göre daha az girdi ve daha zor bakım-besleme koşullarına dayanıklı olmaları sebebiyle yaygın bir şekilde yapılan hayvancılık faaliyetidir. Et, yapağı ve kıl veriminin olmasının yanı sıra vücut yapısına oranla süt veriminin diğer hayvan türlerinden yüksek olması, koyun ve keçi yetiştiriciliğini önemli hale getirmiştir. Koyun ve keçi yetiştiriciliğinin sanayi atıklarından uzak alanlarda yapılması sebebiyle daha organik ürünlerin elde edilmesine imkân sağlamaktadır. Bu sebeple de koyun ve keçiden elde edilen ürünlere olan talep her geçen gün artmaktadır. Dünyadaki küçükbaş hayvan varlığı son yıllar itibariyle artmıştır. Ancak Dünyada üretilen toplam sütün % 3.30’u küçükbaş hayvanlardan elde edilmektedir. Bu veriye göre küçükbaş hayvanların daha çok et ihtiyacını karşılamak amacıyla yetiştirildiği söylenebilir. Ayrıca küçükbaş hayvanların yetiştiriciliğinin yoğun yapıldığı ülkeler, gelişmekte olan ve sağım sistemlerinin yaygınlaşmadığı ülkelerdir. Dünyada ve ülkemizde sağımın yetiştiriciler tarafından uygulanmasında kırsal alanlarda yaşanan zorlukların etkisi mevcuttur. Ülkemizde koyun varlığının sığır varlığından fazla olduğu ve keçi varlığının da sığır varlığına yakın değerlerde olduğu görülmektedir. Küçükbaş hayvan sayısının geçmiş yıllara göre artış gösterdiği belirlenmiştir. Bu veriler Ülkemizde küçükbaş hayvancılığının her geçen gün önemini arttırdığını ve bu yönde yapılan ve yapılacak çalışmaların ülke ekonomisine sağladığı katkının göz ardı edilemeyeceğini göstermektedir.

Anahtar Kelimeler: Koyun, keçi, süt, sağım sistemleri



CURRENT SITUATION OF SMALL RUMINANT IN THE WORLD AND IN TURKEY, MILKING PRACTICES AND THE IMPORTANCE OF MILK

ABSTRACT

Sheep and goats are common breeding species in the world. Sheep breeding is carried out in areas with high plateaus and pastures, and goat breeding is carried out in mountainous and scrub areas. Products obtained from sheep and goats are important for human nutrition. Especially sheep and goat milk is a valuable product. It is important to milk the milk and market it as processed or raw. Therefore, in the world of small animals being evaluated in this study and the current situation in Turkey, the characteristics of sheep and goat milk, benefits, milking done and problems related to the dissemination of the milking system was examined. In our country, sheep and goat breeding is a widespread animal husbandry activity due to the fact that they are resistant to less input and more difficult care-feeding conditions compared to other livestock. In addition to having meat, fleece and hair yield, the fact that milk yield is higher than other animal species compared to body structure has made sheep and goat breeding important. Since sheep and goat breeding is carried out in areas far from industrial wastes, it enables more organic products to be obtained. For this reason, the demand for products obtained from sheep and goats is increasing day by day. The presence of sheep and goats in the world has increased in recent years. However, 3.30% of the total milk produced in the world is obtained from sheep and goats. According to this data, it can be said that small ruminants are raised to meet their meat needs. In addition, the countries where ovine breeding is intensively carried out are developing countries where milking systems are not widespread. The difficulties experienced in rural areas have an effect on the application of milking by the breeders. It is seen that the presence of sheep is higher than the existence of cattle in our country and the presence of goats is close to the existence of cattle. These data confirm that sheep and goat breeding is common in our country. It has been determined that the number of sheep and goats has increased compared to the previous years. These data show that the importance of sheep and goat farming in our country is increasing day by day and the contribution of the work done and to be done in this direction to the country's economy cannot be ignored.

Keywords: Sheep, goat, milk, milking systems



1. GİRİŞ

Kırsal alanların ekonomiye kazandırılmasında küçükbaş hayvan yetiştiriciliğinin önemli katkısı bulunmaktadır. Dünya genelinde taşlı, engebeli ve yüksek rakımlı, çalı formunda bitkilerin yaygın olduğu bölgelerde tarımsal üretim sınırlı düzeyde gerçekleştirilmektedir. Bu bölgelerin özellikleri sebebiyle yaşayan insanlar geçimlerini sağlamak amacıyla küçükbaş hayvan yetiştiriciliğine yönelmişlerdir. Yılın her döneminde gelir sağlayarak yetiştiricinin geçimini temin etmede önemli yeri vardır. Kırsal alanların çevreyi kirletici faktörlerden uzak olması bu alanlarda üretilen hayvansal ürünlere talebi artırmıştır. Bu açıdan koyun ve keçi yetiştiriciliğinin yapılması ve elde edilen ürünlerin daha sağlıklı olarak değerlendirilmesi gerekmektedir. Dünyada hayvan sayılarının 2017 yılına göre 2019 yılında arttığı Çizelge 1’de görülmektedir. Her yıl Dünya nüfusu artmaktadır. Bu artan nüfusun beslenme ihtiyaçlarını karşılamak için mevcut kaynakların iyi değerlendirilmesi gerekmektedir. Son yıllarda besinlerin insan sağlığı üzerindeki etkileri farkındalığı artmıştır. Bu sebeple özellikle hayvansal birçok ürünün hammaddesi olan sütün sağlıklı olarak işlenmesi önem arz etmektedir.

Çizelge 1. Dünya Büyükbaş ve Küçükbaş Hayvan Varlığı (milyon baş) (FAO, 2021a)

Yıllar	Sığır	Koyun	Keçi	Manda
2019	1.511	1.238	1.094	204
2017	1.477	1.211	1.045	201

Dünyada 2017 yılına göre 2019 yılında sağılan küçükbaş hayvan sayısının arttığı görülmektedir. Bu durum sağımın teşvik edilmesinin ve desteklenmesi ile ilgili yapılacak çalışmaların sonuç vereceğini göstermektedir.

Çizelge 2. Dünya Büyükbaş ve Küçükbaş Sağılan Hayvan Varlığı (milyon baş) (FAO, 2021b)

Yıllar	Sığır	Koyun	Keçi	Manda
2019	265	250	215	69
2017	271	245	209	67

Çizelge 3’de FAO, (2021c) verilerine göre, Dünya toplam süt üretimi 2017 yılında 851 milyon tondan 2019 yılında 877 milyon tona ulaşmıştır. Çizelge 3 ‘de Dünyada üretilen toplam süt içerisinde küçükbaş hayvanların payının % 3.30 olduğu görülmektedir. Bu veri küçükbaş hayvanlarda sağımın daha az yapıldığını göstermektedir. Çizelge 3’de Dünyada toplam süt üretim miktarında artışın sağılan hayvan varlığındaki artıştan daha fazla olmasında süt hayvancılığında gelişmiş sistemlerin kullanımı, ıslah çalışmaları, yeterli ve kaliteli yem kullanımının etkisi olduğu söylenebilir.

Çizelge 3. Dünyada Türler Göre Süt Üretim Miktarları (milyon ton) (FAO, 2021c)

Tür	2017	2019
İnek	695	715
Koyun	10	10
Keçi	20	19
Manda	126	133
Toplam	851	877



2019 yılı TÜİK verilerine göre Türkiye de 37 milyon baş koyun, 17 milyon baş sığır, 11 milyon baş keçi ve 184 bin baş manda olmak üzere toplam 66 milyon baş hayvan bulunduğu Çizelge 4’de verilmiştir (TÜİK, 2021a). Bu verilere göre koyun varlığının sığır varlığından fazla olduğu ve keçi varlığının da sığır varlığına yakın değerlerde olduğu görülmektedir. Bu veriler Ülkemizde koyun ve keçi yetiştiriciliğinin yaygın bir şekilde yapıldığını doğrular niteliktedir. Çizelge 4 incelendiğinde küçükbaş hayvan sayısının geçmiş yıllara göre artış gösterdiği belirlenmiştir. Bu artışta son yıllarda kırsal alanlarda uygulanan projeler ve desteklemelerin etkisi olduğu söylenebilir. Bu veriler Ülkemizde küçükbaş hayvancılığının her geçen gün önemini arttığının ve bu yönde yapılan ve yapılacak çalışmaların ülke ekonomisine sağladığı katkının göz ardı edilemeyeceğini göstermektedir.

Çizelge 4. Türkiye Büyükbaş ve Küçükbaş Hayvan Varlığı (baş) (TÜİK, 2021a)

Yıl	Sığır	Koyun	Keçi	Manda
2017	15.943586	33.677636	10.634672	161.439
2019	17.688139	37.276050	11.205429	184.192

Türkiye’de 2019 yılı sonu itibariyle 19 milyon baş koyun, 5 milyon baş keçi, 6 milyon baş sığır sağılmaktadır (Çizelge 5). Türkiye’de 2019 yılı verilerine göre toplam süt üretimi 24.305160 milyon tondur (TÜİK, 2021b).

