

Latin American

International Conference on
Natural and Applied Sciences-III
Villahermosa, Tabasco, Mexico



Powered by
Arizona State University

Universidad Autónoma de Guadalajara
October 4-6, 2022



PROCEEDING BOOK

EDITORS

Dr. Francisco Espinoza Morales

Dr. Hugo Buenrostro



UNIVERSIDAD JUÁREZ
AUTÓNOMA DE TABASCO

“ESTUDIO EN LA DUDA. ACCIÓN EN LA FE”



LATIN AMERICAN INTERNATIONAL CONFERENCE ON NATURAL AND APPLIED SCIENCES-III



PROCEEDING BOOK

October 4-6, 2022

Villahermosa, Tabasco, Mexico

All rights reserved. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods, without the prior written permission of the publisher, except in the case of brief quotations embodied in critical reviews and certain other noncommercial uses permitted by copyright law.

Institution of Economic Development and Social Research
Publications® (The Licence Number of Publisher:
2014/31220) TURKEY TR: +90 342 606 06 75
USA: +1 631 685 0 853

E mail: iksadyayinevi@gmail.com; www.iksadyayinevi.com

It is responsibility of the author to abide by the publishing ethics rules IKSAD Publications – 2021©
Issued: 06.12.2021

EDITORS

Dr. Francisco Espinoza Morales

Dr. Hugo Buenrostro

ISBN: 978-625-8246-27-8

CONFERENCE ID

LATIN AMERICAN INTERNATIONAL CONFERENCE ON NATURAL AND APPLIED SCIENCES-III

DATE - PLACE

October 4-6, 2022 Villahermosa, Tabasco, Mexico

İKSAD- www.iksad.org.tr

PARTICIPANT ORGANIZATIONS

Universidad Autonoma de Guadalajara UAG,
Universidad Abierta y a Distancia UNAD,
Colombia Universidad Juárez Autónoma de
Tabasco, México

Institute Of Economic Development And Social Research
Violence and Abuse Studies Platform

LANGUAGES

English, Spanish, Turkish, Russian

EVALUATION PROCESS

All applications have undergone a double-blind peer review process

TOTAL NUMBER OF PAPER:66

The number of paper from Turkey: 16

Other Countries:40

PARTICIPANT COUNTRIES:

Türkiye, Mexico, Iraq, USA, Ukraine, Italy, Indonesia,
Azerbaijan, Morocco, Kyrgyz Republic, Egypt,
N. Macedonia, Serbia, Kosovo, Taiwan, India, Pakistan,
Nigeria, Algeria, Greece, Brazil, Georgia, Vietnam, Hungary,
United Arab Emirates, Uzbekistan

ORGANIZING AND SCIENTIFIC COMMITTEES

Dra. Felipa Sánchez Pérez

Universidad Juárez Autónoma de Tabasco, México
Chairman of the conference

Dra. Francisca Silva Hernández

Universidad Juárez Autónoma de Tabasco, México

Dr. Germán Martínez Prats

Universidad Juárez Autónoma de Tabasco, México

Dr. Jose Alberto Del Rivero Del Rivero

Universidad Juárez Autónoma de Tabasco, México

Dr. Rafael Ricardo Renteria Ramos

Universidad Abierta y a Distancia UNAD, Colombia

Dr. Ragif Huseynov

Managing Director of Khazar Educational Center, Azerbaijan

Dr. Raiba Jafarova

Associate Professor of Azerbaijan State Agricultural University, Azerbaijan

Dr. Resmiye Abdullayeva

Associate Professor of Institute of Economics, Azerbaijan

Dr. Maral Jamalova

Assistant Professor of Azerbaijan State University of Economics, Azerbaijan

Bunyamin Seyidov

PhD student of Institute of Philosophy and Sociology, Azerbaijan

PHOTO

























Zoom Toplantı - Hall-4

Hall-4, Dr. Ivan Paolovic, Kadir Ocaklar, Kadir Ocaklar

Kalın: 09:43:59 Görünüm

Katılımcılar (15)

Katılımcı listesi:

- L. (Ortal oturma sahibi ben)
- Hall-4, Dr. Ivan Paolovic
- Külm Ulu - Hall 4
- Aniekan Essienubong Ipe
- Awadhesh Prasad Hall 4
- Awadhesh Prasad, Hall 4
- Batool, Hall 4 (Presenter)
- Dr. Hussein Altan
- edith sánchez gonzalez
- Fouad Mohammad
- Hala Fouad Kayim Farwan
- Hall 4 - DIANA BLAZHEKOVICL

2 Zaten katılmış katılımcı

Yeni Katılımcı

Videoyu Başlat

Katılımcılar

Sohbet

Ekran Paylaşımı

Arayışlar

Uygulamalar

Beşer Tahtaları

Daha Fazla

Ödülleri Aç

Tümünü Sesize Al

Veriden Oturma Sahibi Ol

Zoom Toplantı - Hall-4

Zoom Toplantı - Hall-4

Fouad Mohammad, Kadir Ocaklar, Kadir Ocaklar

Kalın: 09:26:46 Görünüm

Katılımcılar (16)

Katılımcı listesi:

- admin
- Aniekan Essienubong Ipe
- Awadhesh Prasad Hall 4
- Awadhesh Prasad, Hall 4
- Batool, Hall 4 (Presenter)
- Dr. Hussein Altan
- edith sánchez gonzalez
- Hala Fouad Kayim Farwan
- Hall 4 - DIANA BLAZHEKOVICL
- Hall-4 Soemant Tiwari
- Hall-4, Kadir Ocaklar
- Tony Santamaria

Methods

- We used PRISMA and meta-analysis on the indices of acute poisoning (death, signs of poisoning and toxicity score) of organophosphate or carbamate insecticides in laboratory animals.
- The studies were identified after data search, and then they were included in the meta-analysis.

Aniekan Essienubong Ipe

Kadir Ocaklar

Fouad Mohammad

Awadhesh Prasad Hall 4

Yeni Katılımcı

Videoyu Başlat

Katılımcılar

Sohbet

Ekran Paylaşımı

Arayışlar

Uygulamalar

Beşer Tahtaları

Daha Fazla

Ödülleri Aç

Tümünü Sesize Al

Veriden Oturma Sahibi Ol

Zoom Toplantı - Hall-4

Zoom Toplantı - Hall-4

Kalan: 09:33:29 Görüntüle

Katılımcılar (14)

Katılımcı bul

- L (Ortak oturum sahib(ler) beri)
- Fouad Mohammad
- Hall-4, Kadir Ocalan
- Hall-4, Dr. Ivan Pavlovic
- Kujtim Uka - Hall 4
- admin
- admin
- Awadhesh Prasad Hall 4
- Awadhesh Prasad, Hall4
- Batool, Hall 4 (Presenter)
- Dr. Hussein Alkari
- Hall 4 - DIJANA...
- Halk Fouad Kasim Paswan

Videoyu Başlat, Katılımcılar, Sohbet, Ekran Paylaşımı, Reaksiyonlar, Uygulamalar, Beyaz Tahtalar, Daha fazla, Oturumdan Çık

Tümünü Gösterme Aç, Yeniden Oturum Sahibi Ol

Zoom Toplantı - Hall-4

Kujtim Uka - Hall 4 Aktarımı görüntülenmektedir. Seçenekleri Görüntüle

Kalan: 09:17:39 Görüntüle

Polycyclic aromatic hydrocarbons (PAHs) are associated with risks to human health, especially carcinogenesis. One form of exposure to these compounds is through ingestion of smoked fish, which can occur during fish processing, involving high temperatures. Smoking is one of the oldest methods of fish preservation, since smoke contains bactericidal and antioxidant properties.

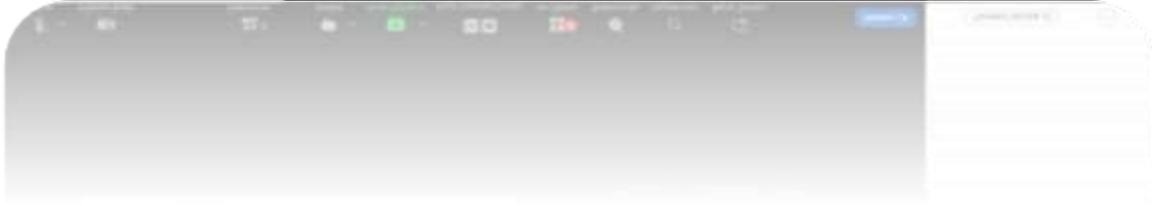
Hall-4, Dr. Ivan Pavlovic

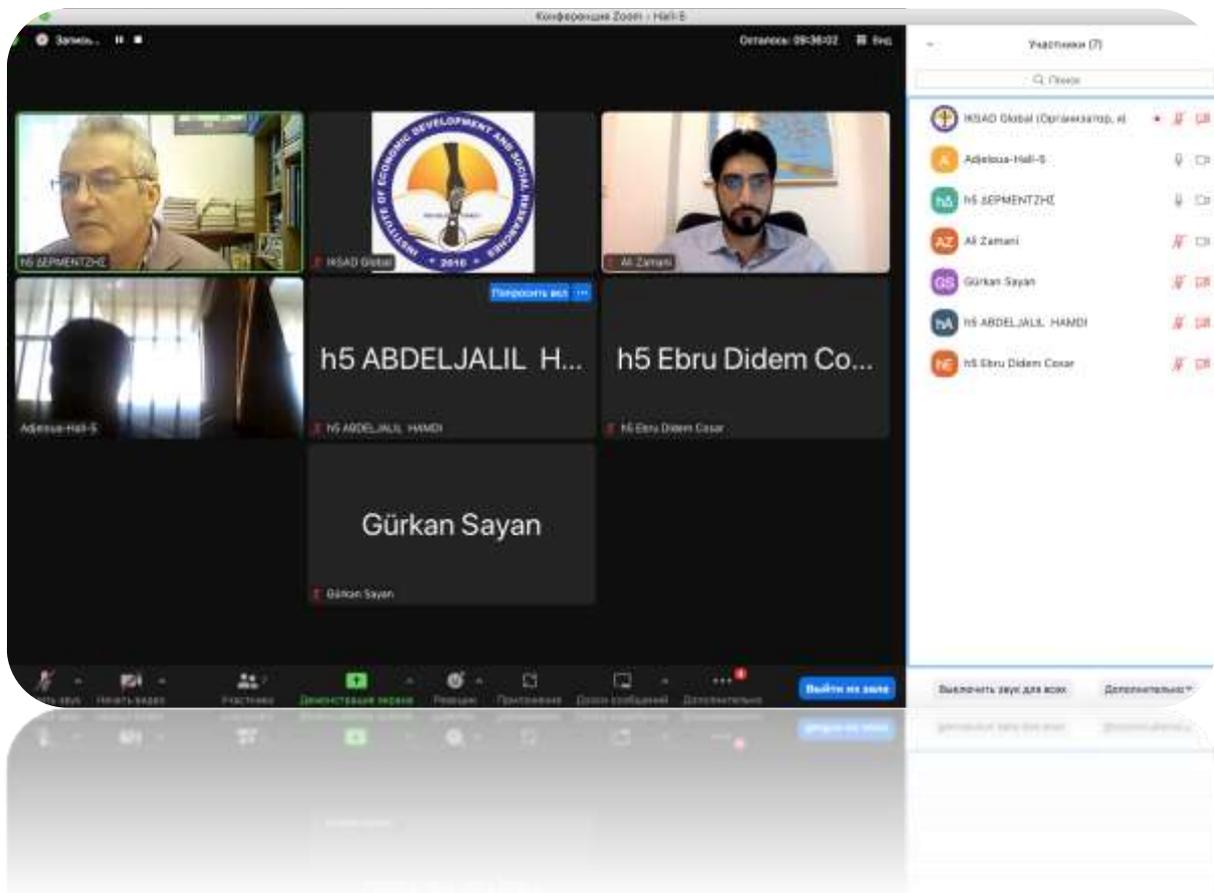
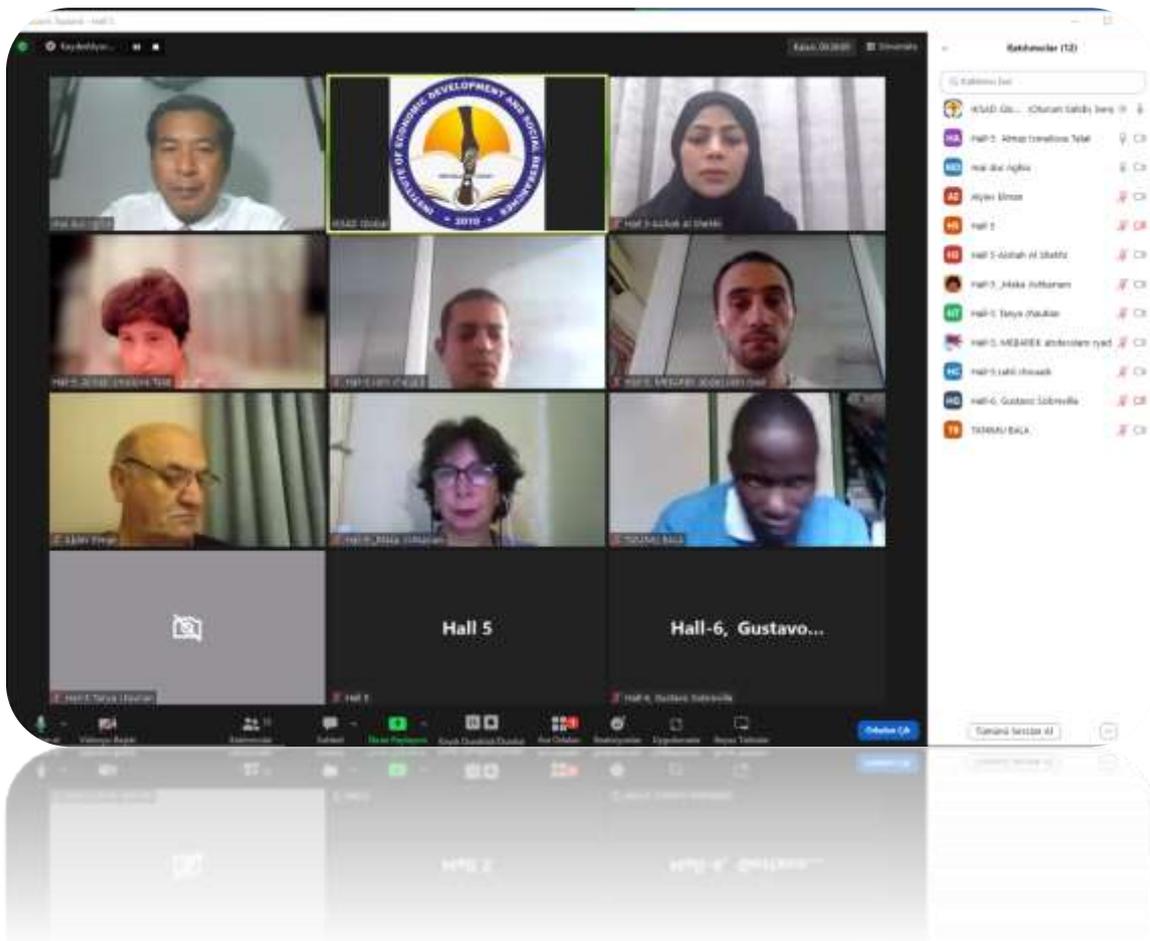
IKSAD Global

Kujtim Uka - Hall 4

Hall-4, Kadir Ocalan

Sesi Aç, Videoyu Başlat, Katılımcılar, Sohbet, Ekran Paylaşımı, Reaksiyonlar, Uygulamalar, Beyaz Tahtalar, Daha fazla, Oturumdan Çık





09:18:55

Synthesis of Phosphazene-based Plasticizers and the Effects of Synthesized Plasticizers on The Properties of Poly(Lactic Acid) Films

Gürkan Sayan*, Prof. Dr. Ayşe Aytaç
 Department of Polymer Science and Technology, Kocaeli University, Turkey
 Chemical Engineering Department, Kocaeli University, Turkey

MS DERMENTZIS
 MSAD GISSIS
 Ali Zamani
 Gürkan Sayan
 h5 ABDELJALI...
 MS ABDELJALI - HAMD...
 h5 Ebru Didem...
 h5 Ebru Didem Coşar

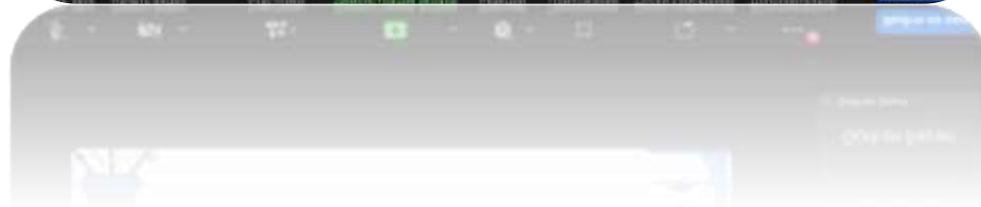


09:34:52

Removal of Sulfide and COD from Petroleum Wastewater Using Electrochemical Methods

Ali Zamani
 Konstantinos Dermentzis
 International Hellenic University
 Department of Chemistry
 Kavala, Greece

MS DERMENTZIS
 MSAD GISSIS
 Ali Zamani
 MS ABDELJALI - HAMD...
 h5 Ebru Didem...
 MS Ebru Didem Coşar
 Gürkan Sayan
 Gürkan Sayan



Oct 20, 2023 09:28:58

Electrocoagulation Reactor

h5 ABDELJALI...
h5 ABDELJALI HAMDI
h5 Ebru Didem...
h5 Ebru Didem Cozar
Gürkan Sayan
Gürkan Sayan

Katılmalar (7)

- L... (Ortak oturum sahibi, beş)
- Hali-4 moderator, Ömer Saltuk
- Hali-4 Burak Uyar
- Hali-4-Efe ARIVOL
- Hali-4 ASGÜRÜ REDUK
- Hali-4 Hıncın İvenc
- Hali-4 İbrahim Ahoğlu

Kalın: 08:18:43 Gözetile

UWG İSKENDERUN TEKNİK ÜNİVERSİTESİ

ANALYSIS AND EVALUATION OF RISKS IN THE CONSTRUCTION SECTOR IN TERMS OF OCCUPATIONAL HEALTH AND SAFETY (OHS)

Asst. Prof. Dr. Ö. Saltuk BÖLÜKBAŞI
Iskenderun Technical University, 31200, Hatay, Turkey
osaltukb@ispu.edu.tr

16.10.2023

Hali-4 ASGÜRÜ REDUK
İKSAD Global
Hali-4 moderator, Ömer Saltuk
Hali-4 Burak Uyar

Tümünü Sesizle Al | Kendini Oturum Sahibi Ol



**LATIN AMERICAN INTERNATIONAL
CONFERENCE ON NATURAL
AND APPLIED SCIENCES-III**



October 4-6, 2022

Villahermosa, Tabasco, Mexico
Universidad Autónoma de Guadalajara

CONFERENCE PROGRAM

Face to face and Online (with ZOOM Conference)

Zoom Meeting ID: 868 6154 8075

Zoom Passcode: 040506



LATIN AMERICAN INTERNATIONAL CONFERENCE ON NATURAL AND APPLIED SCIENCES-III
October 4-6, 2022 Villahermosa, Tabasco, Mexico

IMPORTANT, PLEASE READ CAREFULLY

- To be able to make a meeting online, login via <https://zoom.us/join> site, enter ID instead of "Meeting ID
- or Personal Link Name" and solidify the session.
- The presentation will have **15 minutes** (including questions and answers).
- The Zoom application is free and no need to create an account.
- The Zoom application can be used without registration.
- The application works on tablets, phones and PCs.
- Speakers must be connected to the session **10 minutes before** the presentation time.
- All congress participants can connect live and listen to all sessions.
- During the session, your camera should be turned on at least %70 of session period
- Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

TECHNICAL INFORMATION

- Make sure your computer has a microphone and is working.
- You should be able to use screen sharing feature in Zoom.
- Attendance certificates will be sent to you as pdf at the end of the congress.
- Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

Before you login to Zoom please indicate your name surname and hall number,
exp. Hall-1, Shahla Tahirgizi

ÖNEMLİ, DİKKATLE OKUYUNUZ LÜTFEN

- Kongremizde Yazım Kurallarına uygun gönderilmiş ve bilim kurulundan geçen bildiriler için online (video konferans sistemi üzerinden) sunum imkanı sağlanmıştır.
- Sunumlar için **15 dakika** (soru ve cevaplar dahil) süre ayrılmıştır.
- Online sunum yapabilmek için <https://zoom.us/join> sitesi üzerinden giriş yaparak "Meeting ID or Personal Link Name" yerine ID numarasını girerek oturuma katılabilirsiniz.
- Zoom uygulaması ücretsizdir ve hesap oluşturmaya gerek yoktur.
- Zoom uygulaması kaydolmadan kullanılabilir.
- Uygulama tablet, telefon ve PC'lerde çalışıyor.
- Her oturumdaki sunucular, sunum saatinden **10 dk öncesinde** oturuma bağlanmış olmaları gerekmektedir.
- Tüm kongre katılımcıları canlı bağlanarak tüm oturumları dinleyebilir.
- Moderatör – oturumdaki sunum ve bilimsel tartışma (soru-cevap) kısmından sorumludur.

TEKNİK BİLGİLER

- Bilgisayarınızda mikrofon olduğuna ve çalıştığına emin olun.
- Zoom'da ekran paylaşma özelliğine kullanabilmelisiniz.
- Katılım belgeleri kongre sonunda tarafınıza pdf olarak gönderilecektir
- Kongre programında yer ve saat değişikliği gibi talepler dikkate alınmayacaktır

Zoom'a giriş yaparken önce lütfen adınızı, soyadınızı ve SALON numaranızı yazınız
Örnek: Salon-1, Shahla Tahirgizi

-Opening Ceremony-

04.10.2022

México Local Time: 09³⁰-10⁰⁰

Ankara Local Time: 17³⁰-18⁰⁰

Dr. Mustafa Latif EMEK

President of IKSAD Institute

Mtro Felip Claramonte Candela

*Director General de la Universidad Autónoma de Guadalajara Campus
Tabasco, México*

Dra. Felipa Sánchez Pérez

*Directora de la División Académica de Ciencias Sociales y Humanidades de
la Universidad Juárez Autónoma de Tabasco, México*

M. en C Petrona Gomez Rivera

Secretaria académica de la Universidad Popular de la Chontalpa, México

Dr. Gerardo Arévalo Reyes

Director of CCYTET-Consejo de Ciencia y Tecnología del Estado de Tabasco

LATIN AMERICAN INTERNATIONAL CONFERENCE ON NATURAL AND APPLIED SCIENCES-III
October 4-6, 2022 Villahermosa, Tabasco, Mexico

04.10.2022

Face to Face

Session-1

Hall-1

México Time: 10⁰⁰-12³⁰

Ankara Time: 18⁰⁰-20³⁰

HEAD OF SESSION: Dr. Germán Martínez Prats, Dr. José Guadalupe Chan Quijano, Dr. Carlos Mauricio Tosca Vidal

TOPIC TITLE	AUTHORS	AFFILIATION
CAUSAS DEL DESABASTO DE MEDICAMENTOS ONCOLÓGICOS EN EL IMSS	Luz del Carmen Herrera Cornelio, Aransazú Rivas Avalos, Mariana González Acevedo, Jesús Emiliano García Bautista	Universidad Autónoma de Guadalajara, Mexico
DESCRIPCIÓN DE LOS PARÁSITOS MÁS COMUNES EN EL HOGAR	Ana Sherlyn García Trinidad, Clarissa Fernanda Diaz Jiménez, Monserrat Valenzuela Hernández, Camila Valeria Torruco Narváez	Universidad Autónoma de Guadalajara, Mexico
DESINFORMACIÓN EN EL USO DE MÉTODOS ANTICONCEPTIVOS HORMONALES	Juliana Jazmín Torres Peralta, José Alejandro Jiménez Hernández, Mayra Yuritzí Martínez Barrera, Julissa Carrera García	Universidad Autónoma de Guadalajara, Mexico
EL PEZ DIABLO, ESPECIE INVASORA EN AUMENTO	Miguel Isaac Hernández Martínez, Cesar Enrique Bonilla Gaspar, Diego Enrique González Aparicio, Jorge Arturo Zurita García	Universidad Autónoma de Guadalajara, Mexico
APROVECHAMIENTO DEL RECURSO NATURAL HÍDRICO	Francisca Silva Hernández, Germán Martínez Prats, Candelaria Guzman Fernandez, Tomas Francisco Morales Cardenas	Universidad Juárez Autónoma de Tabasco, Mexico
USO DEL RECURSO NATURAL; AGUA	Francisca Silva Hernández, Germán Martínez Prats, Candelaria Guzman Fernandez, Tomas Francisco Morales Cardenas	Universidad Juárez Autónoma de Tabasco, Mexico
WHAT IS THE IMPACT OF SOIL CONTAMINATION ON AGROBIODIVERSITY?	Mariana Hernández Calzada, Marla Berenice Pérez Bolio, José Elías Torruco Samado, Ivana Rivera Gómez, Dr. José Guadalupe Chan-Quijano,	Universidad Autónoma de Guadalajara, Campus Tabasco;
FERTILITY RECOVERY WITH ORGANIC FERTILIZERS AND TREE SPECIES OF A SOIL CONTAMINATED WITH HYDROCARBONS	Cosme Hiram Andrade García; Cristhian Torres Barredo; German Alejandro Lira Salazar; Mary Jose Chable Aquino; Dr. José Guadalupe Chan-Quijano;	Universidad Autónoma de Guadalajara, Campus Tabasco;
MORPHOLOGICAL DEVELOPMENT OF PROMISING TREE SPECIES FOR THE REMEDIATION OF OIL- CONTAMINATED SOILS	Valeria Callado Nava, Wilbert Hernández Domínguez, Zully Vanessa Hernández López, Janeth Isabella Martínez Ochoa, Dr. José Guadalupe Chan-Quijano,	Universidad Autónoma de Guadalajara, Campus Tabasco;
ENERGIAS RENOVABLES EN TABASCO	Darinka Alejandra Fernandez Magaña - Maria Fernanda Camacho Perez - Johan Sebastian Cerino Madrigal	Universidad Autónoma de Guadalajara
USO DE PLAGUICIDAS EN TRABAJADORES AGRÍCOLAS DE LA SUBREGIÓN CHONTALPA	Dra Damianys Almenares López Dra. Edelia Caudina Villarreal Ibarra	Universidad Juárez Autónoma De Tabasco

LATIN AMERICAN INTERNATIONAL CONFERENCE ON NATURAL AND APPLIED SCIENCES-III
October 4-6, 2022 Villahermosa, Tabasco, Mexico

04.10.2022

Online / Hall-4

México Time: 10⁰⁰-12⁰⁰

Ankara Time: 18⁰⁰-20⁰⁰

HEAD OF SESSION: Wei Chen and Rodolfo Reda

TOPIC TITLE	AUTHORS	AFFILIATION
EVIDENCE-BASED CARE OF CHRONIC OBSTRUCTIVE LUNG DISEASE AT HOME	Fikriye Ceyda PARLAK, Hamdiye ARDA SÜRÜCÜ	Dicle Üniversitesi, Türkiye
THE RELATIONSHIP BETWEEN FALLS IN THE ELDERLY, HOME CARE SERVICES AND NURSING APPROACHES	Hamdiye ARDA SÜRÜCÜ, Meltem SUNGUR	Dicle Üniversitesi, Kilis 7 Aralık Üniversitesi, Türkiye
IMPACT OF SMOKING AMONG HYPERTENSIVE PATIENTS TREATED WITH BETA-BLOCKER DRUGS: A REVIEW	Hala F. Kasim	University of Mosul, Nineveh, Iraq
NEW GENERATION OF SENSITIZERS FOR PHOTODYNAMIC THERAPY – DEEPER AND BETTER	Wei Chen	The University of Texas at Arlington, Arlington, Texas, USA
EARLY POSTOPERATIVE CHANGES OF PRIMARY HEMOSTASIS: PERITONEAL ADHESIONS	Artem Savchuk	Bukovinian State Medical University, Ukraine
SURGICAL-ANATOMICAL EVALUATION OF MANDIBULAR PREMOLARS BY CBCT AMONG THE ITALIAN POPULATION	Rodolfo Reda, Alessio Zanza, Dario Di Nardo, Maurilio D' Angelo, Luca Testarelli	University of Rome La Sapienza, Rome, Italy
EATING HABITS OF INDIVIDUALS WITH CYCLIC MASTALGIA: A CASE CONTROLLED STUDY	Pinar Erdoğan, Alirza Erdoğan	Niğde Ömer Halisdemir University, Türkiye
CO-INFECTION OF ESCHERICHIA COLI PATHOTYPES WITH INTESTINAL PARASITES AMONG CHILDREN LESS THAN FIVE YEARS IN DUHOK CITY, IRAQ	Haveen Khalid Hasan, Souzan Hussain Eassa, Najim Abdalla Yaseen	University of Polytechnique, Duhok, Kurdistan Region, Iraq; University of Duhok,; University Kurdistan Hewler, Erbil, Kurdistan Region, Iraq.
BIOACTIVITY SCREENING OF BACTERIAL COMMUNITIES ASSOCIATED WITH THE OCTOCORAL GORGONIAN <i>Plexaura</i> sp.: ANTIPATHOGENIC ACTIVITY AGAINST NOSOCOMIAL PATHOGEN <i>Acinetobacter baumannii</i>	Stefanie J.H. LARASATI, Ocky Karna RADJASA, Agus TRIANTO, Rizky WULANDARI, Agus SABDONO	Diponegoro University, Semarang; The National Research and Innovation Agency, Jakarta, Indonesia
ASSOCIATION OF RENAL TUBULAR INJURY BIOMARKER, MARKERS OF CHRONIC INFLAMMATION, AND ENDOTHELIAL DYSFUNCTION WITH CKD	Shalala Ismayilova, Irada Mammadova , Afeţ Nesibli , Fidan Ahadova	Azerbaijan Medical University, Azerbaijan
PREDICTIVE SERUM BIOMARKERS OF CARDIOVASCULAR DISEASE IN PATIENTS WITH CKD	Manzar Novruzova, Samira Muradova, Shafag Ibrahimova, Natavan Huseynova Shalala Ismayilova	Azerbaijan Medical University, Azerbaijan

LATIN AMERICAN INTERNATIONAL CONFERENCE ON NATURAL AND APPLIED SCIENCES-III
October 4-6, 2022 Villahermosa, Tabasco, Mexico

04.10.2022

Online / Hall-5

México Time: 10⁰⁰-12⁰⁰

Ankara Time: 18⁰⁰-20⁰⁰

HEAD OF SESSION: Ayse Gul Ince and Banu Karaşah

TOPIC TITLE	AUTHORS	AFFILIATION
NEXT GENERATION PHENOTYPING METHODS FOR CONSERVATION OF BIODIVERSITY AND GENETIC RESOURCES	Ayşe Gul Ince, Mehmet Karaca	Akdeniz University, Antalya, Türkiye
SYSTEMS AND TECHNIQUES FOR SUSTAINABLE AGRICULTURE	Ayşe Gul Ince, Mehmet Karaca	Akdeniz University, Antalya, Türkiye
FIRST REPORT OF DODDER (CUSCUTA SPP.) PARASITIZING CUCUMBER, OKRA, ALFALFA AND BASIL IN IRAQ	Bashar K. H. Al-Gburi Saba A.K. Al-Falooji	University of Kufa, Najaf, Iraq
EFFECT OF THE CONDITIONS OF CULTURE ON THE GERMINATION AND THE GROWTH OF THE ARGAN TREE (ARGANIA SPINOSA (L.) SKEELS)	EL QADMI, I., ZIRI, R ., AKHRIF, F., ABID, N ., BRHADDA, N.	Ibn Tofail University, Morocco
MILK WHEY, PROPERTIES AND APPLICATIONS	Altynai Saalieva, Aigul Usubalieva, Aynagul Sabirbekova	Kyrgyz State Technical University named after I. Razzakov, Kyrgyz-Turkish Manas University, Kyrgyz Republic
UTILIZATION AND IMPORTANCE OF HONEYBEE PRODUCTS	Bardha Ibishi, Amr Ahmed Elsayed, Zekai Aydın, Vesna Karapetkovska - Hristova,	Zagazig University, Egypt, Eskisehir Provincial Directorate of Disaster and Emergency (AFAD), Turkey, University "St. Kliment Ohridski", N. Macedonia
SCIENTIFIC AND EDUCATIONAL ROLE OF BOTANICAL GARDENS: EXAMPLES FROM TÜRKİYE AND THE WORLD	Banu Karaşah, Emine Tarakci Eren, Derya Sarı, Hilal Surat	Artvin Çoruh University, Artvin, Türkiye
A RESEARCH ON ENVIRONMENTAL SATISFACTION MEASUREMENT IN SHORE PARKS; CASE OF FINDIKLI ATATURK PARK, RİZE	Emine Tarakci Eren, Banu Karaşah, Hilal Surat, Derya Sarı	Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi, ARTVİN,
FABRICATION OF ECO-FRIENDLY BLENDED YARNS FOR CLOTHING	Munevver Ertek Avcı, Gamze Okyay, Hilal Bilgiç	Malatya Turgut Ozal University, Malatya, Turkey;

LATIN AMERICAN INTERNATIONAL CONFERENCE ON NATURAL AND APPLIED SCIENCES-III
October 4-6, 2022 Villahermosa, Tabasco, Mexico

05.10.2022

Online / Hall-4

México Time: 10⁰⁰-12⁰⁰

Ankara Time: 18⁰⁰-20⁰⁰

HEAD OF SESSION: Kadir Ocalan and Ivan Pavlović

TOPIC TITLE	AUTHORS	AFFILIATION
CONTAMINATION OF PUBLIC PLACES AT CENTRAL BELGRADE MUNICIPALITIES WITH DOGS PARASITES DURING 2021	Ivan Pavlović	Scientific Institute of Veterinary Medicine of Serbia, Belgrade, Serbia
A META-ANALYSIS ON ANTIDOTAL EFFECTS OF DIPHENHYDRAMINE AGAINST ORGANOPHOSPHATE AND CARBAMATE INSECTICIDES POISONING IN LABORATORY ANIMALS	Fouad K. Mohammad , Ammar A. Mohammed, Hussein M. Rashid, Hishyar M. S. Garmavy,	University of Mosul, Iraq; University of Duhok, Duhok, Kurdistan Region, Iraq
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SMOKED FISH AND HUMAN HEALTH RISK ASSESSMENT	Kujtim Uka, Dijana Blazhekovikj - Dimovska Mentor Ismaili Vlora Zogejani Ariana Kadriu	Kosovo Food and Veterinary Agency, University "St. Kliment Ohridski", Faculty of Biotechnical Sciences, "Partizanska" b.b., Bitola, N. Macedonia, University "Hasan Prishtina", Prishtina, Kosovo,
IN VITRO CHEMOSENSITIVITY OF A CANINE TUMOR VENEREAL TRANSMISSIBLE CANCER CELL LINE	Edson Antonio Santamaría-Martínez, Moisés Armides Franco Molina, Paola Leonor García Coronado, Silvia Elena Santana Krimskaya, Diana Ginette Zarate-Triviño, Natanael Palacios Estrada, Cristina Rodríguez Padilla, Yareellys Ramos Zayas, Jorge R. Kawas, Heriberto Prado García	Universidad Autónoma de Nuevo León, San Nicolás de los Garza, NL, Instituto Nacional de Enfermedades Respiratorias, Ciudad de Mexico, Mexico
UNSUPERVISED MACHINE LEARNING: METHODS AND IMPLICATIONS FOR NETWORKING	Seemant Tiwari	Southern Taiwan University of Science and Technology, Taiwan
AN ANALYTICAL APPROACH TO ACOUSTOELECTRIC EFFECT IN SOLID STATE DEVICES AND MATERIALS	Awadhesh Prasad	Veer Kunwar Singh University, India
A PHENOMENOLOGICAL STUDY OF DRELL-YAN $\Phi^*\eta$ DISTRIBUTION OVER A WIDE MASS REGION THROUGH NNLO+N ³ LL ACCURACY	Kadir Ocalan	Necmettin Erbakan University, Konya, Türkiye
COMPUTATIONAL STUDY ON WIND FIELD DOMAIN AT DISTINCT WIND VELOCITY MAGNITUDES ACROSS HORIZONTAL AXIS WIND TURBINE FOR ESTIMATION OF POWER OUTPUT	Aniekan Essienubong Ikpe, Victor Etok Udoh, Emem Okon Ikpe	Akwa Ibom State Polytechnic, Ikot Osurua
INTERPERSONAL DIFFICULTIES IN MIGRAINE PATIENTS: PREDICTING RISK FACTORS	Zahra Batool, Rabia Khadim	University of Management & Technology (UMT), Lahore, Pakistan

05.10.2022

Online / Hall-5

México Time: 10⁰⁰-12⁰⁰

Ankara Time: 18⁰⁰-20⁰⁰

HEAD OF SESSION: Konstantinos Dermentzis and Ayse Aytac

TOPIC TITLE	AUTHORS	AFFILIATION
REMOVAL OF BPA BY ADSORPTION BY USING ORGANOCCLAYS AND BIO-ADSORBENT	BEN JADDI Mountassira, AHARI M Hamed	Abdelmalek Essaadi University, Al Hoceima, Morocco
EFFECT OF POLLUTANT PARTICLES ON PIPE EROSION: A NUMERICAL STUDY	A. Adjeloua B. Derrar H. Lebbal N. Boualem	University Oran Mohamed Boudiaf, Oran, Algeria
CERAMIC COBALT-CONTAINING PIGMENTS BASED ON WILLEMITE	Alimdjanova D.I. Babakhanova Z.A	Tashkent Institute of Chemical Technology, Uzbekistan
REMOVAL OF SULFIDE AND COD FROM PETROLEUM WASTEWATER USING ELECTROCHEMICAL METHODS	Ali Zamani Konstantinos Dermentzis	International Hellenic University, Kavala, Greece
SYNTHESIS OF PHOSPHAZENE-BASED PLASTICIZERS AND THE EFFECTS OF SYNTHESIZED PLASTICIZERS ON THE PROPERTIES OF POLY(LACTIC ACID) FILMS	Gurkan Sayan Ayse Aytac	Kocaeli University, Kocaeli, Türkiye
SYNTHESIS, CHARACTERIZATION AND COMPARATIVE STUDY OF NEW 2-PHENYLIMIDAZO[1,2-A]PYRIDINE-3-CARBALDEHYDE DERIVATIVES	ABDELJALIL HAMDI Mhamed AHARI M. KOUDAD Hassan AMHAMDI A.EL AATIOUI M. Azzouzi	Abdelmalek Essaadi University, Tetouan, Morocco.
DESIGN, SYNTHESIS, AND IN VITRO PHARMACOLOGICAL EVALUATION OF BISTRIFLUOROMETHYL-DERIVED HYDRAZIDE-HYDRAZONES AS ACETYLCHOLINESTERASE INHIBITORS	Ebru Didem Cosar Efe Doğukan Dincel Tülay Kayra İlhami Gülçin Nuray Ulusoy-Güzeldemirci	Istanbul University, Bezmialem Vakif University, Atatürk University, Türkiye

06.10.2022

Online / Hall-4

México Time: 10⁰⁰-12⁰⁰

Ankara Time: 18⁰⁰-20⁰⁰

HEAD OF SESSION: Ömer Saltuk BÖLÜKBAŞI

TOPIC TITLE	AUTHORS	AFFILIATION
INVESTIGACIÓN DE LOS PARÁMETROS DE FABRICACIÓN DE LOS MATERIALES COMPUESTOS MEDIANTE EL PROCESO DE TRANSFERENCIA DE RESINA (RTM)	Ahmed Ouezgan, Said Adima, Aziz Maziri El Hassan Mallil , Jamal Echaabi	Hassan II University of Casablanca, Morocco.
SPECIFIC ENERGY CONSUMPTION IN REVERSE OSMOSIS UNIT TO TREAT OLIVE MILL WASTEWATER	Reda Askouri, Mohamed Moussetad, Hassan Hannache, Hamdane Hasna,	University Hassan II, Morocco
DETERMINATION OF THE EFFECTS OF CARROT METHYL ESTER ON THE PERFORMANCE OF A CI ENGINE	Hanbey Hazar, Burkay Uyar, Huseyin Sevinc	Firat University, Elazig, Türkiye.
INVESTIGATION OF THE EFFECTS OF ALMOND BIODIESEL ON THE ATTRIBUTES OF A DIESEL ENGINE	Hanbey Hazar, Burkay Uyar, Huseyin Sevinc	Firat University, Elazig, Türkiye.
ANALYSIS AND EVALUATION OF RISKS IN THE CONSTRUCTION SECTOR IN TERMS OF OCCUPATIONAL HEALTH AND SAFETY (OHS)	Ömer Saltuk BÖLÜKBAŞI	Iskenderun Technical University, Türkiye
THE PROBLEMS CAUSED BY COPPER CONTAINING MATERIALS IN IRON AND STEEL PRODUCTION	Ömer Saltuk BÖLÜKBAŞI Efe ARIYOL	Iskenderun Technical University, Türkiye
TO PREVENT WASTE BY USING 5NEDEN, 5S, KANBAN, ANDON FROM LEAN MANAGEMENT TOOLS IN THE FIELD OF HEALTH	Nihal ALOĞLU, İbrahim Sani MERT,	Kahramanmaraş Sütçü İmam Üniversitesi, Antalya Bilim Üniversitesi, Türkiye
ENERGY PLANS TECHNIQUE FOR OROFACIAL PAIN MANAGEMENT	Maria da Luz Rosario de Sousa; Maria Lúcia Bressiani Gil	Universidade Estadual de Campinas
THE INFLUENCE OF MATHEMATICAL REASONING ON PROBLEM SOLVING SKILLS AND COMPETENCE IN CRITICAL THINKING AMONG SECONDARY SCHOOL STUDENTS	Surajo Isa Gaya, Tanimu Bala	Kano University of Science and Technology, Wudil.

LATIN AMERICAN INTERNATIONAL CONFERENCE ON NATURAL AND APPLIED SCIENCES-III
October 4-6, 2022 Villahermosa, Tabasco, Mexico

06.10.2022

Online / Hall-5

México Time: 10⁰⁰-12⁰⁰

Ankara Time: 18⁰⁰-20⁰⁰

HEAD OF SESSION: Almaz Ismailova Talat

TOPIC TITLE	AUTHORS	AFFILIATION
DIFFERENT TYPES OF ENERGY COMPANY'S ROLE IN GEORGIAN POWER ENGINEERING	Maka Jishkariani, Maya Pitskhelauri	Georgian Technical University, Georgia
A STUDY ON THE INFLUENCE OF THE ROTATING PROPELLER ARRANGES ON THE WING OF AN AIRPLANE ON THE LIFT COEFFICIENT OF AN AIRPLANE MODEL USING SOLAR ENERGY	Pham Dinh Trung Mai Duc Nghia	Faculty of Information Technology, Yersin University, Da Lat, Vietnam
USE OF ZR-PILLARED CLAYS FOR PHOSPHATE REMOVAL FROM WATER	Tanya Chauhan Zoltán Németh	University of Miskolc, Hungary
THE EFFECT OF SMART GRID APPLICATIONS ON SECURITY IN NATURAL GAS OPERATIONS	Hamza Yetik Bahadır Furkan KINACI İsa AVCI, Cevat ÖZARPA	Karabuk University, Türkiye
PREVENTIVE MAINTENANCE USING RECYCLED ASPHALT	Aishah H.O. Al Shehhi Gul Ahmed Jokhio Abid Abu-Tair	The British University in Dubai, United Arab Emirates
ISSUES OF GEODYNAMICS OF THE EARTH'S CRUST STRUCTURE IN THE CONJUNCTION ZONE OF THE SOUTHERN SLOPE OF THE GREATER CAUCASUS WITH THE MIDDLE KURA DEPRESSION (THE REPUBLIC OF AZERBAIJAN)	Almaz Ismailova Talat	Azerbaijan National Academy of Sciences, Republican Seismic Survey Center, Azerbaijan
IMPROVING THE INSTALLATION OF HEAT TREATMENT OF SUCKER RODS	Elman A. Aliyev Leyla Z. Vazirova	Azerbaijan State Oil and Industry University, Baku, Azerbaijan
SHUNT ACTIVE POWER FILTER BASED ADALINE NEURAL NETWORK FOR HARMONIC MITIGATION UNDER DISTURBED AND UNBALANCED SYSTEM	MEBAREK Abdesslam Ryad, RAHLI Chouaib, MERABET Leila, SAAD Salah, OUADA Mehdi	LSELM Research Laboratory, Badji Mokhtar, Annaba University, Algeria
COMPARATIVE STUDY BETWEEN DIFFERENT MPPT ALGORITHMS	Rahli Chouaib, Mebrek Abdesslam Ryad, Saad Salah, Ouada Mehdi, Merabet Leila	LSELM Research Laboratory, Badji Mokhtar, Annaba University, Algeria
PREVENTION OF GALACTOSEMIA	Hajiyeva N.M.	Baku State University, Baku, Azerbaijan

CONTENT

CONGRESS ID	I
SCIENTIFIC COMMITTEE	II
PHOTO GALLERY	III
PROGRAM	IV
CONTENT	V

TITLE	AUTORS	NO
CAUSAS DEL DESABASTO DE MEDICAMENTOS ONCOLÓGICOS EN EL IMSS	Luz del Carmen Herrera Cornelio, Aransazú Rivas Avalos, Mariana González Acevedo, Jesús Emiliano García Bautista	1
DESCRIPCIÓN DE LOS PARÁSITOS MÁS COMUNES EN EL HOGAR	Ana Sherlyn García Trinidad, Clarissa Fernanda Díaz Jiménez, Monserrat Valenzuela Hernández, Camila Valeria Torruco Narváez	2
DESINFORMACIÓN EN EL USO DE MÉTODOS ANTICONCEPTIVOS HORMONALES	Juliana Jazmín Torres Peralta, José Alejandro Jiménez Hernández, Mayra Yuritzi Martínez Barrera, Julissa Carrera García	3
EL PEZ DIABLO, ESPECIE INVASORA EN AUMENTO	Miguel Isaac Hernández Martínez, Cesar Enrique Bonilla Gaspar, Diego Enrique González Aparicio, Jorge Arturo Zurita García	4
APROVECHAMIENTO DEL RECURSO NATURAL HÍDRICO	Francisca Silva Hernández, Germán Martínez Prats, Candelaria Guzman Fernandez, Tomas Francisco Morales Cardenas	5
USO DEL RECURSO NATURAL; AGUA	Francisca Silva Hernández, Germán Martínez Prats, Candelaria Guzman Fernandez, Tomas Francisco Morales Cardenas	6
WHAT IS THE IMPACT OF SOIL CONTAMINATION ON AGROBIODIVERSITY?	Mariana Hernández Calzada, Marla Berenice Pérez Bolío, José Elías Torruco Samado, Ivana Rivera Gómez, Dr. José Guadalupe Chan-Quijano,	7
FERTILITY RECOVERY WITH ORGANIC FERTILIZERS AND TREE SPECIES OF A SOIL CONTAMINATED WITH HYDROCARBONS	Cosme Hiram Andrade García; Cristhian Torres Barredo; German Alejandro Lira Salazar; Mary Jose Chable Aquino; Dr. José Guadalupe Chan-Quijano;	8
MORPHOLOGICAL DEVELOPMENT OF PROMISING TREE SPECIES FOR THE REMEDIATION OF OIL- CONTAMINATED SOILS	Valeria Callado Nava, Wilbert Hernández Domínguez, Zully Vanessa Hernández López, Janeth Isabella Martínez Ochoa, Dr. José Guadalupe Chan-Quijano,	9-10
ENERGIAS RENOVABLES EN TABASCO	Darinka Alejandra Fernandez Magaña - María Fernanda Camacho Perez -Johan Sebastian Cerino Madrigal	11
USO DE PLAGUICIDAS EN TRABAJADORES AGRÍCOLAS DE LA SUBREGIÓN CHONTALPA	Dra Damianys Almenares López Dra. Edelia Caudina Villarreal Ibarra	12
EVIDENCE-BASED CARE OF CHRONIC OBSTRUCTIVE LUNG DISEASE AT HOME	Fikriye Ceyda PARLAK, Hamdiye ARDA SÜRÜCÜ	13-29
THE RELATIONSHIP BETWEEN FALLS IN THE ELDERLY, HOME CARE SERVICES AND NURSING APPROACHES	Hamdiye ARDA SÜRÜCÜ, Meltem SUNGUR	30-38
IMPACT OF SMOKING AMONG HYPERTENSIVE PATIENTS TREATED WITH BETA-BLOCKER DRUGS: A REVIEW	Hala F. Kasim	39-48
NEW GENERATION OF SENSITIZERS FOR PHOTODYNAMIC THERAPY – DEEPER AND BETTER	Wei Chen	49
EARLY POSTOPERATIVE CHANGES OF PRIMARY HEMOSTASIS: PERITONEAL ADHESIONS	Artem Savchuk	50

SURGICAL-ANATOMICAL EVALUATION OF MANDIBULAR PREMOLARS BY CBCT AMONG THE ITALIAN POPULATION	Rodolfo Reda, Alessio Zanza, Dario Di Nardo, Maurilio D'Angelo, Luca Testarelli	51
EATING HABITS OF INDIVIDUALS WITH CYCLIC MASTALGIA: A CASE CONTROLLED STUDY	Pinar Erdoğan, Alirza Erdoğan	52-59
CO-INFECTION OF ESCHERICHIA COLI PATHOTYPES WITH INTESTINAL PARASITES AMONG CHILDREN LESS THAN FIVE YEARS IN DUHOK CITY, IRAQ	Haveen Khalid Hasan, Souzan Hussain Eassa, Najim Abdalla Yaseen	60
BIOACTIVITY SCREENING OF BACTERIAL COMMUNITIES ASSOCIATED WITH THE OCTOCORAL GORGONIAN <i>Plexaura</i> sp.: ANTIPATHOGENIC ACTIVITY AGAINST NOSOCOMIAL PATHOGEN <i>Acinetobacter baumannii</i>	Stefanie J.H. LARASATI, Ocky Karna RADJASA, Agus TRIANTO, Rizky WULANDARI, Agus SABDONO	61
ASSOCIATION OF RENAL TUBULAR INJURY BIOMARKER, MARKERS OF CHRONIC INFLAMMATION, AND ENDOTHELIAL DYSFUNCTION WITH CKD	Shalala Ismayilova, Irada Mammadova , Afet Nesibli , Fidan Ahadova	62-63
PREDICTIVE SERUM BIOMARKERS OF CARDIOVASCULAR DISEASE IN PATIENTS WITH CKD	Manzar Novruzova, Samira Muradova, Shafag Ibrahimova, Natavan Huseynova Shalala Ismayilova	64
NEXT GENERATION PHENOTYPING METHODS FOR CONSERVATION OF BIODIVERSITY AND GENETIC RESOURCES	Ayşe Gul Ince, Mehmet Karaca	65-73
SYSTEMS AND TECHNIQUES FOR SUSTAINABLE AGRICULTURE	Ayşe Gul Ince, Mehmet Karaca	74-82
FIRST REPORT OF DODDER (<i>CUSCUTA</i> SPP.) PARASITIZING CUCUMBER, OKRA, ALFALFA AND BASIL IN IRAQ	Bashar K. H. Al-Gburi Saba A.K. Al-Falooji	83-85
EFFECT OF THE CONDITIONS OF CULTURE ON THE GERMINATION AND THE GROWTH OF THE ARGAN TREE (<i>ARGANIA SPINOSA</i> (L.) SKEELS)	EL QADMI, I., ZIRI, R ., AKHRIF, F., ABID, N ., BRHADDA, N.	86
MILK WHEY, PROPERTIES AND APPLICATIONS	Altynai Saalieva, Aigul Usubalieva, Aynagul Sabirbekova	87-92
UTILIZATION AND IMPORTANCE OF HONEYBEE PRODUCTS	Bardha Ibishi, Amr Ahmed Elsayed, Zekai Aydin, Vesna Karapetkovska - Hristova,	93-112
SCIENTIFIC AND EDUCATIONAL ROLE OF BOTANICAL GARDENS: EXAMPLES FROM TÜRKİYE AND THE WORLD	Banu Karaşah, Emine Tarakci Eren, Derya Sarı, Hilal Surat	113-126
A RESEARCH ON ENVIRONMENTAL SATISFACTION MEASUREMENT IN SHORE PARKS; CASE OF FINDIKLI ATATURK PARK, RİZE	Emine Tarakci Eren, Banu Karaşah, Hilal Surat, Derya Sarı	127-138
FABRICATION OF ECO-FRIENDLY BLENDED YARNS FOR CLOTHING	Munevver Ertek Avci, Gamze Okyay, Hilal Bilgiç	139-143
CONTAMINATION OF PUBLIC PLACES AT CENTRAL BELGRADE MUNICIPALITIES WITH DOGS PARASITES DURING 2021	Ivan Pavlović	144
A META-ANALYSIS ON ANTIDOTAL EFFECTS OF DIPHENHYDRAMINE AGAINST ORGANOPHOSPHATE AND	Fouad K. Mohammad , Ammar A. Mohammed, Hussein M. Rashid,	145-146