Çizelge 5. Türkiye Sağılan Hayvan Sayısı ve Türlerine Göre Süt Üretim Miktarları (TÜİK, 2021b)

Yıl	Sığır		Koyun		Keçi		Manda	
	Sağılan Hayvan Sayısı	Süt (ton)	Sağılan Hayvan Sayısı	Süt (ton)	Sağılan Hayvan Sayısı	Süt (ton)	Sağılan Hayvan Sayısı	Süt (ton)
2017	5.969048	18.762319	17.503414	1.344729	4.963581	523.395	69.497	69.401
2019	6.580753	20.782375	19.836985	2.866235	5.471086	577.209	79.333	79.341

2020 yılı Ocak ayı verilerine göre Ülkemizde ticari süt işletmeleri tarafından toplanan inek sütü miktarı 806748 ton, 2021 yılının Ocak ayı verilerine göre 887577 tondur. Toplanan inek sütü miktarında %10 artış olduğu belirlenmiştir (TÜİK, 2021c). 2019 yılı verilere Ülkemizde toplanan sütün % 85.83’ünün büyükbaş hayvanlardan % 14.17’inin küçükbaş hayvanlardan elde edildiğini göstermektedir.

Türkiye’de bölgelere göre farklı ırklarda koyun ve keçi yetiştiriciliği yapılmaktadır. Türkiye’de koyun ve keçiden elde edilen süt daha çok köy peyniri, tulum peyniri, çökelek, tereyağı ve yoğurt olarak satılmaktadır. Bu ürünler daha çok hayvancılık işletmelerine yakın yörelerde satılmaktadır. Son yıllarda büyükşehirlerde koyun ve keçiden elde edilen ürünlerin insan sağlığına faydalarının benimsenmesiyle bu ürünlere talep artmıştır.

SAĞIM GEREKLİLİĞİ

Küresel ısınmanın etkisiyle her geçen gün coğrafik şartların değişimi sebebiyle küçükbaş hayvan yetiştiriciliği ve bu hayvanlardan elde edilen ürünler önemli hale gelmiştir. Hayvansal ürünlerin hammaddesi olan sütün verimliliği üzerine etkili faktörler mevcuttur. Keçilerde süt verimi, saf yetiştirme, melezleme, doğum mevsimi, doğum tipi, laktasyon süresi ve kuruda



geçen süre, sağım tipi, sıklığı ve sağım süresi, çiftleşme mevsimi, ilk gebelik yaşı, oğlakların yaşama oranı, besleme ve hastalıklardan etkilenmektedir (Bolacalı ve Küçük, 2012).

Keçi sütü ve süt ürünlerinin insan sağlığı ve beslenmesi açısından olumlu etkisi vardır. Keçi sütünün elde edilmesi, artırılması amacıyla yetiştirme sistemlerinin iyileştirilmesi üretici açısından fayda sağlayacaktır (Yangılar, 2013). Bu nedenle sağımın öneminin üreticilere anlatılması ve bu değerli ürünün ekonomiye katkısı sağlanmalıdır. Sağım sistemlerinin tanıtılması ve özellikle seyyar sağım sistemlerinin koyun ve keçi yetiştiricileri tarafından kullanılmasının sağlanması amacıyla gerekli eğitimler yapılmalıdır.

Savran ve ark. (2011)'ın yaptıkları araştırmada ailelerin %5'inin keçi sütü, %27'sinin keçi peyniri tükettiği, keçi sütü ve ürünleri tüketenlerin, kişi başına keçi sütü tüketiminin 350 ml/yıl, keçi peyniri tüketiminin ise 6 kg/yıl, şehirlerde kişi başına süt tüketimi 64 lt/yıl, yoğurt tüketimi 55 kg/yıl, peynir tüketimi 23 kg/yıl olarak bildirilmiş, gelir seviyesi arttıkça keçi süt ve ürünlerine olan talebin arttığı bildirilmektedir. Keçi yetiştiriciliğinin yoğun olarak yapıldığı yörelerde tüketim alışkanlıklarından dolayı keçi sütü ve ürünlerine talep daha fazladır (Savran ve ark., 2011).

Dünya'da çiğ sütün kalitesine etki eden faktörlerden biri sütteki somatik hücre sayısıdır (Papae ve ark., 2007). Sütteki somatik hücre sayısının insan sağlığı üzerine olumsuz etkilerinin yanı sıra hayvanlarda süt veriminde azalmalara ve ekonomik kayıplara neden olmaktadır. Daha kaliteli süt elde edilmesi için bütün işlemlerde hijyen kurallarına dikkat etmek gerekmektedir (Patır ve ark., 2012). Sağımın düzenli ve sık aralıklarla yapılmasının meme sağlığı, süt kalitesi ve süt verimine olumlu etkisi bulunduğu bilinmektedir. Sağımın yapılmaması ya da gerekli hijyen koşullarının sağlanmaması meme sağlığını olumsuz etkilemekte zamanla memede körelme meydana gelmektedir. Bu durumda sadece yavrunun beslenmesini sağlamak için dahi yeterli süt elde edilememektedir. Süte ihtiyacı olan yavrunun gelişimi olumsuz etkilenirken değerli olan sütün elde edilmemesi sahada yaşanan sıkıntılar içerisinde yer almaktadır. Koyun ve keçi yetiştiriciliğinin yoğun olarak yapıldığı yörelerde koyun ve keçi sütünün önemi, sağımın gerekliliği, sağım hijyeni, süt veriminin artırılmasına yönelik ıslah çalışmaları ve sütün sağlıklı olarak elde edilmesi amacıyla seyyar sağım sistemlerinin tanıtılması ve kullanımının yaygınlaştırılması için gerekli çalışmalar yapılmalıdır. Özellikle küçükbaş hayvan yetiştiriciliği ile uğraşan nüfusun yaşının ileri olması, elde edilen sütün sadece yavruyu besleyeceği düşüncesi sağımın yapılmasını engelleyen faktörlerden birkaçıdır. Bu sebeple özellikle genç nüfusun koyun ve keçi yetiştiriciliği konusunda istihdam ettirilerek, sağımın önemi ve sağımın teşvik edilmesi için gerekli çalışmaların yapılması gerekmektedir.

SAĞIM SİSTEMLERİ

Sağım uygulamaları olarak iki yöntem kullanılmaktadır. İlki el ile sağım ve ikincisi makinele sağımdır. El ile sağım uygulaması zahmetli, insan işgücüne ihtiyacın fazla olduğu bir uygulamadır. Yetiştiricilik yapan insanların yaş düzeyi elle sağım yapmayı etkilemektedir.

Türkiye'de genel olarak kuzular süttten kesildikten sonra sağım yapılmaktadır. Sağım dönemi veya sağım süresi bölgelere ve yetiştirilen ırkın tipine göre değişmektedir. Bu sürenin 2-4 ay arasında değişebilmektedir. Batı Anadolu ve Trakya'da koyun ırkları diğer bölgelere göre daha uzun sağılırlar. Koyunlarda elle sağım sisteminin uygulanması bölgelere göre değişiklik göstermektedir. Trakya'da sağım ağıl içinde sağım bölmeleri ya da sağım kotralarında yapılmakta, diğer bölgelerde merada "koşan koşma" (koyunlar başları birbirine bakacak şekilde yünden yapılmış urganla bağlanarak) yöntemi ile yapılmaktadır. Genel olarak elde edilen sütün bir kısmı aile ihtiyaçlarını karşılamakta kullanılırken geri kalanı pazara sunulmaktadır (Kaymakçı ve Sönmez, 1996).



Yetiştirici süt veriminin düşük olması, sütün işlenmesi ve pazarlanmasında yaşadığı zorluklar nedeniyle sağım yapmamaktadır. Türkiye’de mevcut koyun ve keçi yetiştiriciliği ile uğraşan nüfusun yaşlı olması ve bunun yanı sıra çoban bulma sıkıntısı, işletmelerin yapısının çok eski olması, süt toplama ve soğuk zincir olanaklarının bulunmaması koyun ve keçi sütünün sağılmasını olumsuz yönde etkileyen yetiştiricilik sorunlarıdır (Ceyhan ve ark., 2015a,b).

Sağım uygulamalarında iki sistem uygulanmaktadır. Bunlar elle sağım ve makineli sağımdır. Makineli sağım uygulamalarında memede kalıntı süt olabileceği için sağımdan sonra elle kontrol edilerek meme dokusuna zarar vermeden kalan sütün alınmasının hayvan sağlığına olumlu etkileyeceği bildirilmektedir (Tölu ve ark., 2016).

Bu sağım sistemlerinden mevcut arazide uygulanabilecek olan seyyar sağım sistemlerinin yaygınlaştırılması ile zaman ve iş gücü gerektiren sütün sağılması kolaylaşarak aile ekonomisine katkı sağlanabilir. Ayrıca bu seyyar sağım ünitelerine bağlı soğutma tanklarının bulunması sütün muhafazasını kolaylaştırarak farklı süt ürünlerine işlenebilirliği artırabilir. Bu seyyar sağım sistemleri yenilenebilir enerji kaynaklarından faydalanarak enerji ihtiyacını kendi karşılayabilmektedir. Elektrik olmayan alanlarda sağım makineleri kullanılamamaktadır. Son yıllarda güneş enerji sistemli kendi kendine temizleme işlemi yapan, sağılan sütü soğutabilen, son teknoloji seyyar sağım üniteleri üretilmiştir. Bu üniteler ile sağım işlemi kolaylaşmakta, sağım üniteleri hayvanların buldukları yerde gerçekleştirilebilmektedir. Sütün hijyen koşullarda elde edilerek muhafazası kolaylaşmaktadır. Bu sistemler gezen hibrit süt sağım sistemi olarak tanımlanmaktadır. Bu araçlar hayvanların buldukları yaylalarda elektrik olmayan alanlarda kullanım yönünden yetiştiricilere avantaj sağlayacaktır. Metin Kıyıcı (2018) tarafından yapılan bir araştırmada sağım makineleri ve sağım tesislerinin kullanımı ile elde edilen toplam süt miktarı arasında pozitif yüksek korelasyon olduğu tespit edilmiştir.

Üretimin sürekli yapılabilir olması dikkate alındığında elde edilecek maddi gelirin aile geçimini iyileştirebileceği düşünülmektedir. Ayrıca koyun ve keçi sütü üretimi için işletmelerden günlük sütlerin soğutma tanklı araçlar kullanılarak toplanmasının süt sağımını ve satışını teşvik edeceği söylenebilir.

KOYUN VE KEÇİ SÜTÜNÜN ÖZELLİKLERİ VE FAYDALARI

Koyun ve keçinin yetiştirilme koşulları ve yetiştiricilikle uğraşan nüfusun yaşlı olması sütün sağılmamasına neden olmuştur. Günümüzde daha çok inek sütü kullanımı söz konusudur. Sıklıkla tüketilen inek sütünün alerji etkisinin söz konusu olmasından dolayı aileler besinsel ihtiyacı gidermek için arayışa girmişlerdir. Bu amaçla yapılan bir araştırmada inek sütü alerjisi tanısı olan çocuklarda inek sütünün yerine ülkemizde yetiştirilen keçilerin sütünün alternatif bir gıda olarak kullanılabilmesi ifade edilmektedir. Keçi sütü kullanılmadan önce inek sütü alerjisi olanlarda prick test yapılarak duyarlılıkları negatif olarak tespit edilenlerde keçi sütü alternatif bir gıda olarak kullanılabilir (Ünsal ve ark., 2013).

Koyun sütleri, özellikle peynir yapımında kullanılmaktadır. Ülkemiz genelinde koyun sütü daha çok tulum peyniri yapımında değerlendirilmektedir. Yapılan bir araştırmada peynir üretiminde en yüksek randıman birinci sırada koyun sütlerinden (%26.81), ikinci sırada keçi (% 18.97) ve üçüncü sırada inek sütünden (% 15.15) elde edilmiştir. En yüksek yağ içeriği keçi ve koyun sütü peynirlerinde belirlenmiştir. Duyusal olarak en fazla beğenilen peynirin koyun sütünden yapılan peynir olduğu bildirilmektedir (Tunçtürk, 2008). Süt çeşidi kefir üretiminde önemlidir. Koyun sütünün kefir üretiminde de kullanıldığı bildirilmektedir (Yaman ve ark., 2010). Yetiştiricilerin koyun sütünü iyi bir fiyattan satabilmesi için gerekli olan alt yapı çalışmalarının yerine getirilmesi gerekmektedir (Kiper ve Alkan, 2016).

Keçilerin çalılık bitkileri sindirilebilirlikleri yüksek olması ve karotenin A vitaminine çevrilmesinde görev alan tiroit bezlerinin keçilerde daha büyük ve daha aktif olması sebebiyle



keçi sütü diğer sütlere oranla A vitamini yönünden 2-3 kat daha zengindir. Keçi sütünde yağ globüllerinin çapının küçük olması, yağ ve proteinin daha homojen dağılımı sebebiyle sindirimi kolaydır. Bu husus sindirim sistemi güçlüğü olanlar ve bebekler için keçi sütünün önemli bir gıda olduğunun göstergesidir (Zengin, 2012). Ünsal ve ark. (2013) tarafından yapılan araştırmada yaş aralığı 6.5 ± 8.6 ay arası çocuklarda inek sütü ve ürünlerinin alımından sonra gerçekleşen alerjik semptomlar belirlenmiştir. Bu alerjik reaksiyonların çoğunlukla erkeklerde gerçekleştiği ve en fazla deri (%73), solunum (%18) ve gastro intestinal sistem (GİS) (%9) de ortaya çıktığı tespit edilmiştir. Keçi sütü, yeni doğanların beslenmesinde, inek sütü proteinine karşı alerjisi sebebiyle oluşan abdominal ağrıya karşı kullanıldığı bildirilmektedir (Park, 1994). Keçi sütünün oligosakkarit içeriği yeni doğanların GİS florasının gelişmesine yardımcı olduğu belirlenmiştir (Özdemir ve Tek, 2015). Keçi sütünde bulunan oligosakkaritlerin miktar ve çeşitlilik bakımından inek ve koyun sütüne göre daha zengin olduğu belirlenmiştir (Martinez-Ferez ve ark., 2006). Keçi sütünde bulunan oligosakkaritlerin kalın bağırsak iltihaplanmasını azaltarak tedavi edici özelliği bulunmaktadır (Daddaoua ve ark., 2006; Lara-Villoslada ve ark., 2006). Keçi sütünün oligosakkarit oranının diğer sütlere göre yüksek olmasının ileride daha çok önem kazanacağına bir göstergesidir. Keçi sütlerinin biyolojik aktif bileşenleri yönünden diğer sütlere göre daha zengin olduğu ve bu açıdan insan beslenmesinde, insan sağlığını iyileştirme ve hastalıkların oluşumunu önlemede önemli bir gıda olarak kullanılabilceği bildirilmektedir (Telli ve Doğruer, 2014). Keçilerin sütlerinde bulunan kazein miktarı keçilerin ırklarına göre değişiklik gösterebilmektedir. Sütteki kazein miktarını etkileyen kazein genlerindeki çeşitlilik keçi sütünün besleme ve teknolojik özelliklerini etkilemektedir. Bu nedenle yerli ırkların kazein genlerinin tespit edilmesi önem arz etmektedir. Kazein içeriği düşük olan sütlerde alerjinin ortaya çıkma olasılığının düşük olduğu birçok araştırmada belirtilmiştir (Bevilacqua ve ark., 2001). Keçi sütünün çocuklar ve erginler de görülen astım, egzama, migren, mide ülseri, ağırlık kayıplarının önlenmesi ve tedavi edilmesi amacıyla kullanıldığı bildirilmektedir (Yaralı ve ark., 2013).

Koyun ve keçi sütünün insan beslenmesi ve sağlığı bakımından sağladığı faydalar değerlendirildiğinde sütün sağılmasının önemli olduğu ve bu yönde çalışmalar yapılmasının zorunlu olduğu dikkate alınmalıdır.

SONUÇ

Dünya genelinde ve Türkiye’de süt ve süt ürünlerine olan talep giderek artmaktadır. Ülkemizin coğrafik yapısı nedeniyle yüksek rakımlı arazi ve engebeli alanlarda çeşitli bitkisel ve hayvansal üretim modelleri uygulanamamaktadır. Bu nedenle bu bölgelerde yaşayan ailelerin ekonomik durumunu iyileştirmek üzere koyun ve keçi yetiştiriciliğinin geliştirilmesi ve mevcut hayvanlardan optimum faydanın sağlanabilmesi için hayvanlardan elde edilebilecek her ürünün en iyi şekilde değerlendirilmesi gerekmektedir.

Türkiye’de koyun ve keçi yetiştiriciliğinde sağımın az yapılması veya hiç yapılmaması nedeniyle önemli düzeyde ekonomik kayıp söz konusudur. Elle sağımın uygulanmasında zorluk ve uygulayacak kişilerin yaşa bağlı durumu, elektrik kaynaklı problemlerden dolayı sağım makinelerinin kullanılamaması, süt ve süt ürünlerinin muhafaza koşullarının sağlanamaması gibi faktörler yetiştiricinin sağım yapmasını etkileyen etmenler olarak söylenebilir. Bu yönde kırsal alanlarda mevcut problemlerin giderilmesi ile değerli olan sütün elde edilerek ekonomiye katkısı sağlanabilir. Bu amaçla bölgeler itibariyle Üniversiteler, Tarım ve Orman Bakanlığı’nın taşra teşkilatı, sivil toplum kuruluşları ve Valiliğin ilgili birimlerinin çözüm odaklı ve koordineli bir şekilde çalışması önem arz etmektedir. Uygulanacak projeler ile koyun ve keçi yetiştiriciliğinin geliştirilmesi ve süt üretimini arttırmak için seyyar sağım sistemlerinin yaygınlaştırılması ve üreticilerin eğitilmesi için eğitim çalışmaları, üreticilerin organizasyonu



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ve üreticilerin destek kaynaklarına ulaştırılması veya yapılacak girişimlerle bu sektöre yeni kaynakların tahsis edilmesinin sağlanması gibi faaliyetlerin yürütülmesi önem arz etmektedir. Koyunlarda süt veriminin artırılması amacıyla ıslah çalışmalarının yapılması, koyunculuk işletmelerinin yapısal imkânları ve bakım besleme koşullarının iyileştirilmesi sağlanmalıdır. Elle sağımın yerini makineli sağıma geçilmesi için yetiştiriciler bu konuda ilgili kurumlar tarafından desteklenmeli ve yetiştiriciliğin yoğun olarak yapıldığı yaylalara seyyar ya da kalıcı sağım sistemlerinin kurulması önerilmektedir.