CARBAMATE INSECTICIDES POISONING IN LABORATORY ANIMALS	Hishyar M. S. Garmavy,	
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SMOKED FISH AND HUMAN HEALTH RISK ASSESSMENT	Kujtim Uka, Dijana Blazhekovikj - Dimovska Mentor Ismaili Vlora Zogejani Ariana Kadriu	147-158
IN VITRO CHEMOSENSITIVITY OF A CANINE TUMOR VENEREAL TRANSMISSIBLE CANCER CELL LINE	Edson Antonio Santamaría-Martínez, Moisés Armides Franco Molina, Paola Leonor García Coronado, Silvia Elena Santana Krimskaya, Diana Ginette Zarate-Triviño, Natañel Palacios Estrada, Cristina Rodríguez Padilla, Yareellys Ramos Zayas, Jorge R. Kawas, Heriberto Prado García	159
UNSUPERVISED MACHINE LEARNING: METHODS AND IMPLICATIONS FOR NETWORKING	Seemant Tiwari	160
AN ANALYTICAL APPROACH TO ACOUSTOELECTRIC EFFECT IN SOLID STATE DEVICES AND MATERIALS	Awadhesh Prasad	161-170
A PHENOMENOLOGICAL STUDY OF DRELL- YAN $\Phi^*\eta$ DISTRIBUTION OVER A WIDE MASS REGION THROUGH NNLO+N ³ LL ACCURACY	Kadir Ocalan	171-178
COMPUTATIONAL STUDY ON WIND FIELD DOMAIN AT DISTINCT WIND VELOCITY MAGNITUDES ACROSS HORIZONTAL AXIS WIND TURBINE FOR ESTIMATION OF POWER OUTPUT	Aniekan Essienubong Ikpe, Victor Etok Udoh, Emem Okon Ikpe	179-195
INTERPERSONAL DIFFICULTIES IN MIGRAINE PATIENTS: PREDICTING RISK FACTORS	Zahra Batool, Rabia Khadim	196
REMOVAL OF BPA BY ADSORPTION BY USING ORGANOCLAYS AND BIO-ADSORBENT	BEN JADDI Mountassira, AHARI M Hamed	197
EFFECT OF POLLUTANT PARTICLES ON PIPE EROSION: A NUMERICAL STUDY	A. Adjeloua B. Derrar H. Lebbal N. Boualem	198
CERAMIC COBALT-CONTAINING PIGMENTS BASED ON WILLEMITE	Alimjanova D.I. Babakhanova Z.A	199-203
REMOVAL OF SULFIDE AND COD FROM PETROLEUM WASTEWATER USING ELECTROCHEMICAL METHODS	Ali Zamani Konstantinos Dermentzis	204-214
SYNTHESIS OF PHOSPHAZENE-BASED PLASTICIZERS AND THE EFFECTS OF SYNTHESIZED PLASTICIZERS ON THE PROPERTIES OF POLY(LACTIC ACID) FILMS	Gurkan Sayan Ayse Aytac	215-222
SYNTHESIS, CHARACTERIZATION AND COMPARATIVE STUDY OF NEW 2- PHENYLIMIDAZO[1,2-A]PYRIDINE-3- CARBALDEHYDE DERIVATIVES	ABDELJALIL HAMDI Mhamed AHARI M. KOUDAD Hassan AMHAMDI A.EL AATIAOUI M. Azzouzi	223
DESIGN, SYNTHESIS, AND IN VITRO PHARMACOLOGICAL EVALUATION OF BISTRIFLUOROMETHYL-DERIVED HYDRAZIDE- HYDRAZONES AS ACETYLCHOLINESTERASE INHIBITORS	Ebru Didem Cosar Efe Dođukan Dincel Tülay Kayra İlhami Gülçin Nuray Ulusoy-Güzeldemirci	224-225
INVESTIGACIÓN DE LOS PARÁMETROS DE FABRICACIÓN DE LOS MATERIALES COMPUESTOS MEDIANTE EL PROCESO DE TRANSFERENCIA DE RESINA (RTM)	Ahmed Ouezgan, Said Adima, Aziz Maziri El Hassan Mallil , Jamal Echaabi	226
SPECIFIC ENERGY CONSUMPTION IN REVERSE OSMOSIS UNIT TO TREAT OLIVE MILL WASTEWATER	Reda Askouri, Mohamed Moussetad, Hassan Hannache, Hamdane Hasna,	227

DETERMINATION OF THE EFFECTS OF CARROT METHYL ESTER ON THE PERFORMANCE OF A CI ENGINE	Hanbey Hazar, Burkay Uyar, Huseyin Sevinc	228-234
INVESTIGATION OF THE EFFECTS OF ALMOND BIODIESEL ON THE ATTRIBUTES OF A DIESEL ENGINE	Hanbey Hazar, Burkay Uyar, Huseyin Sevinc	235-242
ANALYSIS AND EVALUATION OF RISKS IN THE CONSTRUCTION SECTOR IN TERMS OF OCCUPATIONAL HEALTH AND SAFETY (OHS)	Ömer Saltuk BÖLÜKBAŞI	243-249
THE PROBLEMS CAUSED BY COPPER CONTAINING MATERIALS IN IRON AND STEEL PRODUCTION	Ömer Saltuk BÖLÜKBAŞI Efe ARIYOL	250-254
TO PREVENT WASTE BY USING 5NEDEN, 5S, KANBAN, ANDON FROM LEAN MANAGEMENT TOOLS IN THE FIELD OF HEALTH	Nihal ALOĞLU, İbrahim Sani MERT,	255-266
ENERGY PLANS TECHNIQUE FOR OROFACIAL PAIN MANAGEMENT	Maria da Luz Rosario de Sousa; Maria Lúcia Bressiani Gil	267
THE INFLUENCE OF MATHEMATICAL REASONING ON PROBLEM SOLVING SKILLS AND COMPETENCE IN CRITICAL THINKING AMONG SECONDARY SCHOOL STUDENTS	Surajo Isa Gaya, Tanimu Bala	268
DIFFERENT TYPES OF ENERGY COMPANY'S ROLE IN GEORGIAN POWER ENGINEERING	Maka Jishkariani, Maya Pitskhelauri	269-275
A STUDY ON THE INFLUENCE OF THE ROTATING PROPELLER ARRANGES ON THE WING OF AN AIRPLANE ON THE LIFT COEFFICIENT OF AN AIRPLANE MODEL USING SOLAR ENERGY	Pham Dinh Trung Mai Duc Nghia	276-281
USE OF ZR-PILLARED CLAYS FOR PHOSPHATE REMOVAL FROM WATER	Tanya Chauhan Zoltán Németh	282
THE EFFECT OF SMART GRID APPLICATIONS ON SECURITY IN NATURAL GAS OPERATIONS	Hamza Yetik Bahadır Furkan KINACI İsa AVCI, Cevat ÖZARPA	283-287
PREVENTIVE MAINTENANCE USING RECYCLED ASPHALT	Aishah H.O. Al Shehhi Gul Ahmed Jokhio Abid Abu-Tair	288-289
ISSUES OF GEODYNAMICS OF THE EARTH'S CRUST STRUCTURE IN THE CONJUNCTION ZONE OF THE SOUTHERN SLOPE OF THE GREATER CAUCASUS WITH THE MIDDLE KURA DEPRESSION (THE REPUBLIC OF AZERBAIJAN)	Almaz Ismailova Talat	290-297
IMPROVING THE INSTALLATION OF HEAT TREATMENT OF SUCKER RODS	Elman A. Aliyev Leyla Z. Vazirova	298-300
SHUNT ACTIVE POWER FILTER BASED ADALINE NEURAL NETWORK FOR HARMONIC MITIGATION UNDER DISTURBED AND UNBALANCED SYSTEM	MEBAREK Abdesslam Ryad, RAHLI Chouaib, MERABET Leila, SAAD Salah, OUADA Mehdi	301-310
COMPARATIVE STUDY BETWEEN DIFFERENT MPPT ALGORITHMS	Rahli Chouaib, Mebrek Abdesslam Ryad, Saad Salah, Ouada Mehdi, Merabet Leila	311-317
PREVENTION OF GALACTOSEMIA	Hajiyeva N.M.	318-321

CAUSAS DEL DESABASTO DE MEDICAMENTOS ONCOLÓGICOS EN EL IMSS

Luz Del Carmen Herrera Cornelio

Universidad Autónoma de Guadalajara

Aransazú Rivas Avalos

Universidad Autónoma de Guadalajara

Mariana González Acevedo

Universidad Autónoma de Guadalajara

Jesús Emiliano García Bautista

Universidad Autónoma de Guadalajara

RESUMEN

La falta de medicamentos es un problema que trasciende desde años atrás, realidad que ha sido sumamente criticada por la población, esta situación es general en todas las instituciones y en todos los estados de la República Mexicana; el enfoque de estudio de este trabajo será el área oncológica del Instituto Mexicano del Seguro Social; el IMSS aseguró y garantizó el abasto de medicamentos oncológicos para sus pacientes; aun cuando no se cuenta con estadísticas oficiales, diversos testimonios confirman este fenómeno. A lo largo de este trabajo de investigación, se hablará e indagará acerca de los motivos por los cuales se ha presentado esta problemática, que ha estado afectando seriamente a gran porción del sector mencionado. El objetivo de este informe es que, a través de una investigación documental y explicativa, se pueda comprender la causa del desabasto de medicamentos oncológicos en el IMSS, permitiendo así la descripción del causante de la situación, para al final conocer las consecuencias que trae consigo mismo. Como resultado de esta investigación, se demuestra que el desabasto tiene su origen en el cambio de los procesos de adquisición y distribución poco estructurada, puesto que las autoridades subestimaron la complejidad de la cadena de acceso a los medicamentos.

Palabras claves: desabasto, salud, medicamentos, oncología, población

DESCRIPCIÓN DE LOS PARÁSITOS MÁS COMUNES EN EL HOGAR

Ana Sherlyn García Trinidad

Universidad Autónoma de Guadalajara

Clarissa Fernanda Diaz Jiménez

Universidad Autónoma de Guadalajara

Montserrat Valenzuela Hernández

Universidad Autónoma de Guadalajara

Camila Valeria Torruco Narváez

Universidad Autónoma de Guadalajara

RESUMEN

El objetivo de la investigación es describir los principales parásitos que pueden haber en casa, aclarando los parásitos más riesgosos y no tan riesgosos que existan en ella, también informar la clasificación de parásitos encontrados comúnmente, al igual que saber cuántos son los de mayor importancia en el hogar, para tener precaución y poder cuidarnos, transmitir recomendaciones y cuidados de higiene por parásitos riesgosos, con la intención de resolver problemas de parásitos para el cuidado de la salud familiar.

En este trabajo se empleará como método la investigación cualitativa en la que se encontrarán e indagará en discursos o recursos existentes en torno al tema, posteriormente se realizará una resumida, clara y precisa interpretación. Se tomarán diferentes datos, gráficas y estadística ya hechos para el apoyo de la investigación.

Como resultado se espera tener una descripción de los cuidados necesarios que se deben llevar a cabo respecto a los parásitos más comunes en el hogar, esto con la intención de evitar y reducir el número de personas afectadas. Planeando conseguir estos resultados recopilando información en libros, artículos, páginas webs confiables, con el fin de extraer y producir una investigación clara y concisa, para que cualquiera pueda leerla, informarse y llevarla a cabo en su propio hogar. Los tipos de parásitos más comunes son protozoos, helmintos y ectoparásitos. También juntar posibles síntomas al portar un parásito para que, si se presenta cualquiera de ellos acudir al médico, ya que muchas veces las personas no se dan cuenta hasta que empeora. Esperando que además de informar esta investigación pueda realizar un cambio en sus hábitos de higiene para evitar o eliminar la mayoría de estos en el hogar para así proteger a su familia y a ellos mismos.

Palabras clave: Parásito, huésped, protozoos, helmintos y ectoparásitos.

DESINFORMACIÓN EN EL USO DE MÉTODOS ANTICONCEPTIVOS HORMONALES

Juliana Jazmín Torres Peralta

Universidad Autónoma de Guadalajara

José Alejandro Jiménez Hernández

Universidad Autónoma de Guadalajara

Mayra Yuritzi Martínez Barrera

Universidad Autónoma de Guadalajara

Julissa Carrera García

Universidad Autónoma de Guadalajara

RESUMEN

El objetivo de este proyecto de investigación es identificar los factores que llevan a la desinformación en el uso de métodos anticonceptivos hormonales y sus consecuencias, basándonos en la edad, nivel socioeconómico y nivel de estudios de la población femenina. Estos datos fueron obtenidos mediante una encuesta digital que aplicamos a la población 9

Mediante una metodología mixta haremos una recolección de datos basada en distintas investigaciones para compararlas entre ellas, así mismo, llevaremos acabo una recolección de datos por una encuesta. Los datos recolectados demostraron que:

El aproximado de edad de las estudiantes fue de 20.5 años. El 26.15% recibió asesoría por distintos sujetos y diferentes medios al personal de salud. De las sustancias con interacción con los anticonceptivos hormonales, 25% consumía alcohol. Las principales reacciones adversas fueron: cefalea, aumento de peso y sangrado uterino anormal. Principales motivos de cancelación de uso: efectos adversos. El 10.3% de las encuestadas experimentó falla del anticonceptivo.

Con base en los resultados y datos obtenidos, se concluye que es de gran importancia que toda la población desde un nivel básico reciba información respecto a métodos anticonceptivos, así como el uso y posibles efectos de estos, para mantener el control de una vida sexual y reproductiva responsable.

Palabras claves: Desinformación, Anticonceptivos, estudiantes, investigación

EL PEZ DIABLO, ESPECIE INVASORA EN AUMENTO

Miguel Isaac Hernández Martínez

Universidad Autónoma de Guadalajara Campus Tabasco

Cesar Enrique Bonilla Gaspar

Universidad Autónoma de Guadalajara Campus Tabasco

Diego Enrique González Aparicio

Universidad Autónoma de Guadalajara Campus Tabasco

Jorge Arturo Zurita García

Universidad Autónoma de Guadalajara Campus Tabasco

RESUMEN

El objetivo de esta investigación es identificar, analizar y presentar soluciones ante la problemática que conlleva a la presencia de las especies invasoras en el estado de Tabasco, específicamente el **Pez Diablo**, el cual actúa como depredador en el ecosistema local, lo que impide el desarrollo de las especies nativas al igual que las actividades (comercio, alimentación, etc.) que las rodean. Aunque actualmente no hay evidencia directa del impacto sobre esta especie, se puede relacionar varios efectos que posiblemente sean resultados de su presencia en el estado; en este proyecto de investigación se utilizó una metodología cuantitativa ya que del análisis de datos y comparaciones podemos obtener las cifras de especies invasoras en el estado de Tabasco. Para la localización de las especies invasoras, se analizaron los programas de manejo de las áreas protegidas de Tabasco y la presencia de especies acuáticas invasoras en el estado de Tabasco, México., específicamente sobre el *Hypostomus plecostomus*, mejor conocido como Pez Diablo. Mediante una revisión bibliográfica se identificaron reportes de presencia, estatus e impactos de esta especie en el ecosistema al que ha sido introducida. El 90% de los reportes se localizan en la región del Sistema Grijalva, Usumacinta y Laguna de Términos. La principal vía de introducción es la acuicultura. Los efectos planteados en la hipótesis principal son: hibridación, competencia directa por alimento y espacio, destrucción de sustratos de anidación, depredación de huevos y larvas, transferencia de patógenos, alteración del hábitat de las especies nativas, desplazamiento de especies nativas, alteración de la estructura trófica, suspensión de sedimentos y turbidez en la columna de agua, modificación de los ciclos de los nutrientes, introducción y transmisión de parásitos y enfermedades.

Palabras claves: Pez diablo, especies invasoras, impacto biológico, niveles tróficos, hibridación.

APROVECHAMIENTO DEL RECURSO NATURAL HÍDRICO

Francisca Silva Hernández

Universidad Juárez Autónoma De Tabasco

Germán Martínez Prats

Universidad Juárez Autónoma De Tabasco

Candelaria Guzman Fernandez

Universidad Juárez Autónoma De Tabasco

Tomas Francisco Morales Cardenas

Universidad Juárez Autónoma De Tabasco

RESUMEN

El agua es un recurso natural que hoy día tiene un valor agregado que la propia sociedad y sus instituciones le ha otorgado desde los ámbitos académicos, sociales, culturales, económicos y políticos. Sin embargo, ante el valor agregado, el sistema político y económico han permeado en determinar el uso y gestión del mismo. Por lo que ha desencadenado una serie de factores simples y complejos en cuanto a la responsabilidad de proveer dicho recurso administrativamente basado en el acceso del derecho al agua de forma disponible, accesible y con calidad; al mismo tiempo que el Estado debería cumplir con su obligación de respetar, proteger y cumplir con el citado derecho. Este documento describe y analiza el derecho al agua como derecho humano señalando los criterios mínimos que el Estado, debe atender para garantizarlo. Se analiza de forma cualitativa y deductiva el marco normativo, así como los elementos que lo constituyen como derecho humano a partir de un posicionamiento vinculante con otros derechos afectados.

Palabras clave: Agua, Hídrico, Aprovechamiento

USO DEL RECURSO NATURAL; AGUA

Francisca Silva Hernández

Universidad Juárez Autónoma De Tabasco

Germán Martínez Prats

Universidad Juárez Autónoma De Tabasco

Candelaria Guzman Fernandez

Universidad Juárez Autónoma De Tabasco

Tomas Francisco Morales Cardenas

Universidad Juárez Autónoma De Tabasco

RESUMEN

La seguridad de la humanidad responde a la necesidad imperante de salvaguardar el medio ambiente en el que se encuentran inmersos diversas especies que congregan acciones específicas para un fin determinado, esa acción concreta vincula un hecho social que acontece en diversas manifestaciones de acuerdo a las necesidades e intereses predispuestos, parte de esos intereses hoy día es el hecho o fenómeno social que reside en particular con el recurso natural del agua. El recurso hídrico en el siglo XXI representa un paradigma para la sobrevivencia del ser humano, atendiendo a un ritmo acelerado su demanda mundial. Como tal, es un recurso natural limitado que por lo tanto resulta ser escaso, estimado y sobrevalorado. Ante tal situación, el interés que adquiere resulta ser prioritario a nivel mundial por lo que a partir del principio de necesidad y seguridad ha emergido control y poder por este recurso susceptible de crear conflictos entre países y naciones por su uso, disponibilidad y distribución; de ese punto central se partió para desarrollar esta investigación.

Palabras clave: Agua, Recurso Natural, USO

WHAT IS THE IMPACT OF SOIL CONTAMINATION ON AGROBIODIVERSITY?

Mariana Hernández Calzada

Student of the Chemical Pharmaceutical Biologist degree, Universidad Autónoma de Guadalajara,
Campus Tabasco

Marla Berenice Pérez Bolio

Student of the Chemical Pharmaceutical Biologist degree, Universidad Autónoma de Guadalajara,
Campus Tabasco

José Elías Torruco Samado

Student of the Chemical Pharmaceutical Biologist degree, Universidad Autónoma de Guadalajara,
Campus Tabasco

Ivana Rivera Gómez

Student of the Chemical Pharmaceutical Biologist degree, Universidad Autónoma de Guadalajara,
Campus Tabasco

Dr. José Guadalupe Chan-Quijano

Universidad Autónoma de Guadalajara, Campus Tabasco

RESUMEN

Agroecosystems are of biological and cultural relevance and are important in agri-food production that revolves around fibers and medicines of natural origin. However, these systems have been affected by soil contamination by heavy metals, oil spills and pesticides. Therefore, the objective of the research was to analyze the impact of soil contamination on geodiversity in Mexico. For this, a systematized bibliographic review was carried out under the prism method to order the primary and secondary information regarding the subject, a descriptive analysis was applied. Soil contamination in agroecosystems has become relevant at a global level due to the threats that have been appearing, since it affects the life of microorganisms (which are used directly and indirectly for food and agriculture), of plants (including crops), animals (livestock, forestry and fishing) and even humans and, therefore, impacts the agrobiodiversity production system; This includes the diversity of genetic resources (varieties, breeds) and species used for food, forage, fiber, fuel and pharmaceutical products, which affects food production and, with it, food is reduced and generates a loss in food. of human beings. Information on the impact of geodiversity due to soil contamination is incipient and in others there is even a lack of diversity of contaminants that affect geodiversity, from the physiology of plants, the phiosphere, the relationship between contaminants-plants- humans-atmosphere, bioaccumulation of pollutants in organisms (vegetable, animal, and human) and effects on environmental and human health and the genetic diversity of crops.

Keywords: agroecosystems, agroecology, pesticides, intoxication, contaminant transfer.

FERTILITY RECOVERY WITH ORGANIC FERTILIZERS AND TREE SPECIES OF A SOIL CONTAMINATED WITH HYDROCARBONS

Cosme Hiram Andrade García

Student of the Chemical Pharmaceutical Biologist degree, Universidad Autónoma de Guadalajara,
Campus Tabasco

Cristhian Torres Barredo

Student of the Chemical Pharmaceutical Biologist degree, Universidad Autónoma de Guadalajara,
Campus Tabasco

German Alejandro Lira Salazar

Student of the Chemical Pharmaceutical Biologist degree, Universidad Autónoma de Guadalajara,
Campus Tabasco

Mary Jose Chable Aquino

Student of the Chemical Pharmaceutical Biologist degree, Universidad Autónoma de Guadalajara,
Campus Tabasco

Dr. José Guadalupe Chan-Quijano

Universidad Autónoma de Guadalajara, Campus Tabasco

ABSTRACT

The association of organic fertilizers and tree species is a low-cost alternative to reduce the content of hydrocarbons in the soil since they positively affect its fertility and favor the restoration and remediation of contaminated soils. Therefore, the objective of the study was to evaluate the effect of organic fertilizers and tree species on the fertility of soils contaminated with hydrocarbons. For this, the physical and chemical parameters (texture, pH, N, P, K, MO, and CIC) were considered. The experiment was carried out under nursery conditions for one year; soil contaminated with hydrocarbons with a concentration of 158, 674 mg kg⁻¹ ss was collected. Nine treatments were established that resulted from the combination of three doses (6, 9 and 12 Mg ha⁻¹) with three organic fertilizers (vermicomposting of bat guano, compost of cane filter cake and sheep manure). These same treatments were used with the presence of *Swietenia macrophylla* (mahogany) and *Tabebuia rosea* (macuilís). In addition, there were three controls; one: soil contaminated with the presence of mahogany; soil contaminated with macuilís and the third control contaminated soil without tree species; handling four replicates for each treatment. A factorial ANOVA and the Tukey mean test ($P < 0.5$) were performed on the results. The contents of N, P and K of the soil improved significantly with the application of organic fertilizers. Similarly, when using *S. macrophylla* and *T. rosea*, the parameters pH, N, P, MO, CEC of the contaminated soil are improved, ensuring that the soil characteristics remain at a good level until the end of the experiment. By applying organic fertilizers with plants, the fertility of soils contaminated with hydrocarbons is improved.

Keywords: soil bioremediation, *Swietenia macrophylla* and *Tabebuia rosea*, organic fertilizers, environmental pollution.

MORPHOLOGICAL DEVELOPMENT OF PROMISING TREE SPECIES FOR THE REMEDICATION OF OIL-CONTAMINATED SOILS

Valeria Callado Nava

Student of the Chemical Pharmaceutical Biologist degree; Universidad Autónoma de Guadalajara,
Campus Tabasco

Wilbert Hernández Domínguez

Student of the Chemical Pharmaceutical Biologist degree; Universidad Autónoma de Guadalajara,
Campus Tabasco

Zully Vanessa Hernández López

Student of the Chemical Pharmaceutical Biologist degree; Universidad Autónoma de Guadalajara,
Campus Tabasco

Janeth Isabella Martínez Ochoa

Student of the Chemical Pharmaceutical Biologist degree; Universidad Autónoma de Guadalajara,
Campus Tabasco

Dr. José Guadalupe Chan-Quijano

Universidad Autónoma de Guadalajara, Campus Tabasco

ABSTRACT

The morphological description of tree species with the ability to remediate oil-contaminated soils, when they are young, is scarce and their contribution is important since they allow, based on the characteristics of the cotyledons, protophylls, metaphylls, changes in coloration and the presence of some structures, separate different phases of seedling development that can be used for their identification in contaminated areas. Therefore, the objective of this research is to describe the morphological development of seedlings of ten promising tree species for the remediation of oil-contaminated soils. The description and characterization of the seedlings was made from the biological material from the germination of the seeds of *Bursera simaruba*, *Byrsonima crassifolia*, *Cedrela odorata*, *Eugenia capuli*, *Inga inicuil*, *Pachira aquatica*, *Psidium guajava*, *Swietenia macrophylla* and *Tabebuia rosea*. The type of germination of the seeds was identified; The total height of the seedling was measured, from the base to the terminal bud with a flexometer (cm), the diameter of the root neck (cm) with a vernier at the end of the experiment and the root morphology was described. The types of germination identified were foliaceous phanerocotylar epigeal, with reserve and photosynthetic cotyledons and cryptocotylar hypogeal with foliaceous and storage cotyledons, in addition, phanerocotylar hypogeal with foliaceous and reserve cotyledons. As for the root of the seedlings, all of them have the pivoting one. A good initial morphological development of the seedlings is shown with small variations between species. However, the morphological description of the studied seedlings provides a significant contribution in systematic botany, in addition, they can be used to identify these tree species in areas affected or in the process of remediation due to soil contamination due to oil spills.