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THE EFFECT OF BACTERIAL & HORMONAL APPLICATIONS ON THE ROOTING OF ZIVZİK POMEGRANATE CUTTINGS

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ABSTRACT

Zivzik pomegranate, one of the important agricultural products of Siirt region; it is famous for its fruit juice, which is good in taste, aroma, flavor, and its big aril. Pomegranate production in the region is carried out in closed orchards. One-year-old tube saplings are preferred for establishing successful orchard. Propagation in pomegranate is done by cutting vegetatively. In this way, the main variety that is desired to be grown can be produced without the need for grafting. Due to the capillary root structure of the Zivzik pomegranate, it is not possible to achieve 100% success in propagation by cuttings. For this reason, in our study, the effect of plant growth regulator rhizobacteria and the hormone melatonin on the rooting of pomegranate cuttings was investigated in order to increase the rooting success of the variety. The plant material of the study consists of wood cuttings taken from the one-year-old bottom shoots of 25 years old Zivzik pomegranate trees grown in Pirinçli village of Siirt-Şirvan province. Components applied to promote rooting and development in Zivzik pomegranate cuttings; *Brevibacillus choshinensis* (TV53D) (B1), which carries nitrogen fixing and phosphate solubilizing properties together with 2 mg/L melatonin hormone (M1) and 4 mg/L melatonin hormone (M2) and nitrogen fixer *Pseudoalteromonas tetradonis* (TV126C) (B2) are bacterial strains. The obtained data evaluated according to the TARIST statistical method. LSD test was applied to compare the averages. According to the results of analysis of variance applied to rooting parameters, root number and shoot length parameters were found to be statistically significant ($p < 5\%$). LSD test was applied to the important parameters and lettering was done. Considering the root number parameter among the applications, B1 (Bacteria 1 - TV53D) application achieved the most successful result in rooting with a value of 9.6a. This application gave the best result with 30.4a in shoot length value.

Keywords: Pomegranate, plant growth promoting rhizobacteria, melatonin, cutting, rooting



INTRODUCTION

Southeastern Anatolia Region is the third region that meets 25% of pomegranate production in Turkey. Zivzik, one of the important pomegranate varieties unique to the region, is widely grown in there. This variety is especially cultivated in closed orchards in four villages of Siirt province, Şirvan district, namely Zivzik, Sarıdana, Kapılı and Piriçli (Al-Jabbari et al., 2020). In Turkey pomegranate orchards have been established with the self-rooted plants of the cultivars. Pomegranate is propagated commercially from cuttings (Melgarejo et al., 2008); but, there is great changeability in the rooting ability of the different cultivars (Owais, 2010). Therefore, the use of environment friendly plant growth regulators and rhizobacteria can be expanded to increase the success of pomegranate cultivation, especially in the sapling production stage.

With the first discovery of melatonin in algae (Poeggeler and Hardeland, 1994), it was suggested that it can also be found in the tissues of different plants. Melatonin in plants was first found in 1995 as a result of studies conducted independently by two separate study groups (Dubbels et al., 1995; Hattori et al., 1995). In later studies, it was determined that the seeds, fruits, leaves and roots of many plant species contain very high amounts of melatonin (Reiter, 1999; Tettamanti et al., 2000; Reiter et al., 2007). After its existence in plants, it has been reported that melatonin is found in a wide variety of vegetables, fruits, seeds, grains, medicinal and aromatic plants, ornamental and wild plant species (Paredes et al., 2009; Arnao, 2014; Feng et al., 2014). It has been reported that the amount of melatonin found in plants differs not only from species to species, but also between genotypes or varieties within the same species or in different growth stages of individuals of the same genotype (Dubbels et al., 1995; Hattori et al., 1995; Posmyk and Janas, 2009). For example, while the content of melatonin is low in green tomatoes, it is found in high amounts in ripe and red colored fruits (Van Tassel et al., 2001). Among plant organs, the highest content of melatonin is in generative organs such as buds and flowers, and in fruit and seeds. It is estimated that this situation is due to the fact that melatonin is responsible for the antioxidant defense mechanism in buds and dried seeds (Paredes et al., 2009; Posmyk and Janas, 2009).

It is accepted that melatonin in plants acts like auxin. Auxins, except that promoting rooting, also play a key role in a number of developmental processes where they act as an indicator for the division, elongation, and differentiation of cells (Pasternak et al., 2002; Erdağ et al., 2010). The precursor for melatonin in plants is tryptophan, which is also transformed into IAA (Murch et al., 2000). Melatonin in plant tissues has been shown to affect root growth and promote rooting in cherry rootstocks at a concentration of 1 μ M (Sarropoulou et al., 2012a, 2012b).

Plant development and high yield are depend on adequate intake of nutrients from the soil. (Zaman et al., 2014). Today, sustainability has gained great importance in agricultural activities. Therefore, beneficial microorganisms for human and environmental health are widely used (Döbereiner, 1997). Soil bacteria with different mechanisms that develop in the root zone affect plant growth positively. These bacteria are called plant growth promoting rhizobacteria (PGPR) (Acarsoy Bilgin et al., 2019). PGPRs are effective on growth hormones and organic compound production, germination, root development, nutrient uptake, yield, resistance to stress and disease. (Bhattacharyya and Jha, 2012; Tahir and Sarwar, 2013). In fruit species, bacteria are applied in root inoculation (Eşitken et al., 2010) by spraying on leaves and flowers on the full bloom and on the 15th and 30th days following full bloom to increase the yield. (Eşitken et al., 2006). The most commonly used bacteria are *Bacillus subtilis* OSU 142 (Akça and Ercişli, 2010; Thakur et al., 2015), *Bacillus* M-3 bacteria (Pırlak and Köse, 2009), *Pseudomonas fluorescens*, *Pseudomonas putida* BA-8 (Karakurt et al., 2011), *Agrobacterium rubi* A-18,



Burkholderia gladioli OSU-7 (Karakurt and Aslantaş, 2010) and *Pantoea* FF1 bacteria (İpek et al., 2014). These bacteria are used in rooting rosehip (Ercişli et al., 2004) and kiwi (Ercişli et al., 2003) cuttings; it is used in the combating against fire blight on pear (Özaktan and Türküsay 1996), brown fruit rot on quince (Eşitken et al., 2002) and monilia disease on apricot (Demirci and Hancıoğlu, 2005). In PGPR applications made on fruit types such as apricot, cherry, sour cherry, apple and strawberry up to now so far, in vegetative growth of different bacteria (Pırlak et al., 2007; Eşitken et al., 2010), pomological and chemical properties of fruits (Eşitken et al., 2006; Akça and Ercişli, 2010), yield (Karakurt et al., 2011; Ertürk et al., 2012) and nutrient content (Karlıdağ et al., 2013; Güneş et al., 2015) have been searched on their effects.

The aim of our study is to determine the effect of bacteria and melatonin hormone on the rooting performance of Zivzik pomegranate cuttings and especially in recent years preventing the use of inorganic fertilizers so as to obtain more yields in agricultural products and to highlighted the alternative biological fertilization.

MATERIAL and METHOD

Material

The plant material of the study consists of wood cuttings taken from the one-year-old bottom shoots of 25 years old Zivzik pomegranate trees grown in Pirinçli Village of Siirt-Şirvan province. The cuttings were cut and ready in 40 cm length for the trial.



Figure 1. Preparing the cuttings for planting to rooting media

Components applied to promote rooting and development in Zivzik pomegranate cuttings; *Brevibacillus choshinensis* (TV53D) (Location: Çakırbey Village/Van) (B1), which carries nitrogen fixing and phosphate solubilizing properties together with 2 mg/L melatonin hormone (M1) and 4 mg/L melatonin hormone (M2) and nitrogen fixer *Pseudoalteromonas tetraodonis* (TV126C) (Location: Ulupamir Village/Van) (B2) are bacterial strains.

Method

The study was carried out in Application Greenhouse of Siirt University, Faculty of Agriculture between 10.03.2020 and 14.07.2020. Soil:sand:cattle manure mixture consisting of 2:1:1 ratios was used as the rooting medium of the cuttings. In the study carried out in the glass greenhouse, drip irrigation method was used and weed removal was done manually.



Melatonin Application

In order to determine the effect of melatonin hormone on the rooting of pomegranate cuttings, the solution prepared at 2 and 4 mg/L concentrations was used, except for the control group, where no dose was applied. The 10 cm bottom parts of the cuttings were kept in the hormone solution for 10 seconds and these parts were left open for 5 minutes for the wood tissue to absorb the hormone. Then the cuttings were planted in the soil.