Keywords: systematic botany, ecological restoration, contamination, bioremediation.

ENERGIAS RENOVABLES EN TABASCO

Darinka Alejandra Fernandez Magaña

Universidad Autónoma de Guadalajara

Maria Fernanda Camacho Perez

Universidad Autónoma de Guadalajara

Johan Sebastian Cerino Madrigal

Universidad Autónoma de Guadalajara

RESUMEN

Las energías renovables en nuestro estado han ganado importancia dentro del sector empresarial, es por ello cada vez más son las firmas y compañías que apuestan a la utilización de las mismas. Estas son aquellas que se obtienen de fuentes naturales, tales como energía solar, eólica, hidroeléctrica, biocarburantes, geotérmica y la undimotriz, a gran escala representan el presente y el futuro, ya que contribuyen al cuidado del planeta, puesto que son energías limpias e inagotables para derrotar con certeza el cambio climático.

El artículo se centraliza en la implementación de las energías renovables en el Estado de Tabasco, desglosando las ventajas ambientales, económicas y sociales, tomando en cuenta que Tabasco es una de las entidades con potencial energético según el Área de Comunicación Social de la Secretaría de Energía / Redacción Petroquímex.

No podemos omitir decir que las fuentes de energías renovables están libres de inconvenientes, sin embargo tras investigar las demeritos de ventajas que estas tienen, no es echar de menos que tengan una gran importancia para el futuro de nuestra sociedad, y como ya que apoyan al sector empresarial de manera firme para sanar las finanzas de las empresas productivas del Estado y junto con compañías privadas coadyuvar a la autonomía energética en el país.

Sin menospreciar el constante apoyo en el Estado por parte de la Secretaría de Energía, de manera organizacional de foros en donde se llevan a cabo mesas sobre hidrocarburos, electricidad, energía renovable e innovación tecnológica, todo esto con el fin de estar a la altura de lo que requiere el país, ya que, antes mencionado por el actual Secretario de Gobernación del País, López Hernández Adán Augusto, señala que Tabasco está llamado a ser la capital energética del país y el foro antes mencionado establecerá la ruta para delinear el futuro energético de México.

Keywords: Ventajas, energías, Tabasco, medio ambiente

USO DE PLAGUICIDAS EN TRABAJADORES AGRÍCOLAS DE LA SUBREGIÓN CHONTALPA

Dra Damianys Almenares López
Universidad Autónoma de Guadalajara

Dra. Edelia Caudina Villarreal Ibarra
Universidad Autónoma de Guadalajara

RESUMEN

Los plaguicidas son ampliamente utilizados en la producción agrícola para prevenir o controlar plagas, para reducir o eliminar las pérdidas de rendimiento y mantener la alta calidad del producto. A pesar de las ventajas de su aplicación, se han planteado serias preocupaciones acerca de los riesgos para la salud derivados de la exposición ocupacional y de residuos en los alimentos y el agua potable. Los agricultores, constituyen el grupo de mayor riesgo de sufrir la toxicidad por estos compuestos. Por ello, debido a que Tabasco es un estado con una actividad agrícola importante y a que existen pocos estudios dedicados a la evaluación de los plaguicidas empleados y su repercusión sobre la salud de la población agrícola en la región de la Chontalpa, el objetivo de este trabajo es evaluar el uso de plaguicidas y los síntomas provocados por el mal uso o/y manejo de trabajadores agrícolas de la Sub-región de la Chontalpa en el Estado de Tabasco. Para recabar la información se tomaron muestras de sangre venosa (previa firma del consentimiento informado) a 91 agricultores a los que se les aplicó una encuesta para investigar su historia laboral y de salud, así como el manejo y frecuencia de uso de plaguicidas y los síntomas asociados con la exposición. Los plaguicidas empleados fueron insecticidas, fungicidas y herbicidas. El 63 % de los trabajadores no emplea medidas de seguridad en el uso de plaguicidas. El 37 % presentó algún síntoma de intoxicación, los más frecuentes fueron cefalea, dolor estomacal y dolor muscular. Se pudo constatar que los productores no tienen suficiente conocimiento sobre los riesgos y el manejo adecuado de plaguicidas, lo que favorece situaciones de peligro por intoxicación hacia su salud, la de su familia y la de la población en general. Por lo que es necesario implementar acciones de educación sanitaria y ambiental en campesinos agrícolas de la region lo cual, permitirá minimizar el impacto negativo de estos compuestos sobre la salud.

KRONİK OBSTRÜKTİF AKCİĞER HASTALIĞININ EVDE KANITA DAYALI BAKIMI

Fikriye Ceyda PARLAK

Dicle Üniversitesi Sağlık Bilimleri Enstitüsü İç Hastalıkları Hemşireliği

ORCID 0000-0003-0504-3416

Hamdiye ARDA SÜRÜCÜ

Dicle Üniversitesi İç Hastalıkları Hemşireliği Bölümü

ORCID 0000-0001-7052-1002

ÖZET

Kronik Obstrüktif Akciğer Hastalığı (KOAH), dünyada artan, mortalite ve morbiditeye yol açan, sosyal ve ekonomik yüke neden olan, solunumda önemli ölçüde zorluk oluşturan bir kronik hastalıktır. KOAH'lı bireyler bazı günlük yaşam aktivitelerini yaparken solunum güçlüğü yaşarlar ve hastalığı yönetmekte yetersizlik yaşayabilmektedirler. Bunun sonucunda dispne meydana gelebilmektedir. Bu da hastanın günlük yaşamını önemli ölçüde etkilemektedir. KOAH'da evde verilen hemşirelik bakım hizmeti olarak hasta eğitimi, hastalığa ilişkin risk faktörleri, hastalığın semptomları, psikososyal ve davranışsal girişimlerin sürekliliği sağlanarak hastaların öz-etkililik düzeyi artırılarak bütüncül bir bakım sağlanması hedeflenmektedir. Çalışma Kronik Obstrüktif Akciğer Hastalığı (KOAH) olan bireylerin evde kanıta dayalı hemşirelik bakımının tanımlanması amacıyla yapılmıştır.

Anahtar Kelimeler: KOAH, kanıta dayalı, evde bakım, hemşirelik.

ABSTRACT

Chronic Obstructive Pulmonary Disease (COPD) is a chronic disease, such as respiratory production, which is increasing in the world, causing death and morbidity, social and economic burden. Individuals with COPD experience breathing difficulties while performing some activities of daily living and may experience inability to manage the disease. As a result, dyspnea may occur. This significantly affects the daily life of the patient. As a home nursing care service in COPD, it is aimed to provide holistic care by increasing the self-efficacy level of patients by providing patient education, risk factors for the disease, symptoms of the disease, and continuity of psychosocial and behavioral interventions. The study was conducted to describe the evidence-based nursing care at home for individuals with Chronic Obstructive Pulmonary Disease (COPD).

Keywords: COPD, evidence-based, home care, nursing.

1.GİRİŞ

Kronik obstrüktif akciğer hastalığı (KOAH); sıklıkla zararlı partikül veya gazlara yoğun maruziyetin ve anormal akciğer gelişimini de içeren konakçı faktörlerinin sebep olduğu, hava yolu, alveoller dejenerasyonlara daimi hava akımı azalması ve solunumsal semptomları olan, akciğer parankiminin kronik inflamasyonu ile karakterize, yaygın, önlenebilir ve tedavi edilebilen bir hastalıktır ([1], [2]- [3]). Sigara içmek KOAH gelişiminde önde gelen risk faktörüdür. Bazı hastalarda yüksek derecede obstrüksiyon ve minimal semptomlar görülürken, akciğer fonksiyonu daha iyi olan diğer hastalarda semptom daha fazla olduğundan hastalık seyri değişkendir [4].

Kronik obstrüktif akciğer hastalığı (KOAH) her yıl dünya çapında 3 milyondan fazla insanı öldürüyor.

Semptomların tedavisinde ve akut alevlenmelerin önlenmesinde kaydedilen ilerlemeye rağmen, hastalığın ilerlemesini iyileştirmek veya mortaliteyi etkilemek için çok az ilerleme kaydedilmiştir. KOAH'ın kompleks hastalık mekanizmalarının daha iyi bilinmesi gerekmektedir. Sigarayı bırakma programları, artan fiziksel aktivite ve eşlik eden hastalıkların erken tespiti ve tedavisi, hastalığın yükünü azaltmak için diğer önemli bileşenlerdir. Tütün kullanımını azaltmak, çevresel maruziyeti düzenlemek ve biyokütle yakıtının yoğun kullanımına alternatifler bulmak için küresel bir siyasi ve ekonomik çaba sarf etmek gerekmektedir [5].

2. GENEL BİLGİLER

Aile temelli ve popülasyon temelli çalışmalar, KOAH riskinin önemli bir bölümünün genetik varyasyonla ilişkili olduğunu göstermiştir. Genetik ilişkilendirme çalışmaları, KOAH riskini, azalmış akciğer fonksiyonunu ve KOAH ile ilişkili diğer özellikleri etkileyen yüzlerce genetik varyant tanımlamıştır. Bu genetik varyantlar diğer pulmoner ve pulmoner olmayan özelliklerle ilişkilidir, KOAH heterojenitesinin en azından bir kısmı için genetik bir temel gösterir, toplam KOAH riski üzerinde önemli bir etkiye sahiptir, KOAH patogeneğinde erken yaşam olaylarını içerir ve sıklıkla genleri içerir [6].

KOAH'a çevresel maruziyetler de neden olabilir. Örneğin, işyerinde belirli tozlara yoğun maruz kalma, kimyasallar ve iç veya dış hava kirliliği duman veya biyokütle yakıtları hastalığın oluşmasına yol açabilirler. Bu faktörlerin hiçbiri olmazsa bile KOAH 'a sahip olunabiliyor. Bazı sigara içenlerde hiç KOAH gelişmediği halde bazı hiç sigara içmemiş hastalarda KOAH gelişmesi genetik faktörlerin rol oynadığını gösterebilir [7].

KOAH genellikle orta-ileri yaş grubunda oluşur ve yavaşça ilerler. Kış aylarında çoğunlukla belirtilerde artış ile ortaya çıkan hastalık alevlenmeleri, ciddi morbidite ve mortalite nedenidir. KOAH çoğunlukla komorbiditelerle beraberdir. Akciğer kanseri, kardiyovasküler hastalıklar, metabolik hastalıklar ve en çok görülen komorbiditelerdir [8].

2.1. KOAH ın Epidemiyolojisi ve Önemi

KOAH da ölüm nedenleri büyük çoğunluğu (%90 dan fazlası) düşük ve orta gelirli ülkelerde meydana gelmektedir. KOAH (Kronik obstrüktif akciğer hastalığı)2019 da dünyada 4. Mortalite sebebi iken 2020 yılında 3. Sıraya gelmiştir [9].

Kronik obstrüktif akciğer hastalığının (KOAH) dünya çapında 350 milyondan fazla insanı etkilediği ve yılda 3,2 milyon ölümden sorumlu olduğu tahmin edilmektedir, KOAH, iskemik kalp hastalığı ve neoplazmalardan sonra dünya çapında üçüncü önde gelen ölüm nedenidir [10].

Kadınlarda kronik obstrüktif akciğer hastalığı (KOAH) prevalansının giderek artmıştır, kısmen dünya çapında kadınlar arasında artan tütün kullanımını ve biyokütle yakıtlarına maruz kalma nedeniyle 2008'den beri erkeklerinkine eşit olmuştur [11].

Kadınlarda, KOAH prevalansı ve mortalitesi, son 20 yılda iki kat artış göstermiştir. Ayrıca kadınların tütün dumanının etkilerine karşı daha duyarlı olduğu ileri sürülmüştür ve çevresel tütün dumanına maruz kalmanın KOAH ile ilişkili olduğuna ve kadınları erkeklerden daha çok etkilediğine dair kanıtlar vardır [12].

Global Youth Tobacco araştırmasının 13-15 yaş arası ergenler üzerindeki son bulguların, genç kızların genç erkekler kadar sigara içtiğini göstermiştir. Akciğerleri erkeklerinkinden daha küçük olduğu için, sigara içmeye erken başlamanın akciğer fonksiyonu üzerinde daha büyük bir zararlı etkisi olabilir. Buna göre, içilen belirli sayıda sigaraya aynı maruziyet, kadınlarda daha zararlı etkilere yol açabilir [13].

2019 Türkiye İstatistik Kurumu (TÜİK) verilerine göre solunum sistemi hastalıkları, Türkiye’de dolaşım sistemi hastalıklarından(%36.8) ve tümörlerden (%18.4) sonra görülen üçüncü ölüm sebebidir. Türkiye’de tüm ölümler içinde solunum hastalıklarına bağlı ölümlerin payı, 2010 yılında %8.3’den 2019 yılında %12.9’a ulaşmıştır [14].KOAHA ve bronşektaziye endekli ölümler ise tüm ölümlerin %5.4’ünü meydana getirmiştir TÜİK verilerine göre 2017 yılında bütün ölümler içinde KOAH, dördüncü sıradadır [15].

Ülkelerin çoğunda ölüm hızları düşerken, yaşlanmanın artışı, hava kirliliği nüfus artışı, gibi risk faktörlerine maruziyetin yükselmesi ve kentli nüfusun artışına paralel olarak KOAH’tan mortalite artmaktadır. Mevcut veriler KOAH’lı hastalarda daha erken yaşlarda komorbiditelerin gelişebileceğini göstermektedir. KOAH ile ilişkili komorbiditeler, KOAH’lı hastalarda ölümlerle ilişkili olabilir. Pek çok ülkede erkeklerde KOAH mortalite hızı daha fazla iken, Yeni Zelanda, Amerika Birleşik Devletleri (ABD) ve İngiltere’de ise kadın-erkek mortalite oranlarının aynı seviyede olduğu gözlenmektedir. Düşük-orta gelirli ülkelerde ve gelişmiş ülkelerin yoksul kesimlerinde ise hastalıktan ölümler artmayı sürdürmektedir [16].

2.2. KOAH’ın Risk Faktörleri

Risk faktörleri arasında önemli sigara içme öyküsü olan 35 yaşından büyük yaş, α 1-antitripsin eksikliği ve iç veya dış ortam hava kirliliğine, mesleki tozlara veya kimyasallara önemli ölçüde maruz kalma öyküsü yer alır. KOAH olasılığını artıran öykü ve fizik muayeneden elde edilen diğer bulgular arasında 40 paket-yıldan fazla sigara içme öyküsü bulunur. Kronik solunum yolu hastalıkları (KOAHA) için en önemli risk faktörleri tanımlanmıştır ve bunlar arasında sağlıksız beslenme, tütün kullanımı, obezite, fiziksel hareketsizlik iç ve dış kirliticilere maruz kalma, mesleki maruziyet alerjenler, ve diğer faktörler yer almaktadır [17].

KOAHA, esas olarak tütün dumanına, biyokütle yakıt dumanına veya zehirli gazlar, kömür parçacıkları veya inorganik eser kirliticilerle kirlenmiş havaya maruz kalmanın neden olduğu solunum sisteminin kronik inflamatuvar bir hastalığıdır. KOAH hastalarının yaklaşık %25-45’i hiç sigara içmemiştir ve hava yolu enfeksiyonları, açlık, kronik astım, bozulmuş akciğer büyümesi ve kötü sosyoekonomik durum gibi diğer risk faktörlerinin KOAH gelişimi için önemli olduğunu gösteren daha fazla kanıt vardır. Mesleki toza maruz kalma, endüstriyel toksik gazlar ve buharlar ve biyokütle yakıtlarının kapalı ortamlarda yakılması gibi dış risk faktörlerinin ilave etkilerinin yanı sıra, doğuştan gelen genetik yatkınlık, doğum öncesi doğum, bebek enfeksiyonları ve doğum öncesi annenin dumanına maruz kalması riski artırır. KOAH da en sık görülen risk faktörleri, düşük gelirli ülkelerde hayvan gübresi, mahsul artıkları, kömür ve odun gibi biyokütle yakıtlarının ısınma ve yemek pişirmek için yakılmasıdır [17].

Sigara Kullanımını ve Pasif İçicilik: KOAH gelişimi için baskın risk faktörü, eski veya halen tütün içimidir hamilelik veya erken çocukluk döneminde ikinci el sigara dumanı gibi faktörlerde KOAH oluşumuna neden olmaktadır [2]. Tütün içimi KOAH için temel çevresel risk faktörü olmasına rağmen, dünya çapında etkilenen hastaların yaklaşık üçte biri sigara içmiyor [18].

Hava Kirliliği: KOAH’da trafikle alakalı kirlilik ve tütün dumanına maruziyet belirleyici görülmektedir. Çalışmalar gelişmiş batı ülkelerinde sigara içme yaygınlığı ve hava kirliliğindeki azalmaya doğru orantılı olarak hastalıktan ölümlerin bazı ülkelerde azalmaya başladığı göstermektedir [15]. KOAH fizyopatolojisi inhalasyon yolu ile alınan zararlı gaz ve tozlar KOAH hastalarının akciğerlerinde

Kapalı Mekan Hava Kirliliği: Biyokütle yakıtına maruz kalma çevresel pişirme inflamatuvar yanıtı yol açarlar. Meydana gelen bu inflamatuvar yanıt, akciğer savunma ve onarım mekanizmalarını etkileyerek

fizyolojik anormalliklere, hava akımı obstrüksiyonuna ve doku hasarına, yol açmaktadır [19].ve ısıtma işleminden çıkan duman gibi kirleticiler kapalı mekan hava kirliliğine yol açmaktadır [18].

Mesleki maruziyet Mesleki toza maruz kalma, endüstriyel toksik gazlar, bilhassa silika, kömür tozu, tahıllar ve tekstil aşamasında kullanılan malzemelerin KOAH etmeni olduğunu gösteren güçlü düzeyde kanıt vardır [20].

Yaş: 40 yaş üstü yetişkinlerde görülme sıklığı %15-20'dir [21].

Alfa-1 Antitripsin Eksikliği: Mendel sendromlarına ek olarak, genom çapında ilişkilendirme çalışmalarında KOAH duyarlılığını etkileyen birçok genomik bölge tanımlanmıştır. Benzer şekilde, kantitatif amfizem ölçümleri gibi KOAH ile ilişkili fenotiplerle ilişkili çoklu genomik bölgeler bulunmuştur [22].

Solunum Yolu Virüsleri ve Bakteriler: Kronik obstrüktif akciğer hastalığının (KOAH). alt solunum yolunu enfekte eden ve hava yolu iltihabını artıran solunum yolu virüsleri ve bakteriler tarafından tetiklenirler. Alevlenmelerin sıklığı, hızlanmış akciğer fonksiyonu düşüşü, yaşam kalitesinde bozulma ile ilişkilidir. Alevlenmeler de sağlıkta giderleri önemli ölçüde arttırır [23].

Kronik obstrüktif akciğer hastalığı (KOAH), HIV enfeksiyonunun yeterince tanınmayan bir komplikasyonudur. HIV ile enfekte kişilerin %25'inin KOAH'a sahip olabileceği tahmin edilmektedir. HIV, akciğer iltihabı, tekrarlayan akciğer enfeksiyonları, özellikle tüberküloz (TB), artan sigara içimi, sosyo-ekonomik durum, çocuklukta solunum yolu hastalıkları ve endüstriyel ve çevresel maruziyetler gibi birçok faktörün karmaşık etkileşiminin bir sonucu olarak KOAH ile ilişkilidir; bunların her biri kendi başına KOAH için risk faktörleridir(KOAH, HIV enfeksiyonu olan kişilerde KOAH daha erken yaşta ortaya çıkar [22].

Yetersiz Beslenme: gelişmekte olan ülkelerde son yıllarda meyve, sebze, kepekli tahıllar ve balık tüketiminin azalması ve işlenmiş ve rafine gıdaların tüketiminin artmasıyla birlikte diyetle yapılan değişiklikler, başta KOAH olmak üzere kronik hastalıkların artan prevalansına artmasına neden oldu [1].

Düşük Sosyoekonomik Durum: KOAH durumu daha çok görülmektedir. Kötü beslenme, kötü yaşam koşulları, enfeksiyona maruz kalma gibi nedenler hastalık riskini arttırmaktadır [24].

2.3.KOAH Belirtileri

WHO,2019 a göre KOAH'ın en yaygın semptomları dispne, aşırı balgam üretimi ve kronik öksürüktür. Dispne :KOAH 'ilk görülen belirtisidir. Dispne, solunumun anormal ve bireyi rahatsız edici bir his olarak algılanması veya farkına varılması olarak da açıklanabilir [25].

2.4. KOAH'ta Komorbiditeler

Kardiyovasküler hastalıklar, KOAH ve gastroözefagial reflü, iskelet kası disfonksiyonu, anksiyete ve depresyon, uyku bozuklukları, akciğer kanseri, metabolik sendrom osteoporoz, KOAH ta metabolik sendrom ve diabetes mellitus gibi komorbiditeler bulunması olasıdır [26].

Epidemiyolojik çalışmalar, KOAH ile anksiyete ve depresyon gibi komorbid psikiyatrik bozukluklar arasında, depresyon prevalansı %16 ila %88,4 arasında güçlü bir ilişki belirlemiştir. Dahası, KOAH'lı bireylerde iskemik inme, geçici iskemik atak, uyku bozuklukları, demans ve parkinson hastalığı prevalansı daha yüksek olup, yaşla birlikte artmaktadır [27].

Çok şiddetli KOAH'lı hastalarda yorgunluk, kilo kaybı ve anoreksiya sık görülen sorunlardandır ([8], [28]).

2.5. KOAH Tanısı

GOLD'a göre spirometri, KOAH tanısı için temel araç olarak kabul edilir [30]. KOAH'ın teşhisi, değerlendirilmesi ve yönetimi çoğunlukla, bir saniyedeki zorlu ekspiratuar hacim (FEV1), zorlu vital kapasite (FVC),bu ikisinin (FEV1/FVC) oranı ile değerlendirilen hava akımı sınırlamasının derecesi tarafından yönlendirilir. İnspiratuar kapasite/toplam akciğer kapasitesi (TLC) oranı, arteriyel kan gazları ve egzersiz kapasitesi hastalığın şiddeti hakkında tamamlayıcı bilgi sağlar [8].

2.6. KOAH'ın Evrelendirilmesi

Bronkodilatör sonrası FEV1 temelinde KOAH şiddetinin spirometrik olarak Sınıflandırması [8].

Tablo 1. FEV1/FVC'nin <0.70 olduğu hastalarda sınıflandırma [8].

EVRELER

GOLD 1	Hafif	FEV1 ≥ %80'i beklenenin
GOLD 2:	Orta	%50 ≤ FEV1 < %80
GOLD 3:	Ağır	%30 ≤ FEV1 < %50
GOLD 4	Çok Ağır	FEV1 < %30'u

2.7. KOAH Tedavisi

Kronik obstrüktif akciğer hastalığı (KOAH), ulusal ve dünya çapında önde gelen ölüm nedenidir. Hastalarda hastalık seyri değişkendir. Farmakolojik tedavinin amacı semptomları en aza indirmek, egzersiz toleransını iyileştirmek ve alevlenme riskini azaltmaktır [4].

İnhale ilaçlar, astım ve KOAH gibi hava yolu obstrüksiyonu hastalıklarının farmakolojik tedavisinin temelidir. KOAH hastalarının çoğu, semptomların giderilmesi için kısa etkili beta-agonistler (SABA'lar) veya SABA/kısa etkili antikolinerjikler, ardından bronkodilasyonun sürekli idamesi için uzun etkili beta-agonistler veya antikolinerjikler ile tedavi edilecektir. İnhale kortikosteroidler KOAH monoterapileri olarak önerilmez, ancak tekrarlayan alevlenme öyküsü olan seçilmiş hastalarda idame tedavilerine eklenebilir [7]. KOAH tedavisinde kullanılan antioksidanlar, antiinflamatuvar ilaçlar, antibiyotikler, fosfodiesteraz enzim ,inhale kortikosteroidler inhibitörleri olarak sınıflandırılabilir [9]. Antibiyotiklerin alevlenme dönemleri dışında profilaktik olarak kullanımı hem maliyet artışına neden olduğundan hem de direnç gelişiminden dolayı önerilmemektedir [30].

Farmakoterapi ve sigarayı bırakma tedavinin temelidir ve hastalarda pulmoner rehabilitasyon, uzun süreli oksijen tedavisi ve cerrahi düşünülebilir [31]. Mevcut kılavuzlar, tedaviye inhale bronkodilatör ile başlamayı, gerektiğinde kombinasyon tedavisine geçmeyi ve semptomların şiddeti ve hava akımı tıkanıklığı ilerledikçe inhale kortikosteroidlerin eklenmesini önermektedir [32].

α -1 Antitripsin Tedavisi: α -1 antitripsin amfizemin tanımlanmış genetik bir nedenidir. Erken dönemde amfizemi başlayan bazı olgularda bu enzim ya hiç yoktur ya da çok düşük seviyededir. Bu hastalara α -1 antitripsin verilmektedir [33].

Antidepresanlar: KOAH hastalar üzerinde psikolojik açıdan olumsuz etkiler meydana getirebilir. Bu da kişilerin yaşam kalitesinde azalmaya neden olacağından ihtiyaç duyan hastalara kontrollü şekilde antidepresan tedavisi alabilmektedirler [34].