Bacteria Application

The bacterial isolates used in the study were strains isolated from the Van Lake Basin and whose PGPB (Plant Growth Promoting Bacteria) activities were detected (Erman et al., 2010). These isolates obtained from the Field Crops Department were diagnosed with the MIS system and their PGPB activity was revealed in both greenhouse and field conditions. Nutagar (Merck-VM71680604) was used as solid medium for the propagation of bacteria. By adding 20 g of nutrientagar to one liter of distilled water, the pH was adjusted to 7.0 and the mixture was sterilized by autoclave at 121°C for 15 minutes. After sterilization, the media were cooled to 50 °C, then transferred to petri dishes and waited for solidification. Stock cultures of bacteria were inoculated on nutrientagar medium with loops and incubated for 24 hours at 26 ± 2 °C. Nutrientbroth (Merck-VM775843711) was used as liquid medium. 8 g of nutrientbroth medium was added to one liter of distilled water and the pH was adjusted to 7.0. The mixture was sterilized by autoclave at 121 °C for 15 minutes and then left to cool. Single colony was taken from the bacteria grown in the nutrientagar medium and transferred to the nutrientbroth medium under aseptic conditions. Bacteria transferred to the broth were incubated at 26 ± 2 °C for 24 hours in a horizontal shaker at 120 rpm. After incubation, bacterial concentrations were turbidimetrically adjusted to 108 cfu/ml. The 10 cm bottom parts of the cuttings were kept in the bacterial solution for 30 minutes and these parts were left open for 5 minutes for the wood tissue to absorb the solution. Then the cuttings were planted in the soil. One week after the cuttings were planted, equal amounts of the same bacterial solutions were applied to the bottom of all the cuttings involved in the bacterial application in order to increase the effectiveness of the bacteria. In the experiment, there were 11 applications in which melatonin and rhizobacteria applications were applied to pomegranate cuttings individually and in combination (Table 1).

Statistical Analysis

The experiment was set up with three repetitions according to the design of random plots. 60 cuttings were included in each application, with 20 cuttings in each repetition. The obtained data evaluated according to the TARIST statistical method. LSD test was applied to compare the averages (Açıköz et al., 1994).



Table 1. Treatments

No	Application	Application Type
1	Control	-
2	B1	Bacteria 1 (TV53D)
3	B2	Bacteria 2 (TV126C)
4	M1	Melatonin 1 (2 mg/L)
5	M2	Melatonin 2 (4 mg/L)
6	M1 x B1	Both Melatonin 1 & Bacteria 1
7	M1 x B2	Both Melatonin 1 & Bacteria 2
8	M2 x B1	Both Melatonin 2 & Bacteria 1
9	M2 x B2	Both Melatonin 2 & Bacteria 2
10	B1 x B2	Both Bacteria 1 & Bacteria 2
11	Wounding & M2	Both cambium tissue removal of the cuttings bottom side & Melatonin 2

RESULTS and DISCUSSION

The Effect Of Bacteria And Melatonin Applications On Rooting

The first rooting observations were taken on May 15, 2020 in our trial, which started on March 10, 2020, where bacteria and hormone applications were tested on pomegranate cuttings and ended on July 14, 2020. Since only two cuttings were rooted in M1 (Mel – 2 mg/L) application, which is included in the applications, this application was not subjected to variance analysis and was eliminated. According to the results of the statistical analysis on the application results, the control application was the least successful application in bacteria and melatonin applications. According to the results of analysis of variance applied to rooting parameters, root number and shoot length parameters were found to be statistically significant ($p < 5\%$). LSD test was applied to the important parameters and lettering was done. The values found for root number and shoot length parameters in the LSD test are given below (Table 2). Considering the root number parameter among the applications, B1 (Bacteria 1 - TV53D) application achieved the most successful result in rooting with a value of 9.6a. This application gave the best result with 30.4a in shoot length value. The scar tissue x M2 (7.3ab) and M1 x B2 (7.6ab) applications were also in the same group with the B1 application in terms of rooting success according to the root number value in terms of statistical analysis. M2 (Mel - 4 mg/L) application (6.7b), M2 x B2 (Bacteria 2 - TV126C) application (6.3b), M1 x B2 application (6.1b), B1 x B2 application (5.9b), M2 x B1 application (5.7bc) and B2 (Bacteria 2 - TV126C) application took place in the second successful group statistically in terms of rooting status depending on root number values. M2 application (28.0ab), M1 x B2 application (25.1abc), M2 x B2 application (23.5abc), M1 x B1 application (22.2abc) and M2 x B1 application (21.9abc) were the most the successful group statistically in terms of shoot length values. B1 x B2 application (20.9bc) and B2 application (19.7bcd) were also included in the second successful group according to the results of the statistical evaluation of shoot length values. Wounding x M2 application (18.0cd) is in the third group in this regard. The control group, in which no application was made, was the group with the lowest success in terms of rooting status, according to the results of the analysis of variance. In our study, it was seen that melatonin and bacteria applications, which were made



to promote the rooting of pomegranate cuttings, gave successful results both alone and in combination. Since melatonin acts as an auxin hormone in the plant, it encourages the rooting of the cambium tissue. It has been observed that the melatonin application, especially on the wounded tissue cuttings formed by the removal of the cambium tissue, gives very good results in terms of root number. In addition, in our trial, it was observed that the dose of melatonin applied as 4 mg/L gave more successful results. B1 bacteria application also gave better results than B2 application alone. In a study on rosehip cuttings, bacteria and IBA hormone were applied to the cuttings for rooting and similar results were obtained in our experiment (Kınık and Çelikel, 2017). Likewise, auxin (IBA) application and *Agrobacterium rubi* inoculation in *Rosa canina* wood cuttings were found to promote the formation and development of lateral roots (Ercişli et al., 2004). Many studies have been carried out to determine the effects of plant growth promoting rhizobacteria on vegetative growth in different plant species. Apricot Eşitken et al. (2003), Eşitken et al. (2006), in apple Aslantaş et al. (2007) found an increase in vegetative development of plants as a result of bacterial applications. In the study conducted to determine the effects of some rhizobacteria on vegetative development in apple, it was determined that there were significant increases in the number of shoots, shoot length, shoot diameter, plant height and leaf area values as a result of the application (Aslantaş et al., 2007). Similarly, in another study on apples, it was determined that rhizobacteria provided significant increases in shoot length and shoot diameter (Karlıdağ et al., 2007). It has been reported that leaf area significantly increased with bacterial applications in bilberry (De Silva et al., 2000) and mulberry (Sudhakar et al., 2000) species. In the light of this information, it can be said that the results of our experiment support the results of previous studies.

Table 2. The effect of bacteria and melatonin applications on rooting parameters in pomegranate cuttings

Application	Root Number* (Piece)	Root Length** (cm)	Shoot Number** (Piece)	Shoot Length* (cm)
Control	3.0 c	7.2	3.5	10.4 d
M2	6.7 b	11.8	4.2	28.0 ab
M1xB1	6.1 b	10.2	4.5	22.2 abc
M2xB1	5.7 bc	9.5	3.7	21.9 abc
B1	9.6 a	14.6	5.6	30.4 a
B2	5.7 b	9.7	4.1	19.7 bcd
M1xB2	7.6 ab	12.0	4.4	25.1 abc
M2xB2	6.3 b	12.7	3.9	23.5 abc
B1xB2	5.9 b	10.4	4.7	20.9 bc
WoundingxM2	7.3 ab	11.2	4.4	18.0 cd

*There are statistically significant differences among the values denoted by different letters in the same column ($P < 0.05$)

LSD_{root number}= 2.759 LSD_{shoot length}= 9.405 ** Not statistically significant.



CONCLUSION

Bacteria and melatonin hormone applications made in our study, which we carried out in order to increase the success rate in production with pomegranate cuttings, gave successful results compared to the control application. The B1 application was the application with the highest rooting success. B2 bacteria and melatonin (2 mg/L) also gave good results together. However, since the Zivzik pomegranate has a capillary root structure, it is a variety that tends to form more successful roots in a perlite-peat mixture with a permeable and strained rooting medium. The rooting medium consisting of a mixture of garden soil-sand- cattle manure mixture used in our study at a ratio of 2:1:1 negatively affected the success rate of the study due to the capillary root structure of Zivzik pomegranate. It is estimated that the heavy and clayey structure of the orchard soil used in the study may have reduced the rooting rate of this variety. For this reason, in future studies, a perlite-peat mixture can be applied in a rooting medium with alternative doses of melatonin hormone alone or in combination with bacteria, and it can be used in cuttings of pomegranate and different fruit species to increase the rooting rate.