Mukoaktif ve Antioksidan ilaçlar: KOAH hastalarındaki önemli sorunlardan birisi de aşırı sekresyon oluşumudur. Bu sorun dispne ve enfeksiyona neden olabilmektedir. Bu gruptaki ilaçlar hastaların sekresyonlarını rahat atılmasını sağlamaktadır. Bu ilaçlar, ekspektoranlar, mukolitikler ve mukoregülatuarlardır [35].

KOAH atakları çoğunlukla enfeksiyonlar tarafından tetiklenmektedir. Atakları önlemek için hastalara

grip ve pnömokok aşılarını yaptırmaları önerilmektedir. Fakat konu ile ilgili çalışmalar göstermiştir ki KOAH hastalarında aşılama oranları yeterli değildir [36].

İnfluenza aşısı: Çalışmalar KOAH olgularında influenza aşılama oranının hastaneye yatış gerektiren ciddi alt solunum yolu infeksiyonlarını ve mortaliteyi azalttığını göstermiştir. KOAH lı hastalar gripten korunmak için ölü ya da inaktive influenza aşılarını yılda bir kez tekrarlanması önerilmektedir. İnfluenza aşısının bilhassa yaşlılarda iskemik kalp hastalığı riskini azalttığını gösteren kanıtlar vardır [36].

Pnömokok aşısı: PPSV23 aşısının ise 65 yaş üstünde ve özellikle komorbid hastalığı olan, ileri evre KOAH'lı hastalarda uygulanmalıdır [36].

Tablo 2. Modifiye Medical Research Council (mMRC)'' dispne skalası [1].

Derece 0	Sadece ağır egzersiz sırasında nefesim daralıyor
Derece 1	Sadece düz yolda hızlı yürüdüğümde ya da hafif yokuş çıkarken nefesim daralıyor.
Derece 2	Nefes darlığım nedeniyle düz yolda kendi yaşlarıma göre daha yavaş yürümek ya da ara ara durup dinlenmek zorunda kalıyorum
Derece 3	Düz yolda 100 m veya birkaç dakika yürüdükten sonra nefesim daralıyor ve duruyorum.
Derece 4	Nefes darlığım yüzünden evden çıkamıyorum veya giyinip soyunurken nefes darlığım oluyor

Tablo 3. KOAH Değerlendirme Anketi (CAT) [1].

SKOR

Hiç öksürmüyorum	0 1 2 3 4 5	Sürekli öksürüyorum
Akciğerlerimde hiç balgam olmaz	0 1 2 3 4 5	Akciğerlerim her zaman balgam ile dolu
Göğsümde hiç tıkanma/daralma hissetmiyorum	0 1 2 3 4 5	Göğsümde çok daralma hissi mevcut
Yokuş veya bir kat merdiven çıktığımda nefesim daralmıyor	0 1 2 3 4 5	Yokuş veya bir kat merdiven çıktığımda nefesim çok daralıyor
Evdeki hareketlerimde hiç zorlanmıyorum	0 1 2 3 4 5	Evdeki hareketlerimde çok zorlanıyorum
Akciğerlerimin durumuna rağmen evden çıkarken hiç çekinmiyorum	0 1 2 3 4 5	Akciğerlerimin durumu nedeniyle evden çıkmaya çekiniyorum
Kendimi çok enerjik hissediyorum	0 1 2 3 4 5	Kendimi hiç enerjik hissetmiyorum
TOPLAM SKOR		

2.8. KOAH ve Hemşirelik Bakımı

Özellikle hemşireler, benzersiz konumları nedeniyle KOAH hastalarının uzun süreli bakımına önemli bir katkıda bulunabilirler. Hemşireler, hastalığın önlenmesinden yaşamın sonuna kadar bakımın tüm aşamalarında yer alır. KOAH bakımındaki başlıca zorluklar, bir hastayı hastalığın sonuçlarıyla birlikte

günlük yaşamda yönlendirmek, semptomların etkisini azaltmak ve sağlıkla ilgili yaşam kalitesini iyileştirmek [37].

KOAH'ta En Sık Kullanılan Hemşirelik Tanıları

Gaz değişiminde bozulma, etkisiz hava yolu temizliği, aktivite intoleransı, uyku örüntüsünde bozulma, beden gereksiniminden az beslenme, anksiyetedir [24].

Evde Bakım

Kronik hastalıkların erken ve geç komplikasyonlarını özellikle evde bakım hizmeti, hastaneye uzun süreli yatışları ve ciddi maliyet artışlarını azaltır. Avrupa'da evde sağlık hizmeti uzun yıllardır uygulanan bir toplum hizmetidir. Türkiye'de evde bakım hizmetleri, 10/3/2005 de ve 2575 sayılı Resmi Gazete'de yayımlanan "Evde Bakım Hizmetleri Sunumu Hakkında Yönetmelik" ile yasal düzenleme kurulmuş, Ankara da bulunan 18 devlet ve 15 eğitim araştırma hastanesinde "Evde Sağlık Hizmetleri Birimleri" kurulmuştur [38].

Solunum sistemi hastalıklarında evde çeşitli sağlık hizmetleri, sağlık ekibi tarafından sunulmaktadır [1].

2.9. Kronik Obstrüktif Akciğer Hastalığının Evde Kanıta Dayalı Bakımı

Kronik hastalıkların yönetiminde Kanıta Dayalı Rehber kullanımı hastanın, öz bakımının desteklenmesini bakıma aktif katılımını, hasta ile sağlık personeli arasındaki ilişkinin sürekliliğini sağlar [38].

Kronik hastalık yönetiminde kanıta dayalı klavuzlar kullanılmalıdır. Sağlık uygulamaları bakım ihtiyacı olan hastalara daha iyi hizmet verebilmek için yeniden organizasyon sağlanmalıdır. Hastalarda yaşam tarzı değişiklikleri ve davranış değişikliklerini yapabilmek için hastaları bilinçlendirmek amacıyla hasta ve hastaların ailelerine eğitimler verilmelidir [39]. Uzman ekibin kuvvetlenmek için kılavuzlar ve diğer materyaller yoluyla ekibin bilgisi yükseltilmeli, karar verme yetileri geliştirilmelidir. Bakımın iyi planlanıp geri bildirimlerin yapılabilmesi için ekipte bir bilgi ağı oluşturulmalıdır [40].

GOLD 2021 raporuna göre, KOAH tedavisinde kullanılan ilaçların (kortikosteroidler, bronkodilatörler, inhale) mortalite ve akciğer fonksiyonlarında uzun dönem azalmayı etkilediğine dair net bir kanıt yoktur. KOAH'ta ilaç tedavisi, semptomları azaltmak, alevlenmelerin sıklığını, şiddetini azaltmak ve egzersiz toleransı ile sağlık durumunu iyileştirmek için kullanılır [1].

Kronik obstrüktif akciğer hastalığı ülkemizde ve tüm dünyada önemli bir halk sağlığı sorunu olmasına karşın, sağlık yöneticileri, kamuoyu ve hekimler tarafından yeterince bilinmeyen, yeterince teşhis edilmeyen, teşhis edilenlerin de genellikle aşırı tedaviye maruz kaldığı bir hastalıktır. Gelişmiş ülkelerde muhtemelen kadınlarda sigara içme davranışının yaygınlaşmasıyla KOAH prevalansı ve mortalitesi kadın ve erkeklerde eşitlenmeye başlamıştır [1].

KOAH'lı hastanın evinde uygulanan pulmoner rehabilitasyon programının uygulanması, hastanede uygulanan rehabilitasyona göre daha maliyetsizdir, hastanın ulaşım sorunu yoktur ve kendi ortamında yaşam şeklini değişikliği için programın etkisi daha uzun sürebilir. Evde bakım programları yakın izlem gerektirmeyen, motivasyonu ve öz yönetimi yüksek olan hastalar için daha uygundur. KOAH'lı bireylere ve ailelerine motivasyonel eğitim faydalı gelmektedir. Hemşire liderliğinde sunulan KOAH'lı hasta ve ailesinin eğitimini, bireylere etkili evde bakım programları, bireyin maksimum bağımsızlık ve aktif katılımını sağlayarak yaşamında sorumluluk almasını, bireysel bakım gücünün arttırılmasını hedeflemektedir [41].

PULMONER REHABİLİTASYON

İlk olarak 1974 yılında American College of Chest Physicians Committee tarafından tanımlanan pulmoner rehabilitasyon (PR), KOAH semptomlarını en aza indirmeye, sağlıkla ilişkili yaşam kalitesini iyileştirmeye ve günlük yaşamda fiziksel ve duygusal katılımı artırmaya yönelik bir yaklaşımdır [42].

En iyi kanıtlar ve mevcut tüm uluslararası kılavuzlarda, KOAH'lı kişilerin tedavisinde pulmoner rehabilitasyonun merkezi rolü bulunmaktadır. Programlar, hastanın hastalığının ağırlığını, problemlerini çözmek için gerekli bileşenleri, sonucu belgelemek için yeterli değerlendirmeyi ve hastanın tercihlerine özen göstermelidir. Multidisipliner rehabilitasyon ekibi, rehabilitasyon konusunda uzman bir göğüs doktoru, bir beslenme uzmanı bir fizyoterapist, egzersiz eğitimi uzmanı, bir psikolog, bir sosyal hizmet uzmanı, bir uğraşı terapisti ve bir hemşireden oluşur. Konuşma terapisti gibi diğer disiplinler daha az yaygındır. Egzersiz eğitimi için bol miktarda kanıt olmasına rağmen, diğer disiplinler, belirli hastalarda varlıklarının açık bir gerekçesi olmasına rağmen, çok daha az kanıta dayalıdır. Ek olarak, hastalara farklı sağlık hizmeti sağlayıcıları ile deneyimleri sorulduğunda, hastaların büyük bir kısmı rehabilitasyon ekibinin bu üyelerinin programın genel olarak algılanan yararına katkıda bulunduğunu bildirmiştir [43]. Pulmoner rehabilitasyon, KOAH'lı hastalarda hastaneye yatışların ve yeniden yatışların sayısını ve süresini azaltır ve sağlıkla ilgili yaşam kalitesini iyileştirir [44].

Başarılı rehabilitasyon, hastaların günlük yaşamlarına daha fazla fiziksel aktivite ve öz yeterliliğin aktarılmasıyla sürdürülmeli ve desteklenmelidir Ne yazık ki, pulmoner rehabilitasyona sırasında elde edilen kas fonksiyonu ve fiziksel performans yeteneğindeki gelişmeler, hastaların günlük yaşamlarında aktivite davranışlarında bir artışı otomatik olarak tetiklemez. Bu, hastaların kendi motivasyonlarının önemini bir kez daha vurgulamaktadır. Uzun vadede etkinliği artırmaya ve böylece halkla ilişkiler sırasında elde edilen faydalı etkileri kalıcı olarak yerleştirmeye yönelik özel motivasyon programları bugüne kadar çelişkili sonuçlar vermiştir, daha fazla araştırmaya ihtiyaç vardır. Tedavi sürecine katılan herkesin hastaları tekrar tekrar fiziksel aktiviteye katılmaya teşvik etmeye devam etmesi önemlidir. Yüksek kaliteli kanıtlar, bir alevlenmeden sonra pulmoner rehabilitasyonun sağlıkla ilgili yaşam kalitesini iyileştirdiğini göstermektedir. Dispne, yorgunluk ve duygusal işlev alanları için istatistiksel olarak anlamlı ve önemli etkiler gözlemlendi [45].

KOAH ve Sigarayı Bırakma

Sigara içmek KOAH'ın en önemli nedensel faktörü olarak kabul edilir, ancak sigara içenlerin sadece %10-20'si hastalığa yakalanır [46].

Farmakolojik olmayan müdahaleler tüm KOAH hastalarının yönetiminde önemli bir rol oynamaktadır. Yaşam kalitesindeki iyileşme ve hastaneye yatış riski göz önüne alındığında, her yaşta hastaya sigarayı bırakma teşvik edilmelidir [47]. Tütün dumanı, kronik obstrüktif akciğer hastalığının önde gelen nedenidir. Sigarayı bırakmak KOAH'ın doğal ilerleyiş seyrini değiştirebilir. 2018 yılında yapılan bir araştırmaya göre vareniklin ile elde edilen sigara bırakma tedavisinin, özellikle hafif KOAH'ta bronkodilatör ile kombine edildiğinde çok önemli bir tedavi seçeneği olduğu görüldü. Sigarayı bırakan hastalar, kısa vadede her iki tedaviden de fayda görebilir, akciğer fonksiyonlarını ve solunum semptomlarını iyileştirebilir ve dolayısıyla yaşam kalitelerini iyileştirebilirler [48].

Trivedi ve arkadaşlarının 2022 de yayınladığı bir çalışmaya göre sigarayı bıraktıktan sonra, eski sigara içenlerin sigara içmeyle ilişkili olduğu tespit edilen çok sayıda genin tersine çevrilebilirliğini göstermesi gerçekten ilgi çekicidir. Sigaranın bırakılmasıyla birlikte genin KOAH'ı bırakanlarda başlangıç değerlerine dönmeye başladığını ve böylece KOAH'ı eski sigara içenlerde aşırı mukus üretimini azalttığını göstermektedir. Yapılan bir çalışmaya göre, sigarayı bırakmanın erken bir aşamada başlatılırsa

faydalı olduđu görüşü desteklemektedir [49].

İç Mekân Hava Kirliliđi ve KOAH

Kronik Obstrüktif Akciđer Hastalığı için Küresel Girişim (GOLD)e göre, odun ve diđer biyokütle yakıtlarının yakılmasından kaynaklanan iç mekan hava kirliliđini KOAH için önemli bir risk faktörü olarak tanımlamaktadır. Pasif içiciliđe(SHS) maruz kalma ile KOAH gelişimi arasında bağlantı kuran çalışmalar olmuştur ve KOAH'lı olanlar arasında SHS(pasif içicilik) maruziyetinin daha kötü yaşam kalitesine, nefes darlığına ve KOAH alevlenmesi riskinin artmasına neden olduğunu gösteren kanıtlar vardır [50].

Kontrollü şekilde havalandırma, yemeđi uygun hava kirletmeyen şekilde pişirme iç ve dış hava kirliliđinin engellenmesinde önemlidir [51].

Hava sıcaklığı ve KOAH

İklim deđişikliği bağlamında öngörülen sıcaklıkta beklenen artışlarla birlikte ısıya maruz kalmanın etkilerine artan bir ilgi vardır. Çalışmalar, yaşlı bireylerin ve KOAH da dahil olmak üzere altta yatan kalp ve solunum yolu hastalıkları olan kişilerin, ısıya maruz kalmanın olumsuz sağlık etkileri açısından yüksek risk altında olduğunu tutarlı bir şekilde bulmuştur [50].

12 ABD şehrinde yapılan bir araştırma, yaz aylarında sıcak havaların etkisinin KOAH'a atfedilen ölüm riskini %25'e kadar artırabileceđini tahmin ediyor [52].

KOAH Beslenme

KOAH'lı hastalarda yağsız vücut kütleindeki bir kaybın kötü bir prognostik parametre olduğu bulunmuştur. Biyoelektrik empedans analizi kullanılarak deđerlendirilebilen yağsız kütle kaybına, kas güçsüzlüğü ve yaşam kalitesinin düşmesi eşlik eder. Hedeflenen kalorili gıda takviyesi, özellikle yetersiz beslenen hastalarda yağsız kütle üzerinde faydalı bir etkiye sahip olabilir ve ayrıca fiziksel performans kabiliyetini, yaşam kalitesini ve hatta akciđer fonksiyonunu iyileştirebilir [51].

Nefes darlığı nedeniyle büyük ana öğünler yiyemeyen hastalarda daha sık, küçük öğünler önerilir. Hastanın diyeti dengeli ise vitamin veya mineral eklenmesi gerekli görülmez. Bireysel beslenme tedavisi, özellikle yetersiz beslenen hastalarda ve beden eğitimi ile birleştirildiğinde, KOAH ile mücadelede etkili bir müdahaledir [52].

Diyet, kronik hastalıkların gelişimi ve ilerlemesi için deđiştirilebilir bir risk faktörü olarak kabul edilmiştir bilim topluluđu, önlemeden tedaviye KOAH yönetiminin ayrılmaz bir parçası olarak diyetle çok dikkat etmeye başlamıştır. Kesin veriler olmamasına rağmen, mevcut bilimsel kanıtlar bazı gıdaların ve besinlerin, özellikle antioksidan ve anti-inflamatuar özelliklere sahip olan ve dengeli beslenme düzenleri şeklinde kombinasyonlar halinde tüketildiğinde, daha iyi pulmoner fonksiyon, daha az akciđer fonksiyonu düşüşü ve daha az KOAH riski ile ilişkilidir. KOAH üzerindeki diyet etkilerinin bilgisi, sağlık uzmanlarına, hastalara gelişmiş akciđer sağlığına yönelik daha iyi danışmanlık yapmak için kanıta dayalı bir yaşam tarzı yaklaşımı sağlayabilir. Son yıllarda sebze, meyve, tahıllı ürünler ve balık tüketiminin azalması ve işlenmiş rafine gıdaların tüketiminin artmasıyla birlikte diyetle yapılan deđişiklikler, KOAH olmak üzere gelişmekte olan ülkelerde kronik hastalıkların prevalansını yükseltmiştir [1].

Antioksidan ve Antiinflamatuar Gıdaların Rolü: Meyve ve Sebzeler, Vitamin ve Vitamin Olmayan Antioksidanlar, Mineraller, örneđin selenyum, normalize edilmiş kalsiyum, klorür ve demirin serum seviyeleri ile bađımsız ve pozitif olarak ilişkiliydi ve genel popülasyonda, potasyum ve sodyum ile ters orantılıydı [53].

Alkol ve Şarap, Düşük alkol tüketimi olan deneklerin daha yüksek FEV1 düzeylerine, daha düşük KOAH semptomları prevalansına ve tüketmeyenlere kıyasla daha düşük KOAH riskine sahip olduğunu bulmuştur [55].

Tam Tahıllar ve Lifler, Bir prospektif çalışmada diyetle daha yüksek toplam lif alımı KOAH riskini yaklaşık %40 oranında azaltmıştır [55].

D vitamini, Düşük plazma D vitamini seviyeleri ile ilişkili D vitamini bağlayıcı proteindeki genetik varyantlar da KOAH riski ile ilişkilendirilmiştir [56]. D vitamini düzeyleri düşük olan hastalarda (yani, aktif metabolit 25-hidroksivitamin D düzeyleri <25 nmol/L) bir faydaya işaret etmiştir [57].

Kahve ve Bileşenleri: Düzenli kafeinsiz kahve alımı ile gelişmiş akciğer fonksiyonu ve solunum hastalığına bağlı ölümlerde azalma arasında bir ilişkiye işaret etmektedir [58].

Akciğer Fonksiyonu ve KOAH Üzerinde Potansiyel Zararlı Etkileri Olan Gıdalar Potansiyel zararlı gıdalar arasında, işlem görmüş(pastırma, sosisli sandviç ve işlenmiş etler) tüketimi ile kırmızı et ve solunum fonksiyonları arasında istatistiksel olarak anlamlı bir ters ilişki rapor edilmiş olup, KAH(kronik akciğer hastalığı) dahil olmak üzere diğer solunumla ilgili olmayan hastalıklardaki zararlı etkilerin kanıtlanmıştır [1]. İşlenmiş et alımının KOAH'a yeniden yatış riskini artırdığını bulmuştur [59].

Veriye Dayalı Diyet Modelleri ve KOAH

Çinli Singapurlularda yapılan bir kohort çalışması, (konserve yiyecekler; kırmızı et, pirinç, erişte, derin yağda kızartılmış yiyecekler) balgamlı öksürük vakalarında artışla ilişkili olduğunu buldu [60].

KOAH Egzersiz

KOAH'lı kişiler, aynı yaştaki sağlıklı bireylere kıyasla önemli ölçüde daha düşük günlük fiziksel aktivite (FA) seviyelerine sahiptir, FA'dan kaçınma genellikle artan hareketsizlik, kas zayıflığı ve azalmış egzersiz kapasitesi ile sonuçlanan efor dispnesi ile ilişkilidir [61].

KOAH'ta fiziksel hareketsizlik, kardiyovasküler hastalık, sık alevlenmeler, düşük sağlık durumu ve artan semptomlar riskini artırır. Garcia-Aymerich ve meslektaşları, en az 2 hafta süreyle yürüyüşe veya bisiklete binmeye eşdeğer fiziksel aktiviteye katılımın, KOAH'a bağlı hastaneye yatış ve mortalite riskinde %30-40'lık bir azalma ile ilişkili olduğunu bulmuşlardır [62].

KOAH'lı hastaların yönetiminde günlük fiziksel aktivite düzeylerini artırmaya yönelik müdahaleler önem kazanmaktadır KOAH'lı hastalarda düşük fiziksel aktivite düzeyleri, artan hastaneye yatış ve mortalite riski ile ilişkilidir. KOAH'lı hastalarda günlük fiziksel aktiviteyi iyileştirmeye yönelik etkili yaklaşımlara ihtiyaç vardır. Armstrong, ve ark yaptığı sistematik derleme ve meta-analize göre, son zamanlarda yayınlanmış iki RKÇ(randömize kontrollü çalışma) dahil olmak üzere, tek başına veya pulmoner rehabilitasyonun yanında bir müdahale olarak kullanıldığında adım sayar temelli fiziksel aktivite teşvikinin günlük adımları desteklediğine dair kanıtlar sunmaktadır. Fiziksel aktivite seviyeleri >4000 adım·gün olduğunda hastaların fiziksel aktivite teşvikinden daha fazla fayda sağladığına dair daha fazla kanıt bulmuştur [61]. KOAH da uygulanan antrenman tiplerinden bazıları:

Dayanıklılık antrenmanı: Üst ve alt uzuvlar için klasik antrenman şeklidir ve bu nedenle popülerdir. Duran bir bisiklet üzerinde yapılan antrenmana ek olarak, dayanıklılık antrenmanı da yürüyüş egzersizi olarak (koşu bandında veya zeminde) yapılabilir [62].

Kuvvet antrenmanı: Kuvvet antrenmanı bağlamında, amaç, alt ekstremiteyi çalıştırarak büyük kas gruplarını güçlendirmektir, çünkü bu, hastalıkla ilişkili kas atrofisinin genellikle en belirgin olduğu yerdir. kuvvet antrenmanı ekipmanı, serbest ağırlıklar veya kişinin kendi vücut ağırlığı kullanılarak - bireysel hastaya göre ayarlanmış bir seviyede yapılabilir [63].

Nöromusküler Elektrik Stimülasyonu: KOAH'lı hastalarda sıklıkla iskelet kası disfonksiyonu görülür.

Beden eğitimi yapamayan veya yapmaya isteksiz olanlar için nöromusküler elektrik stimülasyonu (NMES) alternatif bir rehabilitasyon yöntemi sağlayabilir. Bu eğitim yöntemi özellikle ileri derecede engelli veya hareketsiz olan hastalarda kullanılır; yakın tarihli bir meta-analize göre, bu alt grupta 6 dakikalık yürüme mesafesini +37m (P<0.001) kadar önemli ölçüde iyileştirebilir [64].

Tüm vücut titreşim eğitimi: Titreşim eğitimi, genellikle bir titreşim platformu üzerinde durarak, salınan bir titreşim uyarıcısı aracılığıyla harici stimülasyon ile karakterize edilir. Belirli bir titreşim frekansının üzerinde, esneme uyarısı, istemsiz bir kas kasılmasına yol açan bir refleksi tetikler. Çok şiddetli KOAH'lı hastalarda yapılan daha önceki bir randomize kontrollü çalışma, ek olarak, genel antrenmana ek olarak vibrasyon antrenmanının, 6 dakikalık yürüme testinde fiziksel performans kabiliyetini daha fazla geliştirdiğini bulmuştur [44].

KOAH'lı hastalarda egzersiz kapasitesini değerlendirmek için en yaygın kullanılan yöntemlerden biri 6 dakikalık yürüme testidir, bir egzersiz testidir [65].

KOAH'ta Oksijen Tedavisi

Evde uzun süreli oksijen tedavisinin KOAH ve ciddi istirahat hipoksemisi olan hastalarda sağ kalımı iyileştirdiği gösterilmiştir(Lacasse ve ark., 2018). Uzun süreli oksijen tedavisi (LTOT), şiddetli gündüz hipoksemisi olan hastalarda sağ kalımı iyileştiren kronik obstrüktif akciğer hastalığı (KOAH) yönetiminin tek bileşenidir [66].

Evde Oksijen Tedavisi Terminolojisi

Ayakta Oksijen: Birey serbestçe yürürken egzersiz veya günlük yaşam aktiviteleri sırasında verilen oksijendir [67].

Sürekli akış oksijen: Oksijen, solunum: hızından bağımsız olarak sabit bir hızda verilir [67].

Sürekli Oksijen: Oksijen 24 saat/gün reçete edilir [67].

Evde Oksijen: Bir evde verilen oksijendir. Evsel oksijen olarak da bilinir. Yalnızca uzun süreli oksijeni değil, aynı zamanda kısa süreli, gece, palyatif, ayaktan ve kısa süreli oksijeni de içerir. Sağlık ve acil durum ortamlarında oksijen kullanımını içermez [67].

Uzun Süreli Oksijen: Oksijen, kronik hipoksemili hastalara, çoğu durumda hastanın hayatının geri kalanı boyunca verilir. Uzun süreli oksijen tedavisi genellikle en az 15-18 saat/gün olarak reçete edilir [67].

Gece-Oksijeni: Oksijen sadece uyku sırasında verilir [67].

Palyatif Oksijen: Sürekli veya gece oksijen olarak veya ambulasyon sırasında sağlanabilir. Kısa süreli oksijen tedavisi bu kategoriye girer [67].

Taşınabilir Oksijen: Oksijen, hafif olan ve hastalar tarafından evlerinden çıkmalarına izin verecek şekilde taşınabilen sistemler aracılığıyla (örneğin, arabalarda veya taşınabilir konsantratörlerde taşınan oksijen tüpleri) verilir [67].

Nabız-Doz Oksijen: Solunum sırasında verilen oksijen, yalnızca: uygulanan oksijen miktarı solunum hızından etkilenecek şekilde verilir. Hasta ekshalasyon yaparken dağıtım sistemi istirahat halindedir [67].

Kısa Süreli Oksijen: Bilinen hipoksemisinin yokluğunda genellikle ihtiyaç duyulduğunda kullanılan, egzersizden önce-ve/veya sonraki ve-aralıklı oksijen uygulamasıdır [67].

Orta ve şiddetli KOAH'lı hastalar, uzun süreli oksijen tedavisi ihtiyacını belirlemek için hipoksemi açısından periyodik olarak değerlendirilmelidir. Oksijen tedavisi alan hastalar, %88 ila %92 hedef oksijen saturasyonu veya 60 mm Hg'den büyük PaO₂ elde etmek için günde en az 15 saat kullanılmalıdır. Efor veya gece dispnesini azaltmak için oksijen tedavisi kullanılabilir, ancak istirahat PaO₂'si 55 mm Hg'den az değilse, mortaliteyi azalttığına veya sağlıkla ilgili yaşam kalitesini veya gündüz hipoksemisini iyileştirdiğine dair bir kanıt yoktur [32].

Evde USOT (uzun süreli oksijen tedavisi) kullanımı hastalar açısından rahatlık sağlar ama pahalı bir tedavi yöntemidir. Oksijen tedavisinin de istenen etkiye ulaşabilmesi için bazı şeylere dikkat edilmesi gerekmektedir. hemşire hastaya Oksijenin doğru kullanımı konusunda gerekli olan eğitimi planlamalı ve uygulamalı göstermelidir. Evde USOT'da en önemli nokta oksijenin günlük minimum 15 saat kullanılmasıdır. Uygun O₂ miktarı 1-3 lt/dk'dan olması gerekmektedir. Yüksek konsantrasyonda oksijen kullanımında solunum depresyonuna kadar giden istenmeyen etkiler görülebilmektedir. Oksijen yanıcı bir gaz olduğundan oksijen kaynağının yanında sigara ve yanıcı şeylerin kullanılmaması gerektiği açıklanmalıdır. oksijen sağlayıcı cihazın servis bakımlarının düzenli olarak yaptırılmasının önemi vurgulanmalıdır [1].

İnhaler ilaç kullanımı

İnhalerin doğru kullanımı ve inhale ilaçların etkinliğinin sağlanması için hasta eğitimi hayati önem taşımaktadır. Hastanın başarılı öğrenmesinin önündeki potansiyel engelleri değerlendirmede ve inhaleler tekniğini ve ilaç yönetimini iyileştirmede kritik bir role sahiptir. Yapılan çalışmalarda yanlış inhaleler kullanma oranının % 21-91 arasında olduğu belirlenmiştir. Yanlış inhaleler kullanımı, semptomların kontrol edilmesinde başarısızlığa yol açmaktadır [68].

İnhaleler ilaç kullanan KOAH'lı bireylerin kontrol edilmesidir. İnhaleler ilaç eğitimi verilirken kanıta dayalı rehberlerin kullanılmalıdır. Eğitimin verimli sürdürülebilmesi için inhaleler ilaç eğitimi, alanında uzmanlaşmış hemşirelerin danışmanlığında, hasta özellikleri dikkate alınarak düzenli verilmesi, inhaleler ilaç eğitiminin görsel ve işitsel yöntemler ile birlikte sürdürülmesi, eğitimin periyodik aralıklarla kontrol edilip tekrarlanması önerilebilir [68].

Solunum Egzersizleri

Solunum egzersizlerinin KOAH hastalarının yorgunluk düzeylerine etkisini araştıran bir çalışma, bu programın KOAH hastalarının yorgunluk düzeyi açısından etkili olduğunu göstermiştir [69].

Aerol tedavi, akciğerin gelişmesine yardımcı yöntemler, diyafragmatik solunum, pursed lips solunum, pulmoner rehabilitasyonda solunum sisteminin tedavisinde etkilidir [24].

Hasta Eğitimi

Halkla ilişkiler sırasında hastaları bilgilendirmenin ve eğitmenin birincil amacı, öz yeterlilikte bir artış sağlamaktır. Eğitim kursları, yalnızca didaktik bir araçtan, hastaların kendi kendine yeterliliği de dahil olmak üzere, uyarlanabilir ve yaşam boyu davranış değişiklikleri ile tutum ve farkındalıktaki değişikliklere doğru gelişmiştir. Değişen davranışlar için olumlu örnekler ilaçlara daha iyi uyum, egzersizin devamı ve diyet değişiklikleri, fiziksel aktivitede artış, sigara bırakma, günlük yaşam aktiviteleri sırasında enerji tasarrufu stratejilerinin kullanılmasını içerir [44]. Bu nedenle, yalnızca bilgi ve bilgi aktarmanın yanı sıra, birincil hedefler pratik, gerçekçi beceriler uygulamak (örneğin, doğru inhalasyon tekniklerini öğrenmek) ve hastalıklarla aktif bir başa çıkma yöntemi geliştirmektir [44].

SONUÇ

KOAH'lı bireylere evde verilen kanıta dayalı hemşirelik bakımı, hasta ve ailesinin eğitimini, bireyin öz yeterliliğini ve bakıma etkin katılımını sağlayarak yaşamında hastalığında sorumluluk almasını, öz bakım gücünün artırılmasını sağlamaktadır. KOAH'lı bireylere holistik anlayışla verilen evde bakım yönetiminin sağlanması birey ve ailesinin hastalığı yönetim sürecinde akut alevlenmeleri ve hastalık yönetimi ile ilgili yol gösterici olacaktır. Bu konuda ülkemizde evde bakım konusunda KOAH ve diğer kronik hastalıklar konusunda daha çok çalışma yapıp hastalar ve ülkenin ekonomik refahı için gerekmektedir.

KAYNAKLAR

- [1]. Global Initiative for Chronic Obstructive Lung Disease (GOLD).(2021) Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease.
- [2]. Scoditti, E., Massaro, M., Garbarino, S. ve Toraldo, DM (2019).Kronik obstrüktif akciğer hastalığının önlenmesi ve tedavisinde diyetin rolü. *Besinler*, 11 (6), 1357.
- [3]. Labaki, W. W., & Rosenberg, S. R. (2020). Chronic Obstructive Pulmonary Disease. *Annals of internal medicine*, 173(3).
- [4]. Duffy, S. P., & Criner, G. J. (2019). Chronic Obstructive Pulmonary Disease: Evaluation and Management. *The Medical clinics of North America*, 103(3), 453–461.
- [5]. Rabe, K. F., & Watz, H. (2017). Chronic obstructive pulmonary disease. *Lancet (London,England)*, 389(10082), 1931–1940.
- [6]. Michael H Cho, Brian D Hobbs, Edwin K Silverman (2022). Genetics of chronic obstructive pulmonary disease: understanding the pathobiology and heterogeneity of a complex disorder, *The Lancet Respiratory Medicine*, Volume 10, Issue 5,
- [7]. Lareau, S. C., Fahy, B., Meek, P., & Wang, A.(2019). Chronic Obstructive Pulmonary Disease (COPD). *American journal of respiratory and critical care medicine*,199(1), P1–P2.
- [8]. Global Initiative for Chronic Obstructive Lung Disease (2019). Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease.
- [9]. Eroğlu N, Temiz G. (2021). Kronik Hastalıklarda Hemşirelik Süreci .Kronik Hastalıklar İstanbul: Nobel Tıp Kitabevleri: 1-59
- [10]. Lee, Hyun; SIN, Don D. (2022). KOAH'ın birçok nedenini ve yüzünü tanımak. *Lancet Solunum Tıbbı*, 10.5: 426-428.
- [11]. Gut-Gobert, C., Cavaillès, A., Dixmier, A., Guillot, S., Jouneau, S., Leroyer, C., Marchand-Adam, S., Marquette, D., Meurice, J. C., Desvigne, N., Morel, H., Person-Tacnet, C., & Raheison, C. (2019). Women and COPD: do we need more evidence?. *European respiratory review : an official journal of the European Respiratory Society*, 28(151), 180055. <https://doi.org/10.1183/16000617.0055-2018>
- [12]. McIvor, E. R., Saraiva, I., Denning, J., & McIvor, R. A. (2020). Women with COPD. *Breathe*, 16(4).
- [13]. Sansores, Raúl H.; Ramírez-Venegas, Alejandra. (2016). COPD in women: susceptibility or vulnerability?. *European Respiratory Journal*, 47.1: 19-22.
- [14]. Kocabaş, A., Yıldırım, N., Gürgün, A., Köktürk, N., Şen, E., Uzaslan, A., & Umut, S. (2010). Türk Toraks Derneği Kronik Obstrüktif Akciğer Hastalığı Tanı Ve Tedavi Uzlaşı Raporu. *Toraks Dergisi*.
- [15]. Şen, E., Apaydın, A.Ö (2021). Türk Toraks Derneği'nin GOLD 2021 Kronik Obstrüktif Akciğer Hastalığı (KOAH) Raporuna Bakışı.
- [16]. Xie, M., Liu, X., Cao, X., Guo, M., & Li, X.(2020). Trends in prevalence and incidence of chronic respiratory diseases from 1990 to 2017. *Respiratory research*, 21 (1), 1-13.I
- [17]. Szalontai, K., Gémes, N., Furák, J., Varga, T., Neuperger, P., Balog, J. Á., ... & Szebeni, GJ (2021). Kronik obstrüktif akciğer hastalığı: epidemiyoloji, biyobelirteçler ve akciğer kanserine giden yolu döşemek. *Klinik Tıp Dergisi*, 10 (13), 2889.
- [18]. Agusti, A. ve Hogg, JC (2019). Kronik obstrüktif akciğer hastalığının patogenezinde güncelleme. *New England Tıp Dergisi*, 381 (13), 1248-1256.
- [19]. Kara, N. (2019). *Kronik Obstrüktif Akciğer Hastalarının Bakım Bağımlılığı*. Doktora Tezi.

Marmara Üniversitesi (Turkey).

- [20]. Şahan, C. (2019). Mesleki KOAH Tanısına Yaklaşım. Güncel Göğüs Hastalıkları Serisi; 7 (2): 67-73.
- [21]. Köksal, N., ve Durgun, H. (2022). Koah Tanısı İle İzlenen Bireyin Watson İnsan Bakım Kuramı'na Göre Hemşirelik Bakımı: Olgu Sunumu. *Bandırma Onyedi Eylül Üniversitesi Sağlık Bilimleri Ve Araştırmaları Dergisi*, 4(1), 82-93.
- [22]. Laloo UG, Pillay S, Mngqibisa R, Abdool-Gaffar S, Ambaram A.(2016) HIV and COPD: a conspiracy of risk factors. *Respirology*. Oct;21(7):1166-72. doi: 10.1111/resp.12806. Epub 2016 May 30. PMID: 27237114.
- [23]. Ritchie AI, Wedzicha JA. (2020). Kronik Obstrüktif Akciğer Hastalığı Alevlenmelerinin Tanımı, Nedenleri, Patogenezi ve Sonuçları. *Klinik Göğüs Med*. Eylül;41(3):421-438. doi: 10.1016/j.ccm.2020.06.077. PMID: 32800196; PMCID: PMC7423341
- [24]. Eroğlu, N. ve Temiz, G. (2021). Kronik Hastalıklarda Hemşirelik Süreci. *Kronik Hastalıklar*. İstanbul: Nobel Tıp Kitabevleri. 103-105.
- [25]. Demir, G., Akkoca, Ö., Doğan, R., Saryal, S., ve Karabıykoğlu, G. (2003). KOAH'da Dispne ve Yaşam Kalitesinin Değerlendirilmesi. *Tüberküloz ve Toraks Dergisi*, 51(4), 365-372.
- [26]. Türk Toraks Derneği (2017). Türk Toraks Derneği'nin GOLD kronik obstrüktif akciğer hastalığı (KOAH) raporuna bakışı.
- [27]. Jurevičienė, E., Burneikaitė, G., Dambrauskas, L., Kasiulevičius, V., Kazėnaitė, E., Navickas, R., Purnaitė, R., Smailytė, G., Visockienė, Ž., & Danila, E. (2022). Epidemiology of Chronic Obstructive Pulmonary Disease (COPD) Comorbidities in Lithuanian National Database: A Cluster Analysis. *International journal of environmental research and public health*, 19(2), 970. <https://doi.org/10.3390/ijerph19020970>
- [28]. Erişen, M. (2019). *Kronik obstrüktif akciğer hastalığına sahip hastaların yorgunluk düzeylerinin incelenmesi*. Yüksek Lisans Tezi, Balıkesir Üniversitesi Sağlık Bilimleri Enstitüsü.
- [29]. Soriano, Joan B.; Polverino, Francesca; Cosío, Borja G. (2018). Erken KOAH nedir ve neden önemlidir?. *Avrupa Solunum Dergisi*, 52.(6).
- [30]. Vestbo J, Hurd SS, Agustí AG, Jones PW, Vogelmeier C, Anzueto A, Barnes PJ, Fabbri LM, Martinez FJ, Nishimura M, Stockley RA, Sin DD, Rodriguez-Roisin R.(2012). Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. *Am J Respir Crit Care Med*. 2013 Feb 15;187(4):347-65. doi: 10.1164/rccm.201204-0596PP. Epub Aug 9. PMID: 22878278.
- [31]. Lareau, S. ve C. Hodder, Richard. (2012). Teaching inhaler use in chronic obstructive pulmonary disease patients. *Journal of the American Academy of Nurse Practitioners*, 24.2: 113-120.
- [32]. Gentry S, Gentry B. (2017). Chronic Obstructive Pulmonary Disease: Diagnosis and Management. *Am Fam Physician*. Apr 1;95(7):433-441. PMID: 28409593.
- [33]. Olgun, N., Eti Aslan F., Çil Akıncı A, Karadakovan A, Eti Aslan F (Editör).(2014).Toraks ve Alt Solunum Sistemi Hastalıkları. İçinde: Dahili ve Cerrahi Hastalıklarda Bakım (geliştirilmiş 3.Baskı). Ankara: Akademisyen Tıp Kitabevi; 2014: s. 364-369.
- [34]. Doğan, U. (2016). *KOAH tanılı hastalara verilen sağlık eğitiminin günlük oksijen konsantratörü kullanım sürelerine etkisi*. Master's Thesis. Sağlık Bilimleri Enstitüsü.
- [35]. Özsu, S., Uçar, E., Arslan, Y., Maden, E., & Bilgiç, H. (2011). KOAH hastalarında influenza ve pnömokok aşılama kursu. *Ana*, 13 (1), 21-5.

- [36]. Weldam, SW, Lammers, JWJ, Zwakman, M., & Schuurmans, MJ (2017). Hemşirelerin birinci basamak ortamlarında KOAH hastaları için yeni bir bireyselleştirilmiş hemşirelik bakımı müdahalesine bakış açıları: bir karma yöntem çalışması. *Uygulamalı hemşirelik araştırması* , 33 , 85-92. .
- [37]. Kalender, N., ve Sütçü Çiçek, H.(2014). Kronik hastalıkların yönetimindeki engeller.' *Türkiye Klinikleri J Nurs Sci,* , 6(1), 46-53.
- [38]. Türkiye Kronik Hava Yolu Hastalıklarını Önleme ve Kontrol Programı. (2011). Göğüs Hastalıklarında Evde Sağlık Hizmeti Sunumu. Ankara.
- [39]. Fenercioğlu, A. ve Sipahioğlu, N. (2020). Birinci Basamakta Kronik Hastalık Bakım Modeli.
- [40]. Özkaptan, Bilge Bal; Kapucu, Sevgisun.(2015). KOAH'lı Bireylerde Öz-Etkililiğin Geliştirilmesinde Evde Bakımın Önemi. *Cumhuriyet Hemşirelik Dergisi*, 4.2: 74-80.
- [41]. Puhan, M. A., Gimeno-Santos, E., Cates, C. J., & Troosters, T. (2016). Pulmonary rehabilitation following exacerbations of chronic obstructive pulmonary disease. *The Cochrane database of systematic reviews*, 12(12), CD005305. <https://doi.org/10.1002/14651858.CD005305.pub4>.
- [42]. Troosters, T., Blondeel, A., Janssens, W., & Demeyer, H. (2019). The past, present and future of pulmonary rehabilitation. *Respirology (Carlton, Vic.)*, 24(9), 830–837. <https://doi.org/10.1111/resp.13517>
- [43]. Early F, Wellwood I, Kuhn I, Deaton C, Fuld J. (2018). KOAH'lı Kişilerde Pulmoner Rehabilitasyona Sevki Ve Alımı Artırmaya Yönelik Müdahaleler: Sistemik Bir Derleme. *Int J Chron Obstrüksiyon Pulmon Dis*.
- [44]. Gloeckl, R., Schneeberger, T., Jarosch, I., & Kenn, K. (2018). Rehabilitation und Trainingstherapie bei chronisch obstruktiver Lungenerkrankung. *Dtsch Arztebl Int*, 115(8), 117-23.
- [45]. Puhan MA, Gimeno-Santos E, Cates CJ, Troosters T. (2016). Pulmonary Rehabilitation Following Exacerbations Of Chronic Obstructive Pulmonary Disease. *Cochrane Database Syst Rev*.
- [46]. Terzikhan, N., Verhamme, K. M., Hofman, A., Stricker, B. H., Brusselle, G. G., & Lahousse, L. (2016). Prevalence and incidence of COPD in smokers and non-smokers: the Rotterdam Study. *European journal of epidemiology*, 31(8), 785–792.
- [47]. Guilleminault, L.; Rolland, Y.; Didier, A.(2018). Characteristics of Non-Pharmacological Interventions In The Elderly with COPD. Smoking Cessation, Pulmonary Rehabilitation, Nutritional Management and Patient Education. *Revue des Maladies Respiratoires*, , 35.6: 626-641.
- [48]. Pezzuto, A., Stellato, M., Catania, G., Mazzara, C., Tonini, S., Caricato, M., Crucitti, P., & Tonini, G. (2018). Short-term benefit of smoking cessation along with glycopirronium on lung function and respiratory symptoms in mild COPD patients: a retrospective study. *Journal of breath research*, 12(4), 046007. <https://doi.org/10.1088/1752-7163/aad0a8>
- [49]. Trivedi, A., Bade, G., Madan, K., Bhat, M. A., Guleria, R., & Talwar, A. (2022). Effect of Smoking and Its Cessation on the Transcript Profile of Peripheral Monocytes in COPD Patients. *International journal of chronic obstructive pulmonary disease*, 17, 65.
- [50]. Hansel, NN, McCormack, MC ve Kim, V. (2016). Hava kirliliği ve sıcaklığın KOAH üzerine etkileri. *KOAH: Kronik Obstrüktif Akciğer Hastalığı Dergisi* , 13 (3), 372-379.
- [51]. Gloeckl R, Schneeberger T, Jarosch I, Kenn K. (2018) Kronik Obstrüktif Akciğer Hastalığında Pulmoner Rehabilitasyon ve Egzersiz Eğitimi. *Dtsch Arztebl Int*. Şubat 23;115(8):117-123. doi: 10.3238/arztebl.2018.0117. PMID: 29526182; PMCID: PMC5852307.
- [52]. Zanolletti, Antonella, et al. (2012). Kronik hastalığı olan yaşlı insanlar arasında yaz sıcaklık değişkenliği ve uzun süreli sağ kalım. *Ulusal Bilimler Akademisi Bildiriler Kitabı*, 109.17: 6608-6613.

- [53]. McKeever, Tricia M., et al. (2008). Serum besin düzeylerinin ve akciğer fonksiyonunun çok değişkenli bir analizi. *Solunum araştırması*, 9.1: 1-10.
- [54]. Tabak C., Smit HA, Heederik D., Ocke MC, Kromhout D.(2001). Diyet ve kronik obstrüktif akciğer hastalığı: Meyvelerin, tam tahılların ve alkolün bağımsız faydalı etkileri (MORGEN çalışması) *Clin. Tecrübe. Alerji.*; 31: 747–755. doi: 10.1046/j.1365-2222.2001.01064.x
- [55]. Kaluza, Joanna, et al. (2018). Diyet lifi alımı ve kronik obstrüktif akciğer hastalığı riski. *Epidemioloji*, 29.2: 254-260.
- [56]. Janssens, Wim, et al. (2010). D vitamini eksikliği KOAH'ta oldukça yaygındır ve D vitamini bağlayıcı gendeki varyantlarla ilişkilidir. *Toraks*, 65.3: 215-220.
- [57]. Jolliffe DA, Greenberg L., Hooper RL, Mathysen C., Rafiq R., de Jongh RT, Camargo CA, Griffiths CJ, Janssens W., Martineau AR, et al. (2019). KOAH alevlenmelerini önlemek için D vitamini: Randomize kontrollü çalışmalardan bireysel katılımcı verilerinin sistematik incelemesi ve meta-analizi. *Toraks.*; 74 :337–345. doi: 10.1136/thoraxjnl-2018-212092.
- [58]. Alfaro TM, Monteiro RA, Cunha RA, Cordeiro CR. (2018). Kronik kahve tüketimi ve solunum hastalığı: Sistematik bir derleme. *klinik. Nefes al. J.*; 12: 1283–1294. doi: 10.1111/crj.12662
- [60]. De Batlle, Jordi, et al.(2012). Tedavi edilmiş et tüketimi KOAH hastalarında yeniden hastaneye yatış riskini artırmaktadır. *Avrupa Solunum Dergisi*, 40.3: 555-560.
- [61]. Butler, Lesley M., et al. (2018). Çinli Singapurular arasında diyet kalıpları ve balgamlı kalıcı öksürük üzerine prospektif çalışma. *Amerikan solunum ve kritik bakım tıbbi dergisi* , 2006, 173.3: 264-270.ROBINSON, Hayley, et al. Facilitators and barriers to physical activity following pulmonary rehabilitation in COPD: a systematic review of qualitative studies. *NPJ Primary Care Respiratory Medicine*, 28.1: 1-12.
- [61]. Albarratı, Ali M., et al. (2020). Daily physical activity and related risk factors in COPD. *BMC pulmonary medicine*, 20.1: 1-8.
- [62]. Armstrong, Matthew, et al. (2019). Use of pedometers as a tool to promote daily physical activity levels in patients with COPD: a systematic review and meta-analysis. *European Respiratory Review*, 28.154.
- [63]. Lu, Y., Li, P., Li, N., Wang, Z., Li, J., Liu, X., & Wu, W. (2020). KOAH'lı bireylerde evde yapılan solunum egzersizlerinin etkileri. *Solunum bakımı* , 65 (3), 377-387.
- [64]. Chen, Rong-chang, et al. (2016). Orta-şiddetli KOAH rehabilitasyonu için nöromusküler elektrik stimülasyonunun etkinliği: bir meta-analiz. *Uluslararası Kronik Obstrüktif Akciğer Hastalığı Dergisi*, 11: 2965.
- [65]. Magnet FS, Storre JH, Windisch W. (2017). Home oxygen therapy: evidence versus reality. *Expert Rev Respir Med.* Jun;11(6):425-441. doi: 10.1080/17476348.2017.1325323. Epub 2017 May 10. PMID: 28454510
- [66]. Lacasse, Y., Tan, A. Y. M., Maltais, F., & Krishnan, J. A. (2018). Home oxygen in chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine*, 197(10), 1254-1264.
- [67]. Ergin, Ç., Muz, G. (2019). *Kronik obstrüktif akciğer hastalığı (KOAH) tanısı almış bireylere verilen inhaler ilaç eğitiminin öz-bakım gücü ve öz-yeterlilik düzeyine etkisi..* Master's Thesis. Nevşehir Hacı Bektaş Veli Üniversitesi.
- [68]. Khoshkesht, Sahar, et al. (2015). The effect of home-based pulmonary rehabilitation on self-efficacy in chronic obstructive pulmonary disease patients. *rehabilitation*, 17: 18.

[69]. Saza, S; evik, K. (2020). KOAH tanısı almıř hastalara uygulanan progresif gevřeme egzersizlerinin yorgunluk ve yařam kalitesine etkisi. *Cukurova Medical Journal*, 45.2: 662-671.

YAŞLILARDA DÜŞME, EVDE BAKIM HİZMETLERİ VE HEMŞİRELİK YAKLAŞIMLARI ARASINDAKİ İLİŞKİ

Hamdiye ARDA SÜRÜCÜ

Doç. Dr, Dicle Üniversitesi, Atatürk Sağlık Bilimleri Fakültesi Hemşirelik Bölümü, Diyarbakır, Türkiye, ORCID: 0000-0001-7052-1002

Meltem SUNGUR

Arş. Gör, Kilis 7 Aralık Üniversitesi, Yusuf Şerefoğlu Sağlık Bilimleri Fakültesi Hemşirelik Bölümü, Kilis, Türkiye, ORCID: 0000-0002-2702-5748

ÖZET

Gün geçtikçe genel nüfus içerisinde yaşlı bireylerin sayısı artmakta ve yapılan tahminlere göre gelecekte bu artışın devam etmesi beklenmektedir [1,2]. Bu artışa paralel olarak yaşlı bireylerin karşılaştıkları sağlık problemlerinin sıklığı artmaktadır. Bu sorunların başında sağlık, barınma, ekonomi ve yaşlılığa uyum yer almaktadır. Yaşlılar, yaşlanma sürecinin getirdiği değişiklikler sonucunda daha fazla sağlık sorunlarıyla mücadele etmek zorunda kalmaktadır [3,4]. Sıklığı ve sonuçlarıyla dikkat çeken bu problemlerden biri olan düşme, yaşlılar için gün geçtikçe daha fazla önemsenmesi gereken bir durum olmuştur [5]. Yaşlıların düşme sıklığındaki artış hem yaşlı bireylerin sağlıklarını riske sokmakta hem de tedavilerini daha karmaşık hale getirmektedir [6,7]. Düşmelerin, hem düşenler için hem de ailelerinin yaşam kalitesi ve sağlık sistemi için ekonomik olarak ani ve uzun vadeli sonuçları vardır. Bu durum aynı zamanda ülke ekonomisini de olumsuz yönde etkilemektedir [6].