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FARKLI LOKASYONLARIN BAZI TRİTİKALE GENOTİOLERİNİN YETİŞTİRİCİLİĞİNE OLAN ETKİSİ

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ÖZET

Bu araştırma, 1 adet tescil adayı ve 4 adet standart tritikale çeşidi ile Güneydoğu Anadolu Bölgesinin her üç alt bölgesini temsilen dört lokasyonda yürütülmüş ve bu genotiplere ait çevre genotip interaksiyonu ve stabilitesi ana etkiler ve çarpımsal interaksiyonlar (AMMI) analizi ile incelenmiştir. Denemeler tesadüf blokları deneme desenine göre dört tekrarlamalı olarak 2012-2013 yetiştirme sezonunda yürütülmüştür. Ana etkiler ve çarpımsal interaksiyonlar analiz sonuçlarına göre, Çevre ve genotip istatiki anlamda % 1, çevre genotip interaksiyonu ise % 5'e göre önemli bulunmuş ve karalar ortalaması sırasıyla % 6.1'i genotipten, %91.6'sı çevre ve %2.2'si ise interaksiyondan etkilendiğini göstermiştir. Genotiplerin tane verimi daha çok çevrelerin oldukça farklı özelliklerinden etkilendiği tespit edilmiştir. AMMI analizi sonuçlarına göre G2 diğer genotiplere göre daha yüksek verimli(301.0 kg/da), G1 ise daha stabil($b=2.32807$) oldukları tespit edilmiştir. Ayrıca çalışmanın yürütüldüğü çevrelerden Diyarbakır yüksek ortalama verim (375.1 kg/da), Mardin lokasyonu ise düşük ortalama verime (185.5 kg/da) sahip oldukları görülmüştür. Çalışmanın yürütüldüğü lokasyonlar oldukça farklı özelliklere sahip oldukları için, AMMI analizi sonuçlarına göre her bir lokasyon için önerilen çeşitler farklılık göstermiştir. Çalışmaların yürütüldüğü Diyarbakır lokasyonu için birinci dereceden G3, Mardin lokasyonu için G1, ve Adıyaman lokasyonu için G4, Hazro lokasyonu için ise G2 ön plana çıkmıştır. Her bir lokasyon için 2. 3. ve 4. sırada önerilecek çeşitler farklılık göstermiştir. Bu nedenle herhangi bir bölge veya alt bölgeye yönelik tescil adaylarını belirleyebilmek için stabilite çalışmalarının yapılması oldukça önemlidir. Ana etkiler ve çarpımsal interaksiyonlar analizi hem görsel olarak genotip ve çevre durumlarını tespit etmek hem de her bir lokasyon için ilk dört sırada önerilecek genotiplerin belirlemek için kullanılabilir bir yöntem olduğu ortaya çıkmıştır.

Anahtar Kelimeler: Interaksiyon, Çevre, Çeşit Adayı, Biplot



THE EFFECTS OF DIFFERENT LOCATIONS ON TRITICALE GENOTYPES CULTIVATION

ABSTRACT

This research was carried out with 1 registration candidate and 4 standard triticale cultivars in four locations representing all three sub-regions of the Southeastern Anatolia Region, and the environmental genotype interaction and stability of these genotypes were examined by main effects and multiplicative interactions (AMMI) analysis. Experiments were carried out in a randomized block design with four replications in the 2012-2013 growing season. According to the results of the main effects and multiplicative interactions analysis, the environment and genotype were found to be statistically significant compared to 1%, and the environment genotype interaction was found to be significant compared to 5%, and the average of squares demonstrated to be affected 6.1% from the genotype, 91.6% from the environment and 2.2% from the interaction, respectively. It has been determined that the grain yield of the genotypes is mostly affected by quite different characteristics of the environment. According to the results of AMMI analysis, G2 was found to be more productive (3010 kg/ha) and more stable ($b=2.32807$) than G1 compared to other genotypes. In addition, it has been observed that Diyarbakır has a high average yield (3751 kg/ha), while the Mardin location has a low average yield (1855 kg/ha). Since the locations where the study was carried out had quite different characteristics, the varieties recommended for each location differed according to the results of the AMMI analysis. First-order G3 for the Diyarbakır location where the studies were conducted, G1 for the Mardin location, G4 for the Adıyaman location, and G2 for the Hazro location. out. The varieties to be recommended in the 2nd, 3rd and 4th rows for each location differed. For this reason, it is very important to carry out stability studies in order to determine the registration candidates for any region or sub-region. The main effects and multiplicative interactions analysis turned out to be a method that can be used both to visually determine the genotype and environmental conditions, and to determine the genotypes to be recommended in the top four rows for each location.

Keywords: Interaction, Environment, Candidate, Bi-plot



GİRİŞ

Tritikale, *buğday* x *çavdar* melezinden elde edilen, kıraç alanları iyi değerlendiren, az gelişmiş ülkelerde ekmek yapımında gelişmiş ülkelerde ise hayvan yemi olarak kullanılan ve tahıllar arasında yeni bir tür olarak bilinen bir bitkidir. Ülkemizde 2020 yılı itibarı ile 811.149 hektar alanda toplam 276.212 ton üretimi olup dekara verimi 341 kg olarak kayıt edilmiştir. Son on yılda yaklaşık üretim alanı 298 bin hektardan 811 bin hektara, üretimi yaklaşık 104 bin tondan 276 bin tona yükselirken dekara verimi 315 kg ile 349 kg arasında değişim göstermiş ve en yüksek tane verimi 2011 yılı üretim sezonundan elde edilmiştir. Ülkemizde tahıllar içerisinde en yüksek tane verimine sahip olduğu belirtilen tritikalenin üretim alanında sürekli bir artışın olduğu tük verilerinden de anlaşılmaktadır (Anonim, 2021).

Güneydoğu Anadolu Bölgesinde dar alanda ekimi yapılan tritikale' nin aslında bu bölgede kıraç alanları iyi değerlendirebileceği öngörülmektedir (Kendal ve ark., 2012; Kızılgöçü ve ark., 2017). Çünkü, tritikale bitkisinin özellikle kurak ve kıraç şartlara dayanıklı olduğu ve bu alanları iyi değerlendirdiği bazı araştırmacılar tarafından belirtilmiştir (Kendal and Sayar, 2016, Siraç ve ark., 2020). Güneydoğu Anadolu Bölgesinde çevre şartları çok değişken olduğu için bu bölgede yetiştirilecek tritikale çeşitlerinin stabil olması oldukça önemsenmektedir. Bu nedenle çeşit adaylarının ve yeni tescil edilen çeşitlerin alt bölgelerdeki performanslarının araştırılmasına ihtiyaç duyulmaktadır. Çünkü Güneydoğu Anadolu Bölgesinde çok düşük alanlarda tritikale yetiştiriciliği yapılmaktadır. Bu bölgede dar alanda bile çevre şartları çok değiştiği için çeşit tercihi oldukça önemlidir (Kendal ve ark., 2016). Yetiştirilecek çeşitlerin üreticiler tarafından tercih edilmesi için oldukça stabil ve kaliteli olmaları gerekmektedir. Bu nedenle Güneydoğu Anadolu Bölgesine yönelik çeşitlerin belirlenmesi için çeşit, çevre ve interaksiyonun etkisinin iyi irdelenmesine ihtiyaç duyulmaktadır. Yapılan bazı araştırmalarda, Sabaghnia ve ark. (2012), verim performansında genetik kazanımların artırılması daralan genotiplerin adaptasyonunun yükseltilmesi ve özel çevrelerde verimin artırılması genotip çevre interaksiyonu ile belirlenebileceği, Mohammadi ve ark. (2013), interaksiyon test edilen çevrelerde genotiplerin performansı hakkında bilgi sunduğunu ve ıslah programlarında verim stabilitesinin ilerleyişinde önemli bir rol oynadığını, Akter ve ark. (2014), tane verimi, bir çok genetik faktörden ve özellikle diğer belirteçlerden daha karışık olduğundan dolayı çevresel dalgalanmalardan daha çok etkilendiğini bildirmektedirler. Bu anlamda çevre genotip ve interaksiyonun etkisini ortaya koyan çok farklı teknikler kullanılmaktadır. Bu yöntemlerden bir tanesi de ana etkiler ve çarpımsal interaksiyonlar analiz modeli olup hem iki yönlü veri yapısını hem de bir çeşidin genotipik potansiyeli ve üzerindeki çevresel etkilere ilişkin güçlü sonuçları elde etmemizi mümkün kılan ve son zamanlarda çevre genotip çalışmalarında sık sık kullanılan kompleks bir yapıya sahip olan ve oldukça pratik bilgiler sunan bir model olduğu birçok araştırmacı tarafından bildirilmektedir (Derejko ve ark., 2020; Georgieva, 2020; Bocianowski ve ark., 2021; Stoyanov, 2021). Kendal ve ark. (2019), AMMI analizinin gerek çeşitlerin stabilite durumları hakkında gerekse çevrelerin performansları hakkında görsel olarak çok önemli bilgiler sunduğu için kullanılabilirliği, Hagos and Abay (2013), bu yöntemin, farklı çevrelerde ileri kademedeki tescil adayı hatlarını test etmek, onların performansını ve stabilitesini tahmin etmek için çok önemli olduğunu, Asfaw ve ark., (2009), bu yöntemin, genotip çevre interaksiyonunda önemli etkileri ve ilişki boyutlarını sergilediğini, Mukherjee ve ark. (2013), bu yöntemde genotiplerin çevreler üzerinde daha belirleyici görüntüler sergilediğini, özel ve özel olmayan çevreleri belirlediğini, çok özel çevreleri tanımladığını, Tarakanovas and Ruzgas (2006), genotip çevre interaksiyon çalışmalarında bu modelin çok etkili olduğunu bildirmişlerdir. Bu nedenle, ıslah çalışmalarında son zamanlarda sıkça tercih



edilen, başarılı sonuçları sergileyen ve ıslahçılara yön veren, ıslahçıların hızlı ve etkin kararları almalarında etkili olan ana etkiler ve çarpımsal interaksiyonlar analiz modeli kullanılmıştır.