Düşmelerin engellenmesinde ve yönetiminde evde bakım hizmetlerinin daha fazla işlevselliğinin olması gerekmektedir [8]. Evde bakım, işlevsel yeteneği korumayı ve artırmayı, yaşam kalitesini iyileştirmeyi ve bağımsızlığı sürdürmeyi ve kişinin evde kalmasını mümkün kılmayı amaçlar [6]. İdeal olarak hastanın ihtiyaçlarının tüm yönlerini karşılamak için bu hizmetleri sağlamak amacıyla disiplinler arası bir sağlık ekibi mevcuttur. Uzun süreli bakım maliyetlerinin gelecekte önemli ölçüde artması beklenmektedir. Yaşlı bireylerin sağlığı iyiyse ve evde kalabiliyorsa bu masraflar büyük ölçüde azaltılabilir [9]. Evde bakım hizmetleri yaşlı bireyler arasında bağımsızlığı sürdürmek, fonksiyonel sağlık durumuna katkıda bulunmak ve yaşam kalitesini iyileştirmek için önemlidir [9]. Evde bakım hizmeti alan bireyler daha yüksek yaşam kalitesi, uzun ömür, ağrı veya hareket kısıtlılığında azalma gibi daha az sayıda şikayet ile ve evde yalnız kalmayı başarma ile ilişkilendirilmiştir [9]. Evde bakım ekibi, bakımın teknik ve klinik yönlerini hastaya ve ailesine şefkat ve destekle bütünleştirmelidir. Hemşire evde sağlık bakım ekibinin önemli bir üyesidir. Evde bakımda hemşire, bir hastanın hastalığı ile evde nasıl yaşayabileceği, nasıl yönetebileceğini ve hastalığın yönetimi için dışarıdan diğer hizmetlerden nasıl yararlanabileceği konusunda yardımcı olur [10]. Evde bakım hizmeti üyelerinden biri olan hemşirelere bu aşamada önemli roller düşmektedir. Hemşireler rollerini yerine getirirken hastayı bütüncül değerlendirerek bakım verici rolünü yerine getirmelidir Evde bakımın önemli bir sağlayıcısı olan hemşirenin verdiği bakımın sonuçlarının değerlendirilmesi önemlidir Bu sayede verilen evde bakım hizmetlerinin kalitesi artacaktır [11]. Tedavinin evde başlamasından önce eğitim ve terapi süresince devam eden eğitim, özellikle hastanın hafızasının bozulduğu veya azaldığı durumlarda başarı için zorunludur [8]. Düşmeler, bireyler ve aileler için toplum sağlık hizmetleri ve ekonomi için önemli bir sosyal ve ekonomik yük getirmektedir [12]. Bireysel düşme riskini etkileyen bilinen içsel ve dışsal

faktörler olmasına rağmen tekrarlayan düşüşün bir öngörücüsü önceki bir düşüştür [13]. Evde sağlık hizmetleri sağlayıcıları düşme deneyimi olan bireylere düşme sonucu yaralanmanın tekrarını önlemek için yardımcı olur. 3 ay içinde düştüğünü bildiren evde bakım hizmeti alan 30 yaşlı bireyin düşme riskinin değerlendirildiği çalışmada; genel olarak yaşlıların kronik hastalık ve ilaçlar nedeniyle yüksek bir düşme riski yaşadığı saptanmıştır [13]. Yaşlı bireyleri düşme riskleri konusunda eğitmek, planlamanın yalnızca bir parçasıdır ve planlamalar; hareketliliği, ilaçların uygun şekilde alınmasını, görme bozukluklarının değerlendirilmesini ve yönetimini, çevre ve davranış değişikliklerini ele alan konularla birleştirilmelidir [13]. Evde bakım hizmetinin kaliteli olmasını sağlamak ve hizmetin verilmesini kolaylaştırmak için sağlık çalışanları arasında etkili bir işbirliği şarttır. Bu tür bir hizmet sağlık koruyucuları olarak hemşireler tarafından yerine getirilen tutarlı ve kesin bir ekip çalışması gerektirir [14]. Bu derleme ile yaşlılarda düşme, evde bakım hizmetleri ve hemşirelik yaklaşımları arasındaki ilişkiye dikkat çekilmiştir.

Anahtar Kelimeler: Düşme, evde bakım hizmetleri, hemşire, yaşlı

THE RELATIONSHIP BETWEEN FALLS in THE ELDERLY, HOME CARE SERVICES and NURSING APPROACHES

Hamdiye ARDA SÜRÜCÜ

PhD, RN, is an Associate Professor, Dicle University Atatürk Faculty Health Science, Nursing Department, Diyarbakır, Türkiye, ORCID: 0000-0001-7052-1002

Meltem SUNGUR

PhD, RN, is a Research Assistant, Kilis 7 Aralık University Yusuf Şerefoğlu Faculty of Health Sciences, Nursing Department, Kilis, Türkiye, ORCID: 0000-0002-2702-5748

ABSTRACT

The number of elderly individuals in the general population is increasing day by day and according to the forecasts, this increase is expected to continue in the future [1,2]. Parallel to this increase, the frequency of health problems faced by elderly individuals is increasing. At the beginning of these problems are health, accommodation, economy and adaptation to old age. The elderly have to deal with more health problems as a result of the changes brought about by the aging process [3,4]. Falling, which is one of these problems that draws attention with its frequency and consequences, has become a situation that needs to be given more importance day by day for the elderly [5]. The increase in the frequency of falls in the elderly not only puts the health of elderly individuals at risk, but also complicates their treatment [6,7]. Falls have immediate and long-term economic consequences, both for the survivors and their families' quality of life and the health system. This situation also negatively affects the country's economy [6]. Home care services should have more functionality in the prevention and management of falls [8]. Home care aims to preserve and increase functional ability, improve quality of life and maintain independence and make it possible for the person to stay at home [6]. An interdisciplinary healthcare team is available to provide these services, ideally to meet all aspects of the patient's needs. Long-term care costs are expected to increase significantly in the future. These costs can be greatly reduced if the elderly are in good health and can stay at home [9]. Home care services are important for maintaining independence, contributing to functional health status and improving quality of life among older people. Individuals receiving home care services have been associated with higher quality of life, longevity, fewer complaints such as reduced pain or limitation of movement, and being able to be alone at home [9]. The home care team should integrate the technical and clinical aspects of care with compassion and support to the patient and family. The nurse is an important member of the home health care team. In home care, the nurse assists a patient with how they can live with their disease at home, how they can manage it, and how they can benefit from other services from outside for the management of the disease [10]. Nurses, one of the members of the home care service, have an important role at this stage. While performing their roles, nurses should fulfill the role of caregiver by evaluating the patient holistically. This will increase the quality of home care services provided [11]. Education before starting treatment at home and continuing education during therapy are essential for success, especially in cases where the patient's memory is impaired or diminished [8]. Falls impose a significant social and economic burden on community health services and the economy for individuals and families [12]. Although there are known intrinsic and extrinsic factors that affect individual fall risk, one predictor of recurrent fall is a previous fall [13]. Home health care providers assist individuals who have experienced a fall to prevent

recurrence of injury from a fall. In the study evaluating the fall risk of 30 elderly individuals who received home care services who reported falling within 3 months; In general, it has been determined that the elderly have a high risk of falling due to chronic diseases and drugs [13]. Educating older people about the risks of falling is only part of planning, and planning; should be combined with topics that address mobility, appropriate medication intake, assessment and management of visual impairments, environmental and behavioral changes [13]. Effective cooperation among health professionals is essential to ensure quality home care service and to facilitate service delivery. This type of service requires consistent and precise teamwork performed by nurses as health guardians [14]. In this review, attention was drawn to the relationship between falls in the elderly, home care services and nursing approaches.

Keywords: Fall, home care services, nurse, elderly

GİRİŞ

Dünya Sağlık Örgütü (DSÖ) yaşlılığı “65 yaş ve üstü olup, çevreye uyum sağlayabilme yeteneğini kaybetme durumu” olarak tanımlamaktadır [1]. DSÖ’ye göre yaşlı nüfus gün geçtikçe artmakta ve 2050 yılına kadar 60 yaş üstü nüfus oranının %20’ ye ulaşacağı tahmin edilmektedir. Dünya Nüfus Yaşlanma Raporu’na (2019) göre ise 2050 yılında yaşlı nüfusun 1.5 milyar olacağı belirtilmiştir [1, 2]. Yaşlı nüfusun artmasıyla yaşlı birey ve toplum için farklı sorunlar ortaya çıkmıştır. Bu sorunların başında sağlık, barınma, ekonomi ve yaşlılığa uyum yer almaktadır. Yaşlılar, yaşlanma sürecinin getirdiği değişiklikler sonucunda daha fazla sağlık sorunlarıyla mücadele etmek zorunda kalmaktadır [3,4]. Bu sorunlardan biri olan düşmeler, yaşlı bireylerde önde gelen morbidite ve mortalite nedenidir [5]. Düşmeler, küresel hastalık yüküne önemli ölçüde katkıda bulunur. 65 yaşın üstündeki yaşlı bireylerin yaklaşık %30’u yılda bir kez düşme yaşar [6]. Düşmeler nadiren tek bir nedene bağlıdır ve düşmelerin yaklaşık %10’u kırıklarla sonuçlanır [15]. Bununla birlikte kronik hastalıkların artışı, bakım maliyetlerinin artması, hastane yatak kapasitelerinin yetersizliği ve evde bakım teknolojisinin gelişmesi evde bakım hizmetlerinin yaygınlaşmasını ve hastaya sunulacak hizmetin birer parçası haline gelmesini sağlamıştır [16]. Evde bakım; hastaların alışıktır, bilindik ve daha az stres yaşadıkları ortamda tedavi ve bakım almaları sağlanması, hastalar için maliyet etkin olması, yeni teknolojileri ev ortamında kullanımı kolaylaştırması, evde izlenme olanağı yaratması ve daha karmaşık tedavileri yönetebilmesini sağlaması nedeniyle tercih edilmektedir [17]. Evde bakım, yaşlı bireylerin düşmelerini önlemek için dikkat çekilmesi gereken önemli bir hizmettir [6]. Toplumda yaşayan daha savunmasız olan evde bakım hizmeti alan yaşlı grubuna ilişkin araştırmalar bu konuda eksiktir [6]. Yapılan çalışmada yaşlı bireylere yönelik düşmeyi önleme egzersiz programının evde bakım hizmeti alan hastalarda dengeye ek olarak yaşam kalitesini iyileştirebileceğini göstermiştir [6]. DSÖ kılavuzları, yaşlılar için toplum ve ev temelli bakıma odaklanılması gerektiğini vurgulamaktadır [9]. Evde bakım alan yaşlı bireyler, yaşam kalitesi ve düşmeler ile ilgili yapılmış yeterli klinik araştırmalar olmadığı vurgulanmıştır [9]. Bu noktada konunun önemini ortaya koymak için bu derlemede amaç, yaşlılarda düşme ile evde bakım hizmetleri arasındaki ilişkiye dikkat çekmektir.

1. Yaşlılarda Düşme

Düşme, kişinin ağırlık merkezini kaybedip dengesini sağlamak için herhangi bir çaba göstermediği veya bu çabanın etkisiz kaldığı tesadüfi olarak düştüğü olaylar olarak tanımlanmaktadır [18]. Düşmeye bağlı

en yaygın sonuçlar ağrı, morarma, yırtılmalar, üst ekstremit ve kalça kırıkları dahil kırıklar ve ciddi vakalarda intrakraniyal kanamadır [7]. 65 yaş ve üstü kişilerin yaklaşık %28-35'i her yıl düşmekte ve 70 yaş üstü kişilerde bu oran %32-42'ye yükselmektedir. Ayrıca düşen kişilerin %20 ila %39'u düşme korkusu yaşar, bu da yaralanmadan bağımsız olarak aktivitenin daha da kısıtlanmasına yol açar [7]. Düşmeler, yaşlı bireylerde önde gelen morbidite ve mortalite nedenidir. 65 yaş ve üzeri toplum içinde yaşayan yaklaşık her üç kişiden biri yılda en az bir kez düşmekte ve düşme riski yaşla birlikte artmaktadır [5]. Tespit edilen düşme risk faktörleri arasında düşme öyküsü, yardımcı cihazların kullanımı, yetersiz aydınlatma gibi çevresel tehlikeler ve kas zayıflığı, baş dönmesi, yürüme ve denge bozuklukları, görme ve işitme bozuklukları, ortostatik hipotansiyon, diabetes mellitus, osteoporoz bilişsel ve duyuşsal bozukluklar gibi çeşitli sağlık durumları yer almaktadır [7]. Yapılan çalışmada yaşlı bireyler tarafından bildirilen en yaygın sağlık probleminin hipertansiyon olduğu ve bireylerin yaklaşık 88'inin (%55,3) düşme deneyimlediği saptanmıştır [7]. Bazı araştırmalar ayrıca birtakım ilaçları yaşlı yetişkinlerde düşme riskinin artmasıyla ilişkilendirmiştir. Düşme riskini artıran en yaygın ilaçlar; hipnotikler, sedatifler, antipsikotikler ve antidepressanlar gibi sedasyona, denge ve koordinasyon bozukluğuna neden olabilen farklı psikotrop ilaçlardır. Ayrıca diüretikler ve beta blokerler gibi kardiyovasküler ilaçlar ortostatik hipotansiyona ve düşmelere neden olabilir. Antihistaminikler ve antikolinergik ilaçlar yaşlı hastaların bilişsel becerilerini etkileyerek görme bulanıklığına neden olarak düşme riskini artırabilir. Polifarmasi ve psikotrop ilaç kullanımının özellikle kardiyovasküler ilaçlarla kombine edildiğinde yaşlılarda düşme riskini artırdığı bilinmektedir [7]. Düşmelerin, hem düşenler için hem de ailelerinin yaşam kalitesi ve sağlık sistemi için ekonomik olarak ani ve uzun vadeli sonuçları vardır. Düşmeler yaralanma olmaksızın bile sıklıkla hareket, güven ve fonksiyonel bağımsızlık kaybına neden olur [6]. Genel nüfus içinde, yaşlı insanlarda düşme yaygındır ve yaşamı sınırlayıcı ve zayıflatıcı olabilir. Her yıl yaşlı insanların %30 ila %62'sinin düştüğü tahmin edilmektedir [15]. Yaşlı bireylerde düşme insidansı hastaneye yatış ve sağlık bakım maliyetlerini artırır [19].

2.Yaşlılarda Evde Bakım Hizmetleri

65 yaş üstü bireylerin sayısının artması sağlık hizmeti sunumunu etkilemektedir. Bunun sonucunda destek hizmetlerine (hemşirelik, fizik tedavi, mesleki terapi, dayanıklı tıbbi ekipman ve solunum tedavisi), infüzyon terapileri, palyatif bakım ve bakımevi dahil evde sağlık hizmetlerine olan talep artacaktır [8]. Evde bakım, işlevsel yeteneği korumayı ve artırmayı, yaşam kalitesini iyileştirmeyi ve bağımsızlığı sürdürmeyi ve kişinin evde kalmasını mümkün kılmayı amaçlar [6]. Kronik hastalıkları yönetmek uzun süreli bakım gerektirir ve evde sağlık hizmeti sağlanması bu süreci kolaylaştırabilir [20]. Evde bakım, son derece teknik infüzyon terapilerinden çok temel temizlik ihtiyaçlarına kadar birçok hizmet türünü kapsar. Evde bakım hizmetleri, temizlik yardımı, yemek hazırlama ve teslimat, dayanıklı tıbbi ekipman (tekerlekli sandalyeler, yürüteçler, bastonlar, hastane yatakları, infüzyon pompaları) sağlama, solunum bakımı, yara yönetimi, fizik tedavi, mesleki terapi, beslenme danışmanlığı, ağrı yönetimi, IV ilaçları ve evde enteral beslenme ve evde parenteral beslenmeyi içerir [8]. İdeal olarak hastanın ihtiyaçlarının tüm yönlerini karşılamak için bu hizmetleri sağlamak amacıyla disiplinler arası bir sağlık ekibi mevcuttur. Uzun süreli bakım maliyetlerinin gelecekte önemli ölçüde artması beklenmektedir. Yaşlı bireylerin sağlığı iyiyse ve evde kalabiliyorsa bu masraflar büyük ölçüde azaltılabilir [9]. Evde bakım hizmetleri yaşlı bireyler arasında bağımsızlığı sürdürmek, fonksiyonel sağlık durumuna katkıda bulunmak ve yaşam kalitesini iyileştirmek için önemlidir [9]. Evde bakım hizmeti alan bireyler daha yüksek yaşam kalitesi, uzun ömür, ağrı veya hareket kısıtlılığında azalma gibi

daha az sayıda şikayet ile ve evde yalnız kalmayı başarma ile ilişkilendirilmiştir [9]. Örneğin, evde yaşayan yaşlıların daha önce iki veya daha fazla düşme yaşamaları durumunda daha yüksek ölüm riskine sahip oldukları bulunmuştur [21].

3. Yaşlılarda Düşme Yönetiminde, Evde Bakım Hizmetleri içerisinde Hemşirelik Yaklaşımları

Evde bakım, sağlık profesyonelleri tarafından insanlara kendi evlerinde sağlanan disiplinler arası bakım olarak tanımlanır ve pratik yardım ve hastanın güvenliğini sağlama gibi hizmetleri kapsar [6]. Evde bakım ekibi, bakımın teknik ve klinik yönlerini hastaya ve ailesine şefkat ve destekle bütünleştirmelidir. Hemşire evde sağlık bakım ekibinin önemli bir üyesidir. Evde bakımda hemşire, bir hastanın hastalığı ile evde nasıl yaşayabileceği, nasıl yönetebileceğini ve hastalığın yönetimi için dışarıdan diğer hizmetlerden nasıl yararlanabileceği konusunda yardımcı olur [10]. Evde bakımın önemli bir sağlayıcısı olan hemşirenin verdiği bakımın sonuçlarının değerlendirilmesi önemlidir [11]. İnvaziv bir tedavinin veya yaşam tarzı değişikliğinin hastanın yaşam kalitesi üzerindeki etkisi her zaman bir endişe kaynağıdır, ancak hasta yaşlıysa ve teknolojiye ve bakımın karmaşıklığına daha az alışmış ise bu durum daha da endişe vericidir. Tedavinin evde başlamasından önce eğitim ve terapi süresince devam eden eğitim, özellikle hastanın hafızasının bozulduğu veya azaldığı durumlarda başarı için zorunludur. Sözlü açıklamalar ve gösterilere ek olarak yazılı ve resimli materyaller sağlanmalıdır [8]. Evde bakım hizmeti alan yaşlı yetişkinlerin yüksek oranda düşme insidansı vardır ve %10'u önceki 90 gün içinde birden fazla düşme deneyimlerler. Sağlanan hizmetlerin düzeyi, düşme insidansı ile ilişkilidir. Yaşlı bireylerin ayrıca düşme korkusu ve bu korkuyla ilişkili aktivite kısıtlamaları da yüksek prevalansa sahiptir [9]. Düşmeler, bireyler ve aileler için toplum sağlık hizmetleri ve ekonomi için önemli bir sosyal ve ekonomik yük getirmektedir. Yaşlı bireylerin oranı küresel olarak arttıkça, düşmelerle ilişkili maliyetler de artacaktır. Bu nedenle düşmelerin önlenmesi acil bir halk sağlığı sorunudur [12]. Düşmeler ve engellilik, kurumsallaşmanın güçlü belirleyicileridir. Düşme öyküsü olan evde bakım hizmeti alan yaşlılara sunulan hizmet huzurevine başvuru sıklığını azaltabilir [9]. Bireysel düşme riskini etkileyen bilinen içsel ve dışsal faktörler olmasına rağmen tekrarlayan düşüşün bir öngörücüsü önceki bir düşüştür [13]. Evde sağlık hizmetleri sağlayıcıları düşme deneyimi olan bireylere düşme sonucu yaralanmanın tekrarını önlemek için yardımcı olur [13]. Düşme ile ilgili çoğu çalışma genel düşme riskine odaklanırken özellikle evde sağlık hizmeti almakta olan kişilerde düşme tekrarını araştıran az sayıda çalışma vardır [13]. 3 ay içinde düştüğünü bildiren evde bakım hizmeti alan 30 yaşlı bireyin düşme riskinin değerlendirildiği çalışmada; genel olarak yaşlıların kronik hastalık ve ilaçlar nedeniyle yüksek bir düşme riski yaşadığı saptanmıştır [13].

Amerikan Geriatri Derneği ve İngiliz Geriatri Derneği'nin Klinik Uygulama Kılavuzu, düşmeyi önlemede sağlık hizmeti sağlayıcısının yaşlı erişkin hastalara düşmeler hakkında soru sormasını içeren çok faktörlü bir yaklaşım önermektedir; yürüyüş, dengeyi sağlama ve ilaçlar gibi değiştirilebilir risk faktörlerini değerlendirilerek kuvvet ve denge egzersizlerine yaşlı bireyler yönlendirilmelidir [22]. Düşme hakkında konuşmaya başlamak ve uygun bireyselleştirilmiş önleme müdahalelerini tasarlamak ve çeşitli sağlık profesyonellerinin işbirliğini gerektiren uygun planlama için evde sağlık hizmeti verenler arasında düşme riskinin tekrarı konusunda farkındalığın artırılması zorunludur [13]. Yaşlı bireyleri düşme riskleri konusunda eğitmek, planlamanın yalnızca bir parçasıdır ve planlamalar; hareketliliği, ilaçların uygun şekilde alınmasını, görme bozukluklarının değerlendirilmesini ve yönetimini, çevre ve davranış değişikliklerini ele alan konularla birleştirilmelidir [13]. Evde bakım hizmetinin kaliteli olmasını sağlamak ve hizmetin verilmesini kolaylaştırmak için sağlık çalışanları arasında etkili bir

işbirliği şarttır [14]. Bu tür bir hizmet sağlık koruyucuları olarak hemşireler tarafından yerine getirilen tutarlı ve kesin bir ekip çalışması gerektirir [14]. Evde sağlık bakım hizmetlerinde sıklıkla hemşirelik uygulamalara rastlanmaktadır [16]. Evde bakım hizmeti sunmanın önemi ve gerekliliği, hem gelişmiş hem de gelişmekte olan ülkelerde birçok araştırmacıyı hemşirelik bakımını farklı alanlarda araştırmaya ve değerlendirmeye yöneltmiştir. Evde bakım hemşireliği hizmetlerinde standart ve entegre yöntemlerin uygulanmaması, kurum içi ve kurum dışı iletişim eksikliği, uygun organizasyonel altyapının olmaması, yeterli ve etkin insan kaynağının olmaması, yasal ve güvenlik desteklerinin olmaması, ekonomik sorunlar, bilgi yoksulluğu, kültürel kısıtlamalar ve etik konuların göz ardı edilmesi evde bakım hizmetlerinin sunulmasını engelleyen durumlardır [14]. Evde bakım hemşirelerinin sorumlulukları arasında tıbbi tedavinin sürdürülmesi, öğretim ve rehberlik, idari görevler, hasta sağlık bakımının koordinasyonu ve devam eden bakım gereksinimlerini değerlendirmek için hastanın durumunu gözlemlenme yer almaktadır. Yapılan çalışmada evde bakım hemşirelerinin sağlık personelinin düşmeyi önlemeden çok düşmelerin tedavisi ile ilgilendiğini belirttikleri saptanmıştır. Evde bakım hemşirelerinin hasta güvenliği ve düşmelerle ilgili deneyimleri hakkında çok az şey bilinmektedir. Evde yalnız yaşayan ve tamamen evde bakıma bağımlı olan yaşlılara bakım veren evde bakım hemşirelerinin düşme ile ilgili hasta güvenliği deneyimlerinin araştırıldığı çalışmada; hemşirelerin hasta güvenliğini önemseydiği fakat düşme yaşandığında hasta güvenliğine odaklanmalarının arttığı saptanmıştır. Ayrıca hemşireler düşmelerin yaşanmasına neden olarak hastaları yeterince takip etmemelerinin neden olduğunu belirtmişlerdir [21]. Evde bakım hizmetleri hastaları hem fizyolojik hem de psikososyal alanlarda desteklemektedir. Hemşirelerin bu alanlarda yetkin ve deneyimli olması evde bakım hizmetlerindeki rolünü arttırmaktadır [23]. Durgun, Turan Ve Kaya (2020)'nin 31 çalışmayı derlediği çalışmada; sağlık profesyonelleri tarafından planlanan yaşlı bireye özgü bakım ile ilaç yönetimi aracılığıyla düşme ve yaralanmaların önlenilebileceği, plansız hastaneye yatışların en aza indirilebileceği, birey ve ailesinin yaşam kalitesinin artırılabilirliği bulunmuştur [16]. Evde bakım hemşiresi vereceği hizmeti, hastanın bireysel farklılıklarını göz ederek ve ailesini/bakım vericisini hizmete katarak planlamalı, uygulamalı ve kontrol etmelidir. Profesyonel düzeyde verilen hemşirelik bakımı, ailenin etnik kökeninden, kültüründen ekonomisinden etkilenmektedir. Bu yüzden evde bakım hizmeti veren hemşire, yaptığı ziyaretler sırasında hastayı değerlendirirken bu faktörleri dikkate alarak ve iletişim yeteneğini kullanarak değerlendirmeler yapmalıdır. Bu sayede bakım verici rolünü daha görünür kılacaktır [24].