Bu çalışmada, AMMI analiz modeli ile tescil adayı ve bazı tescilli tritikale çeşitlerinin tane verimi üzerindeki genotip çevre interaksiyonunun etkisini tespit etmek, büyük çevre gruplarını tanımlamak, her bir mega veya özel çevre için en iyi genotipi belirlemek ve bu sonuçlar ile Güneydoğu Anadolu Bölgesinde tritikale yetiştiriciliğine kısmi olarak katkı sağlamak temel amacımızı oluşturmuştur.

MATERYAL ve METOT

Materyal

Çalışmada çeşit ve hatları kapsayan toplam 5 adet genotip kullanılmıştır (Bu genotiplerden bazılarının çalışmanın yapıldığı dönemde tescil süreçleri devam ettiği için tüm genotipler kodlanarak verilmiştir).

Çalışma, 2010-2011 sezonunda Diyarbakır/Merkez, Diyarbakır/Hazro, Adıyaman/Merkez ve Mardin/Kızıltepe lokasyonlarında yürütülmüştür (Tablo 1).

Tablo 1. Araştırmanın yürütüldüğü çevrelerin kodları, koordinatları ve yağış miktarları

Çevreler	Yükseklik(m)	Enlem	Boylam	Yıllık yağış(mm)
Diyarbakır/Merkez	670	37° 55' N	40° 14' E	496
Diyarbakır/Hazro	553	37° 88' N	40° 18' E	600
Adıyaman/Merkez	669	37° 76' N	38° 27' E	540
Mardin/Kızıltepe	366	36° 84' N	40° 04' E	396

KAYNAK:meteor.gov.tr.

Bu çalışmada kullanılan her bir lokasyon, Güneydoğu Anadolu Bölgesinin her üç alt bölgesinden birini temsilen kullanılmıştır. Çalışma ve değerlendirme toplam 4 çevre üzerinden yapılmıştır. Çevrelerin özellikleri ve uzun yıllar yağış miktarları Tablo 1' de verilmiştir. Bilindiği gibi ortalama yağış miktarları tane verimi üzerinde çok etkilidir. Uzun yıllar ortalama yağış miktarlarına göre lokasyonlardaki verimin etkilendiği ve değiştiğini söylemek mümkündür.

Yöntem

Denemeler tesadüf blokları deneme deseninde dört tekerrürlü olarak kurulmuştur. Deneme parselleri $1.2 \times 6 = 7.2 \text{ m}^2$ olacak şekilde ekim ayında deneme mibzeri ile ekilmiştir. Ekimle birlikte, dekara 6 kg saf P_2O_5 ve 6 kg saf N, Ayrıca 6 kg saf N/da bahar gübresi olarak kardeşlemenin sonuna doğru uygulanmıştır. Ayrıca, geniş yapraklı yabancı otlara karşı kimyasal mücadele yapılmıştır. Gelişme döneminde parselin her iki kenarından 0.5 m kenar tesiri olarak bırakılmış ve parseller 6 m^2 üzerinden parsel biçerdöveri ile hasat edilmiştir.

Toplam 4 çevreden elde edilen ve 5 genotipe ait tane verimini kapsayan veriler AMMI biplot analizleri ile değerlendirilmiştir (Gauch 1988). İstatistik analizleri JMP 5.0 ve Gen Stat Release 14.1 (Copyright 2011, VSN International Ltd.) paket programları kullanılarak yapılmıştır.



3.BULGULAR VE TARTIŞMA

3.1.AMMI Analiz Modeli

Güneydoğu Anadolu Bölgesinin üç alt bölgesindeki lokasyonlarda 5 çeşit ile yürütülen çalışmadan elde edilen veriler Ana Etkiler ve Çarpımsal İnteraksiyonlar analiz metodu ile değerlendirilmiştir. Bu değerlendirme neticesinde tane verimi bakımından, çevre ve genotip istatiki anlamda % 1, çevre genotip interaksyonu ise % 5' e göre önemli bulunmuş ve kareler ortalaması sırasıyla % 6.1'i genotipten, %91.6'sı çevre ve %2.2'si interaksyondan etkilendiği görülmektedir (Tablo 2, Tablo 3). Çeşitlerin tane verimi daha çok çevrenin etkisinde kaldığı tespit edilmiştir. PCA 1 and PCA 2 eksenlerinde (Temel Bileşenler Analizi) PC1 genotip çevre interaksyonun % 78. 8' ini oluşturduğu ve % 0.01'e göre önemli olduğu saptanmıştır (Table 2).

Tablo 2. Tane verimi üzerinden yapılan AMMI analizine ait varyans analiz sonuçları

Varyasyon Kaynakları	Serbestlik Derecesi	Kareler toplamı	Kareler ortalaması	F Değeri	G+Ç+GÇ KO Oranı(%)	GÇ KO Oranı(%)
Genotipler	4	3347580	836895	5.77**	6.1	
Çevreler	3	37529264	12509755	49.43**	91.6	
Tekerrür	12	3036860	253072	1.74		
İnteraksiyon	12	3648274	304023	2.10*	2.2	
PCA1 İnt.	6	2792368	465395	3.21*		78.8
PCA2 İnt.	4	499858	124965	0.86öd		21.2
Uygulama	19	44525117	2343427	16.15		
Hata	48	6964519	145094			
Toplam	79	54526497	690209			

G:Genotip, Ç:Çevre, GÇİ: Genotip Çevre İnteraksyonu, KO: Kareler Ortalaması, **,P=0.01,*,P=0.05, ÖD; Önemi Değil

Tablo 3. Lokasyonlara ait varyans analiz tablosu ve kareler ortalamasına ait değerler ve genotiplerin önemlilik durumları

Kaynaklar	Serbestlik Derecesi	Diyarbakır Merkez	Diyarbakır Hazro	Adıyaman Merkez	Mardin Kızıltepe
Çeşit	4	7557.25*	2830.23öd	5527.03*	1575.13*
Tekerrür	3	2872.55	2690.7	995.15	3564.47
Hata	12	1072.9	3517.72	867.55	345.59

**,P=0.01.*;P=0.05'e göre önemli

Ana etkiler ve çarpımsal interaksyonlar (AMMI) analizi sonuçlarına göre tane verimi bakımından genotipler arasında önemli farklılıkların olduğunu ve çevrenin diğer varyasyon kaynaklarına göre varyasyonu daha fazla etkilediğini göstermiştir.

AMMI analiz modeli tarafından gösterilen genotip çevre interaksyonu özellikle interaksyonun iki temel bileşen eksen(IPCA 1 ve IPCA 2) arasında bölündüğünde etkisinin ortaya çıktığını bildirilmiştir (Tekdal ve Kendal ve 2018; Yan and Hunt 2001). AMMI analizinin bu modeli genotip çevre etkilerini iki yönlü hesaplamaktadır. Hata kareler ortalamasının sonuçlarına göre TBE 1(temel bileşen eksen) eksen %1.0' e göre önemli bulunmuştur(Tablo 4 ve Tablo 5).



Tablo 4. AMMI analiz sonuçlarına göre genotiplerin ortalamaları ve skorları

Genotipler	Ort. Verim(kg/da)	TBEIç[1]	TBEIç[2]
G1	2973	-4.38742	2.32807
G2	3009	8.46122	-4.56536
G3	2708	-21.91000	4.83963
G4	3005	1.65298	-13.55745
G5	2496	16.18323	10.95512

Ayrıca GGE biplot analiz sonuçları TBE 1 ekseninin kareler ortalamasının % 78.8' ini, TBE 2 nin ise sadece 21.2'sine sahip olduğu, tespit edilmiştir (Tablo 2).

Tablo 5. AMMI analiz sonuçlarına göre çevrelerin ortalamaları ve skorları

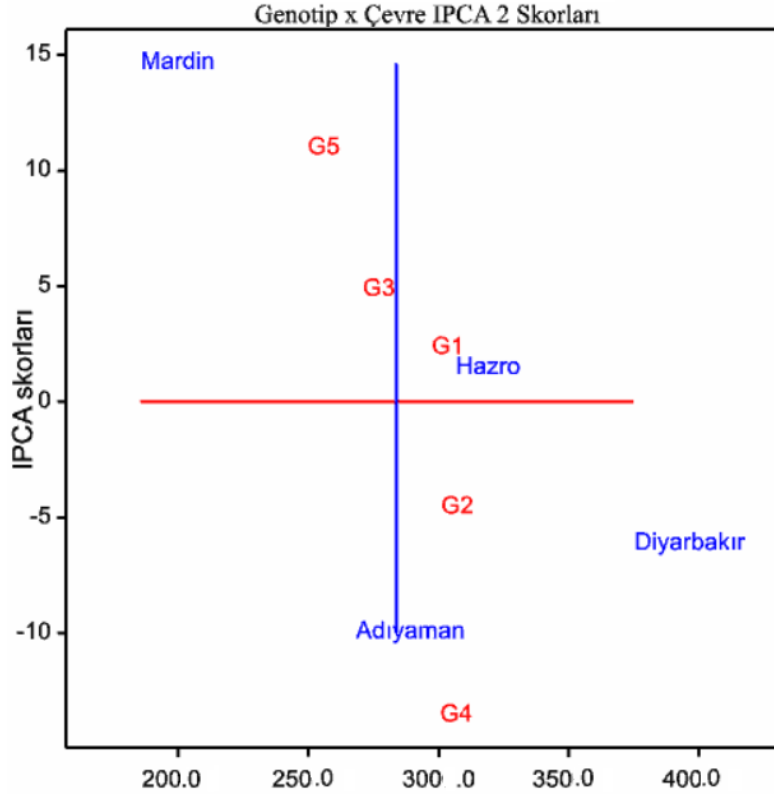
Çevreler	Ort. Verim(kg/da)	Varyans	TBEIç[1]	TBEIç[2]
Diyarbakır (Merkez)	3751	272218	-22.01899	-6.13858
Diyarbakır (Hazro)	3065	324240	15.07604	1.45660
Adıyaman/Merkez	2682	186864	10.51753	-9.96224
Mardin(Kızıltepe)	1855	111268	-3.57458	14.64422

AMMI modeli üç çevreden elde edilen ve beş çeşide ait tane verimi değerlerini 2 adet temel bileşen eksenini üzerinden değerlendirmiş ve her bir bileşen ekseninin interaksiyona olan etkisini ortaya çıkarmıştır. Analiz sonuçlarına göre TBE 1 kareler ortalamasının % 78.8'i. TBA2 % 21.2'si oranında toplam varyasyonda interaksiyon üzerinde etkili olduğu ve sadece TBE 1 % 1' e göre önemli iken TBE 2 ekseninin önemsiz olduğu tespit edilmiştir(Tablo 2). Gauch and Zobel (1996). AMMI modeli her iki temel bileşen ekseninin ya da daha fazlasının birlikte değerlendirebilen ve her birinin genotip çevre interaksiyonunu ne kadar etkilediğini oranlar ile ortaya koyan çok doğru bir model olduğunu bildirmektedir. Genotiplerin temel bileşen eksen değerlerinden (TBEIç[1]. değeri yüksek “+”pozitif değere. TBEIç[2] düşük pozitif değere sahip ise bu genotiplerin tüm çevrelerde o derecede stabil olduğunu aynı şekilde çevrelerin (TBEIç[1]. değeri yüksek “+”pozitif değere. TBEIç[2] düşük pozitif değere sahip ise o derece elverişli olduğunu göstermektedir(Tablo 4. Tablo 5). Çok yönlü analiz modeli genellikle AMMI analiz modeli ile değerlendirilmektedir (Carbonell ve ark.. 2004).

AMMI analizinde görsel olarak şekil üzerindeki x-ekseni çeşitlerin ve çevrenin temel etkisini. y-ekseni ise interaksiyonu açıklamaktadır (Şekil 1). Çevre ve genotipler hem temel etki hem de interaksiyon bakımından çok değişkenlik göstermişlerdir. AMMI görselinde; tüm çevrelerin ortalama tane verimleri üzerinden yapılan değerlendirmede G1, G2 ve G4 dört çevredeki tane verim ortalamasından daha yüksek, G3 ve G5 daha düşük verime sahip olmuşlardır. Ayrıca Heysel G1 (TBEIç(2)= 2.32807) tüm çevrelerin ortalamasına göre stabilite çizgisine (b değerine) yakın olduğundan dolayı ortalama verimi geçen diğer çeşitlere göre daha stabil olduğu tespit edilmiştir(Tablo 4). Sonuçlar G2 genotipinin diğer genotiplere göre yüksek verimli, G1 genotipi ise hem stabil hem de yüksek verimli olduğunu göstermektedir (Şekil 1).



Diğer taraftan AMMI görseline göre 2010-11 yetiştirme sezonunda Mardin ve Adıyaman lokasyonları ortalama verimin altında, aynı yetiştirme sezonunda Adıyaman loDiyarbakır merkez ve Hazro kasyonları ise ortalama tane veriminden daha yüksek verime sahip olmuşlardır(Şekil 1. Tablo 5. Tablo 6).



Şekil 1. Üç çevreye ait verilerden oluşturulan AMMI biplot grafiği

Mirosavlievic ve ark.. (2014), e göre düşük TBEİ 2 değerlerine sahip çeşitler daha stabil, Becker and Leon (1988)' e göre stabilitenin temel istatistik konsepti tüm çevrelerde stabil çeşitlerin minimum varyasyonunu göstermektedir. Yüksek verime sahip genotipler dinamik stabiliteyi temsil etmekte ve ticari bitki ıslahında kullanılmaktadır (Flores ve ark., 1998). G1 genotipi yüksek verim ve düşük TBEİ 2 değerlerine sahip olduğu tespit edilmiştir. Benzer sonuçlar; Kendal ve ark. (2016) tarafından da tespit edilmiştir.

Tablo 6. Genotiplerin 4 çevredeki ve ortalama tane verimi sonuçları(kg/da)

Genotipler	Diyarbakır (Merkez)	Diyarbakır (Hazro)	Adıyaman (Merkez)	Mardin (Kızıltepe)	Ortalama
G1	394.1 a	306.4	280.9 a	207.8 a	297.3 AB
G2	371.4 a	322.0	310.2 a	200.0 ab	300.9 A
G3	408.4 a	263.9	225.0 b	186.0 ac	270.8 BC
G4	400.4 a	334.3	291.2 a	176.3 bc	300.5 A
G5	301.4 b	306.1	233.5 b	157.5 c	249.6 C
Ortalama	375.1 A	306.5 B	268.1 C	185.5 D	
DK(%)	8.73	18.34	10.98	10.02	13.42
AÖF(0.5)	50.46	91.37	45.37	28.64	



AMMI analizi sonuçlarına göre her çevre için sırasıyla önerilebilecek ilk dört genotipin sıralaması Tablo 7’ de verilmiştir. Bu analiz sonucunda her çevre için tercih edilecek ilk iki genotip bakımından farklılık göstermiştir. Diyarbakır merkez için; G3 ve G1, Hazro lokasyonu için G2 ve G4, Adıyaman lokasyonu için G4 ve G2, Mardin Merkez için ise G1 ve G2 genotiplerin ilk iki sırada tercih edilmesi gereken genotiplerdir. Bu anlamda özellikle G5 genotipi geri planda kalmışlardır (Tablo 7). Ayrıca AMMI analizinin Tablo 7’ deki sonuçlarına bakılarak her çevre veya birden fazla çevre için ilk veya ikinci derecede yüksek verim veren ve stabil olan genotipleri seçmek mümkündür (G1, G2).

Tablo 7. AMMI analizine göre her çevre için tercih edilmesi gereken ilk dört genotip

Çevreler	Ort. Verim (kg/da)	Çevrelerin skorları	1. Genotip	2. Genotip	3. Genotip	4. Genotip
Diyarbakır/Merkez	375.1	-22.02	G3	G1	G4	G2
Diyarbakır/Hazro	306.5	15.08	G2	G4	G1	G5
Adıyaman(Merkez)	268.2	10.52	G4	G2	G1	G5
Mardin/Merkez	185.5	-3.57	G1	G2	G3	G4

Aynı zamanda tüm çevrelere en son önerilecek genotiplerin (G5) de bilinmesi açısından son derece önemlidir. Kendal ve Doğan (2015), birden fazla çevreye en uygun ilk iki sıradaki çeşidi veya çeşit adaylarını tüm çevredeki durumlarını görmek açısından AMMI analizi son derece önemli sonuçları aktarma özelliğine sahip olduğunu bildirmiş olup çalışmamızı desteklemektedirler

SONUÇ

Bu çalışmada geleneksel analiz yöntemlerinden farklı bir analiz yöntemi uygulanmış ve yeni 5 genotipin tane verimi bakımından adaptasyon kabiliyetleri ve stabilite yetenekleri kıyaslanmış ve üstün yönleri ortaya konulmuştur. Yapılan analizlerin sonuçlarında, Hevsel G1 genotipin, çalışmanın yürütüldüğü çevrelerde tane verimi bakımından G2 genotipi hariç diğer 3 genotipten üstün verime sahip olduğu, ayrıca genotipler içerisinde en stabil olduğu dolayısıyla çalışmanın yürütüldüğü çevrelerde tritikale yetiştiriciliği yapan yetiştiricilere rahatlıkla tavsiye edilebileceği sonucuna varılmıştır. Ayrıca çalışmaların çok çevrede yürütüldüğü durumlarda AMMI analiz modeli ile çeşitlerin stabilite durumları incelenebileceği ve bu çalışmanın sonuçları görsel olarak da teyit edilebileceğinden dolayı oldukça faydalı bir model olduğunu göstermiştir.



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