SONUÇ

Sonuç olarak popülasyon içerisinde en çok düşme deneyimleyen yaşlı bireylere düşme yönetimine yönelik yapılacak müdahaleler için geç kalınmış olabilir. Düşmelerin neden olabileceği mortalite/morbiditelerin engellenmesi veya düşmeye sebep olabilecek sorunların çözülmesi için gerekli planlamalar evde bakım ekibi tarafından planlanmalıdır. Evde bakım hizmetleri birçok alan ile ilişkili, bireyin farklı yönlerini de ele alan çok yönlü ve farklı meslek gruplarının aktif olduğu bir hizmettir. Bu hizmet, bireye bütüncül yaklaşımın gerekli olduğunu vurgulayan yalnızca hastalıkları tedavi etmek için değil düşme gibi çeşitli durumlardan etkilenen sağlık problemlerini engellemek ve tedavi etmek için işlevselliğinin artırılması gereken bir hizmettir. Hemşire bu planlamaların ve uygulamaların her aşamasında yer almalıdır. Hemşire vereceği hizmetin hasta ve ailesine yönelik olacağını bilmeli, hastaya bütüncül bakış açısıyla yaklaşmalı ve yapacağı planlamaların ve uygulamaların önemiyetinin farkında olmalıdır. Bu yüzden hemşirelerin aktif rol alabileceğini gösteren, evde bakım hizmetlerinin önemini vurgulayan ve düşmelerin önlenilebileceğine dikkat çeken bilimsel araştırmaların

sayısının arttırılması gerekmektedir.

REFERENCES

- [1]. WHO. Ageing and health. Erişim Adresi: <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health> [Date of access: 16.04.2022]
- [2]. WHO. World Population Ageing 2019; Highlights. Erişim Adresi: <https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf> [Date of access: 16.04.2022]
- [3]. WHO. Top 10 causes of death. Access Line: https://www.who.int/gho/mortality_burden_disease/causes_death/top_10/en/. 2018. [Erişim Tarihi: 16.04.2022]
- [4]. TÜİK, Nüfus istatistikleri. 2019, Erişim Adresi: <http://www.tuik.gov.tr/Start.do>, 2019, [Date of access: 16.04.2022]
- [5]. Sherrington, C., Michaleff, Z. A., Fairhall, N., Paul, S. S., Tiedemann, A., Whitney, J., Cumming, R. G., Herbert, R. D., Close, J., & Lord, S. R. (2017). Exercise to prevent falls in older adults: an updated systematic review and meta-analysis. *British journal of sports medicine*, 51(24), 1750–1758. <https://doi.org/10.1136/bjsports-2016-096547>
- [6]. Bjerk, M., Brovold, T., Skelton, D. A., Liu-Ambrose, T., & Bergland, A. (2019). Effects of a falls prevention exercise programme on health-related quality of life in older home care recipients: a randomised controlled trial. *Age and ageing*, 48(2), 213–219. <https://doi.org/10.1093/ageing/afy192>
- [7]. Sharif, S. I., Al-Harbi, A. B., Al-Shihabi, A. M., Al-Daour, D. S., & Sharif, R. S. (2018). Falls in the elderly: assessment of prevalence and risk factors. *Pharmacy Practice (Granada)*, 16(3).
- [8]. Fuhrman M. P. (2009). Home care for the elderly. *Nutrition in clinical practice: official publication of the American Society for Parenteral and Enteral Nutrition*, 24(2), 196–205. <https://doi.org/10.1177/0884533609332173>
- [9]. Bjerk, M., Brovold, T., Skelton, D. A., & Bergland, A. (2018). Associations between health-related quality of life, physical function and fear of falling in older fallers receiving home care. *BMC geriatrics*, 18(1), 253. <https://doi.org/10.1186/s12877-018-0945-6>
- [10]. Gudnadottir, M., Bjornsdottir, K., & Jonsdottir, S. (2018). Perception of integrated practice in home care services. *Journal of Integrated Care*.
- [11]. Sezer, A., Demirbaş, H., Kadioğlu, H. (2015). Evde bakım hemşireliği: Mesleki yetkinlikler ve eğitim standartları. *F.N. Hem. Derg.* 23(2),160-165.
- [12]. Bjerk, M., Brovold, T., Skelton, D. A., & Bergland, A. (2017). A falls prevention programme to improve quality of life, physical function and falls efficacy in older people receiving home help services: study protocol for a randomised controlled trial. *BMC health services research*, 17(1), 559. <https://doi.org/10.1186/s12913-017-2516-5>
- [13]. Solis, G. R., & Champion, J. D. (2017). Examining Fall Recurrence Risk of Homebound Hispanic Older Adults Receiving Home Care Services. *Hispanic health care international : the official journal of the National Association of Hispanic Nurses*, 15(1), 20–26. <https://doi.org/10.1177/1540415317691490>
- [14]. Valizadeh, L., Zamanzadeh, V., Saber, S., & Kianian, T. (2018). Challenges and barriers faced by home care centers: An integrative review. *Medical-Surgical Nursing Journal*, 7(3).
- [15]. Adams, N., Skelton, D., Bailey, C., Howel, D., Coe, D., Lampitt, R., Wilkinson, J., Fouweather, T., de Jong, L. D., Gawler, S., Deary, V., Gray, J., Waterman, H., & Parry, S. W. (2019). Visually

Impaired OLder people's Exercise programme for falls prevenTion (VIOLET): a feasibility study. NIHR Journals Library.

- [16]. Durgun H., Turan N., Kaya H.. (2020). Evde bakımda hasta güvenliğine yönelik kanıt temelli uygulamalar: Sistematik derleme. *Jaren*, 6(2),366- 374.
- [17]. World Health Organization 2012. Home care across Europe: current structure and future challenges. World Health Organization. Regional Office for Europe. Copenhagen, Denmark.
- [18]. Ungar, A., Rafanelli, M., Iacomelli, I., Brunetti, M. A., Ceccofiglio, A., Tesi, F., & Marchionni, N. (2013). Fall prevention in the elderly. *Clinical cases in mineral and bone metabolism : the official journal of the Italian Society of Osteoporosis, Mineral Metabolism, and Skeletal Diseases*, 10(2), 91–95.
- [19]. James, E., Oman, P., Ali, M., Court, P., Goodall, S., Nichols, S. J., & O'Doherty, A. F. (2022). The effectiveness of the Healthworks Staying Steady community-based falls prevention exercise programme to improve physical function in older adults: a 6-year service evaluation. *BMC public health*, 22(1), 1457. <https://doi.org/10.1186/s12889-022-13832-3>
- [20]. Nikbakht-Nasrabadi, A., & Shabany-Hamedan, M. (2016). Providing Healthcare Services at Home-A Necessity in Iran: A Narrative Review Article. *Iranian journal of public health*, 45(7), 867–874.
- [21]. Berland, A., Gundersen, D., & Bentsen, S. B. (2012). Patient safety and falls: A qualitative study of home care nurses in Norway. *Nursing & health sciences*, 14(4), 452-457.
- [22]. Juckett, L. A., Bungler, A. C., Jarrott, S. E., Dabelko-Schoeny, H. I., Krok-Schoen, J., Poling, R. M., Mion, L. C., & Tucker, S. (2021). Determinants of Fall Prevention Guideline Implementation in the Home- and Community-Based Service Setting. *The Gerontologist*, 61(6), 942–953. <https://doi.org/10.1093/geront/gnaa133>
- [23]. Dolu, İ., Dönmez, E., & Kürklü, A. (2022). Hemşirelik Son Sınıf Öğrencilerinin Halk Sağlığı Hemşireliği Dersi Kapsamında Evde Bakım Merkezlerinde Yürütülen Saha Uygulamasına İlişkin Görüşleri. *Sağlık ve Toplum*, 32(1), 138-149.
- [24]. Selcuk, E. D., & Karadeniz, H. (2020). Cultural Awareness in Home Care Nurses/Evde Bakım Hemsirelerinde Kültürel Farkındalık. *Journal of Education and Research in Nursing*, 17(2), 203-207.

IMPACT OF SMOKING AMONG HYPERTENSIVE PATIENTS TREATED WITH BETA-BLOCKER DRUGS: A REVIEW

Hala F. Kasim

Department of Clinical Pharmacy, College of Pharmacy, University of Mosul, Nineveh, Iraq.

Orcid ID: <https://orcid.org/0000-0002-9425-0777>

ABSTRACT

Based on World Health Organization, the tobacco epidemic continues to threaten the global healthcare system through high numbers of related morbidities and mortalities. Cigarette smoking is the most common form of tobacco use, and monitoring the smoking status of patients in hospitals as well as in outpatient clinics is essential for their care. There are dual effects of smoking on hypertension as a disease and on the treatment with antihypertensive drugs, particularly with beta-blocker drugs. Despite inconsistent evidence in multiple types of research about the impact of smoking on increasing blood pressure, the effects of smoking cannot be ignored. These effects are associated with the pathophysiology of the cardiovascular system in general, and in particular cause high blood pressure; hypertension. As well, beta-blocker drugs among antihypertensive drugs appear to be primarily affected by smoking compounds through pharmacokinetic interactions mediated mainly by polycyclic aromatic hydrocarbons in the smoke. Also, there are pharmacodynamic interactions mediated via nicotine of cigarette smoking. As a result, the efficacy of these drugs is affected, which necessitates the dosage modification according to the smoking status of patients to achieve the required therapeutic response. Whether the patients are active or passive smokers, the impact of smoking is unavoidable, especially in the elderly. Older patients are more vulnerable to the negative effects of drug interactions, due to a variety of reasons, such as an increase in the number of prescribed medications and the prevalence of comorbid diseases. Additionally, pharmacokinetic/pharmacodynamic characteristics of drugs are changed in aged patients.

Keywords: Beta-Blocker Drugs, Hypertension, Interaction, Patients, Smoking.

NEW GENERATION OF SENSITIZERS FOR PHOTODYNAMIC THERAPY – DEEPER AND BETTER

Wei Chen

Department of Physics, the University of Texas at Arlington, Arlington, Texas 76019-0059, USA

ABSTRACT

Photodynamic therapy is a combination of light and sensitizers for cancer treatment. The sensitizers and the light are non-toxic but when they interact each other toxins like reactive oxygen species are generated that can kill cancer cells. Photodynamic therapy has the beauty of targeting tumors by the sensitizers themselves and the light, so its side-effect is much lower than chemotherapy or radiotherapy. However, the need of light for activation has some limitations as light cannot penetrate deeply into tissue, so photodynamic therapy has been widely used for skin disease treatment but not for deep cancer treatment. In this webinar, I will discuss the possible solutions for developing photodynamic therapy for deep cancer treatment and some new progress in Photodynamic therapy and the invention of new sensitizers that can be activated by UV, X-ray, microwave and ultrasound to produce reactive oxygen species for deep cancer treatment as well as immunity enhancement. New ideas for the combination of photodynamic therapy and radiation to overcome radiation resistance will be discussed.

EARLY POSTOPERATIVE CHANGES OF PRIMARY HEMOSTASIS: PERITONEAL ADHESIONS

Artem Savchuk

Bukovinian State Medical University, Ukraine

Introduction

Violations of hemostasis play significant role in pathogenesis of peritoneal adhesions as well as multiple organ damage caused by the tight relationship between hemostasis and inflammation. Markers of coagulation have been found to have pathogenetic and prognostic value in many patients undergoing abdominal surgery. Both clinical and experimental studies prove importance of further investigation of coagulation hemostasis including its prognostic and therapeutic potential for abdominal inflammation and formation of peritoneal adhesions.

Objectives

The aim of the study was to analyze changes in the system of primary thrombocyte-vascular haemostasis in patients during the early postoperative period.

Methods

The study covers 52 patients who underwent emergency abdominal surgery for intra-abdominal infection (IAI), aged 18-69 years (41.93 ± 3.47). The control group consisted of 17 patients who underwent elective surgery not related to abdominal cavity. Primary hemostasis analyzed according to prostacycline (6-keto-PGF_{1α}), thromboxane B₂ (T_xB₂) and soluble fibrin monomer complexes (ELISA).

Results

According to the obtained data, in control group patients the T_xB₂ level during 1 day after surgery was 156.11 ± 12.19 pg/ml (n=9), and 6-keto-PGF_{1α} – $166,56 \pm 6.92$ pg/ml (n=9). Under pancreatogenic IAI, these figures grew: T_xB₂ – 48% (p<0.01, n=5), 6-keto-PGF_{1α} to 177.67 ± 12.33 pg/ml (n=5); in peritoneogenic IAI T_xB₂ was 209.50 ± 16.99 pg/ml (P<0.05; n=8) and prostacycline – 172.75 ± 19.05 pg/ml (n=8). Severe course of IAI was marked by the highest concentration of T_xB₂ (384.11 ± 49.52 pg/ml, P<0.001; n=9) with lowest level of 6-keto-PGF_{1α} (86.89 ± 19.75 pg/ml, P<0.001; n=9). Soluble fibrin monomer complexes grew significantly: 5.40 ± 0.31 mkg/ml (control, n=15); 12.40 ± 1.73 mkg/ml (pancreatogenic AIA, n=5; P<0.001); 22.40 ± 4.67 mkg/ml (peritoneogenic AIA, n=5; P<0.001); 54.50 ± 5.21 mkg/ml (severe IAI, n=9; P<0.001).

In addition, statistically reliable regressive dependencies between the soluble fibrin monomer complexes content in blood and T_xB₂ concentration (positive correlation) and the level of 6-keto-PGF_{1α} (negative relationship) were identified.

Conclusions

Significant changes revealed in the system of primary hemostasis in operated IAI patients during the first 24 hours after surgery demonstrate the clear need for the active correction of thromboxane-prostacycline system's violations to prevent postoperative thrombotic complications and formation of peritoneal adhesions.

SURGICAL-ANATOMICAL EVALUATION OF MANDIBULAR PREMOLARS BY CBCT AMONG THE ITALIAN POPULATION

Rodolfo Reda, Alessio Zanza, Dario Di Nardo, Maurilio D'Angelo, Luca Testarelli

Department of Oral and Maxillo Facial Sciences, University of Rome La Sapienza, 00161 Rome, Italy

ABSTRACT

Background: The thorough knowledge of the anatomy of mandibular premolars is an essential factor for a correct approach to endodontic treatment, concerning both non-surgical and surgical treatment.

Aim: Since there is no data on the Italian population in this context, the aim of this study was to evaluate, from a surgical perspective, the anatomy of mandibular premolars among the Italian population through a cone-beam computed tomography (CBCT) analysis, considering the morphology of their root canals according to Vertucci's classification and the prospect of their apices with regard to the vestibular bone plate and the proximity to the inferior alveolar nerve and the mental foramen as well as to evaluate the most appropriate distance from the apex in the radicular resection (3 mm or 5 mm).

Materials and methods: A total of 492 CBCT acquisitions (from 246 males and 246 females) were included retrospectively, evaluating 720 mandibular premolars. Age, gender, the tooth position in relation to the vestibular plate, the number of roots, the tooth length and the root length, the number of canals, the configuration of the root canal system according to Vertucci's criteria, C-shaped canals, the distance from the cemento-enamel junction (CEJ) to the canal bifurcation, the number of apical foramina, and the distance from the apex to the inferior alveolar nerve or the mental foramen were evaluated.

Results: The study highlighted the frequent anatomic variability of the root canal system. It found the presence of 1 root for first and second premolars in 97% and 99% of cases, of 2 roots in 2.7% and 0.7% of cases, and of 3 roots in 0.3% and 0.3% cases, respectively. In 92% of cases, the mental foramen was located below a second premolar, or between a first premolar and a second premolar; only in 8% of cases, it was located close to a first premolar, but never as close as to a second premolar.

Conclusions: Mandibular premolars show a truly surprising anatomical variability, especially for mandibular first premolars, which therefore requires adequate radiographic planning before providing any endodontic treatment, or especially endodontic retreatment or endodontic surgery. Taking into account proximity to the inferior alveolar nerve and the mental foramen, any surgical approach must be carefully planned. Frequently, a two-dimensional (2D) radiographic examination is not sufficient to fully understand the anatomical variability of these teeth.

Keywords: CBCT; endodontic surgery; endodontics; inferior alveolar nerve; mandibular premolars

EATING HABITS OF INDIVIDUALS WITH CYCLIC MASTALGIA: A CASE CONTROLLED STUDY

Pınar Erdoğan

Dr. Öğr. Üyesi, Niğde Ömer Halisdemir University, Zübeyde Hanım Medical Sciences Faculty, Midwifery Department. ORCID: 0000-0002-8435-795X

Alırıza Erdoğan

Dr. Öğr. Üyesi, Niğde Ömer Halisdemir University, Medicine Faculty, General Surgery Department. ORCID: 0000-0002-8931-0907

ABSTRACT

Introduction: Cyclic mastalgia is a chronic pain condition encountered in 30-47% of premenopausal women. In most of the cases no physical cause is demonstrated and the etiopathogenesis is still not yet determined. It has been postulated that hormonal stimulation might be a contributing factor since it is closely related to menstrual cycle. The aim of this study is to compare the eating habits of individuals with and without cyclic mastalgia.

Methods: Patients attending to Niğde Ömer Halisdemir University Research and Training Hospital General Surgery outpatient clinic between June 2021 and January 2022 were evaluated for the study. Patients diagnosed with cyclic mastalgia after physical examination and necessary laboratory and/or radiologic tests were recruited. Control group consisted of individuals attending patients of the same clinic. Individuals with previous and/or present breast diseases, chronic cyclic pain conditions (dysmenorrhea, menstrual migraine vs) were excluded. All participants were asked to fulfill a questionnaire after informed consent was obtained. The participants scored each of the 25 frequent food group. The scoring was 10-likert type, 0 corresponding to no consumption and 9 corresponding to 3 or more times per day consumption.

Results: Total 200 participants (100 for mastalgia group, 100 for control group) were enrolled to the study. The mean age and BMI of the study population was 35.3 ± 6.9 and 25.7 ± 4.5 respectively. The frequency of consumption of meat, fish and raw nuts (including almond, walnut, hazelnut and peanut) was significantly higher in controls (4.3 ± 0.9 vs 3.7 ± 1.6 , $p=0.002$ for meat; 2.4 ± 1.6 vs 1.8 ± 1.4 , $p=0.003$ for fish and 5.7 ± 1.6 vs 4.1 ± 1.8 , $p<0.001$ for raw nuts). On the contrary the frequency of consumption of pasta, packaged chocolate, black tea, coffee and instant beverages was significantly higher in participants with mastalgia. (3.3 ± 1.2 vs 2.9 ± 1.4 , $p=0.046$ for pasta; 3.7 ± 2.1 vs 3.2 ± 1.9 , $p=0.048$ for packaged chocolate; 7.8 ± 1.1 vs 6.5 ± 2.0 , $p<0.001$ for black tea; 4.6 ± 2.5 vs 2.9 ± 2.1 , $p<0.001$ for coffee and 2.4 ± 2.3 vs 1.3 ± 1.6 , $p<0.001$ for instant beverages).

Discussion: The results of this study demonstrate that individuals with mastalgia consume significantly more pasta, packaged chocolate, black tea, coffee and instant beverages while significantly less meat, fish and raw nuts than individuals without mastalgia. Therefore, individuals with cyclic mastalgia might benefit from changes in dietary habits. Additionally, the significantly low consumption of raw nuts in cyclic mastalgia group might validate the previous reports on benefits gamma linoleic acid formulations cyclic mastalgia.

Keywords: cyclic mastalgia, dietary habits, gamma linoleic acid, caffeine

EATING HABITS OF INDIVIDUALS WITH CYCLIC MASTALGIA: A CASE CONTROLLED STUDY

Pınar Erdoğan

Obstetrics and Gynecology Specialist

Niğde Ömer Halisdemir University, Zübeyde Hanım Medical Sciences Faculty, Midwifery Department

ORCID: 0000-0002-8435-795X

Alırza Erdoğan

General Surgery Specialist

Niğde Ömer Halisdemir University, Medicine Faculty, General Surgery Department

ORCID: 0000-0002-8931-0907

ABSTRACT

Introduction

Breast pain is a fairly common phenomenon and is the most common benign condition for referrals in breast clinics. It is estimated that nearly 60-70% of premenopausal women are subject to some degree and some kind of breast pain during their reproductive life span (Chase et al., 2011; Kataria et al., 2014; Smith et al., 2004). In 10-20 % the pain is severe and interfere with sleep, sexual life, sports and social life (Balci et al., 2020; Chase et al., 2011). Breast pain is evaluated in 3 main categories. Noncyclic mastalgia is more associated with anatomical causes like ductal ectasia or previous breast operations and is encountered in postmenopausal period more frequently. Extramammary pain is related to other tissues of chest. Finally, cyclic mastalgia which is the most common type of mastalgia. More than 2/3 of mastalgia referrals are due to cyclic mastalgia. It typically begins at the luteal phase and lasts for at least 7 days prior to menstruation (Chase et al., 2011). Resolution of this cyclic pain usually occurs during menopause or after contentment regarding concerns about malignancy (Chase et al., 2011; Smith et al., 2004). In most of the cases, no physical cause is demonstrated and the etiopathogenesis is still not yet determined (Hafiz et al., 2018). However, it has been postulated that hormonal stimulation might be a contributing factor since it is closely related to menstrual cycle (Salzman et al., 2019). Smoking, consumption of tea, coffee and carbonated beverages in particular worsen mastalgia whereas essential fatty acids (especially gamma and alpha linoleic acid) provides a symptomatic relief (Ader et al., 2001; Idiz et al., 2018; Vaziri et al., 2014).

The aim of this study is to compare the eating habits of individuals with and without cyclic mastalgia and to determine whether any kind of food or food group is more or less consumed by individuals with mastalgia compared to controls.

Keywords: cyclic mastalgia, dietary habits, gamma linoleic acid, caffeine

Methods

This study was designed as case-controlled and it was held in Niğde Ömer Halisdemir University Research and Training Hospital General Surgery outpatient clinic between June 2021 and January 2022. Study group consisted of patients attending with complaint of breast pain. Among these patients, ones diagnosed with cyclic mastalgia after physical examination and necessary laboratory and/or radiologic

tests were recruited. Control group consisted of individuals attending patients of the same clinic. Individuals with previous and/or present breast diseases, chronic cyclic pain conditions (dysmenorrhea, menstrual migraine vs) were excluded.

All participants were asked to fulfill a questionnaire after informed consent was obtained. The participants scored each of the 25 frequent food group. The scoring was 10-point Likert type, 0 corresponding to no consumption and 9 corresponding to 3 or more times per day consumption.

The descriptive statistics were expressed as mean \pm SD for continuous variables and as %(range) for categorical variables. The confidence intervals (95% C.I) were expressed in tables for continuous parameters. The normality of the variables was tested by Kurtosis and Skewness as proposed by Tabachnick and Fidell (Tabachnick & Fidell, 2013). The parametric variables were compared by using Student's t-test. For statistical analysis, IBM SPSS Statistics 24.0 (IBM, Chicago) was used, and p values < 0.05 was accepted as statistically significant. Effect size calculations were performed via https://www.psychometrica.de/effect_size.html (Lenhard & Lenhard, 2016).

Results

Total 200 participants were enrolled (100 for mastalgia group, 100 for control group). Descriptive characteristics like age, BMI, percentage of employed, previously lactated, presence of fibrocystic disease and smoking were given in Table 1 and were similar between groups.

The consumption of various food groups in study population were listed in Tables 2 respectively. The consumption of poultry products, egg and legumes were similar in individuals both with and without mastalgia (Table 2). Both red meat and fish consumption were significantly higher in control group (Table 2). However, looking at the effect sizes, which is the magnitude of the differences between groups, and actually is the main finding of a quantitative study, we easily detect that effect sizes of the differences for meat and fish were rather weak. While interpreting the results, if the effect size is weak (less than 0.5), significant p values are meaningless (Cohen, 2015). Therefore, revisiting the results, although meat and fish consumption in controls was higher, the effect size was small. Bread, other wheat containing food, rice, potato, vegetable and fruit consumption were all similar between study groups (Table 2). Pasta was consumed more frequently in the mastalgia group but the effect size was rather small (Table 2). Raw nut consumption was significantly low in individuals with mastalgia with a medium effect size (4.12 ± 1.78 and 5.66 ± 1.58 , $p<0.001$, $d=0.505$). Milk, yogurt, cheese consumption along with different oil types (margarine, butter, olive oil and sun seed oil) were not statistically significant between groups (Table 2). Packaged chocolate was significantly more consumed by individuals with mastalgia, yet the effect size was small (Table 2). On the other hand, consumption of instant beverages, coffee and black tea were significantly higher in individuals with mastalgia with strong effect sizes ($p<0.001$, $d=0.866$; $p<0.001$, $d=0.754$ respectively) (Table 2).

Discussion

The results of this study demonstrated that individuals seeking medical care for mastalgia and are diagnosed as cyclic mastalgia consume less raw nuts than controls. On the contrary, they consume more black tea, coffee and instant beverages than controls. These results may lead us to a discussion about unsaturated fatty acids and methylxanthines which are both blamed to play a role in the etiopathogenesis of mastalgia. Raw nuts are source of vitamin E, selenium, magnesium and unsaturated fatty acids. At the

etiopathogenesis of mastalgia, saturated fatty acids were blamed to cause sensitization of breast epithelium against circulating steroid hormones. It has been proposed that use of unsaturated fatty acids might reverse this hypersensitization and relieve mastalgia (Balci et al., 2020). Evening primrose oil (EPO), a rich source of gamma-linoleic acid (GLA), has been widely used to treat mastalgia. GLA helps to balance the saturated/unsaturated fatty acid ratio and earlier studies were in favor for the efficacy of EPO in mastalgia treatment. In 1992, 17 years' experience in Cardiff clinic was compiled (Gateley et al., 1992). The results demonstrated that EPO was as effective as danazol, the first line treatment of mastalgia, with 8-fold fewer side effects. As a result, the authors concluded that EPO was recommended as first line treatment along with reassurance (Gateley et al., 1992). However, some recent randomized controlled trials and a meta-analysis concluded that EPO was not more effective than placebo. The mentioned RCT was four-armed, placebo controlled and randomized, and showed that efficacy of a trademark formulation containing GLA did not differ from that of placebo fatty acids, regardless of whether or not antioxidant vitamins were present. However, all four arms showed improvement in mastalgia scores (Goyal & Mansel, 2005). A 2007 dated meta-analysis pooling data of significantly heterogenous 4 RCT revealed that EPO was not different from placebo for treating mastalgia (Srivastava et al., 2007). Accordingly, the most up to date practice bulletin of ACOG (2016) regarding Diagnosis and Management of Benign Breast Diseases states that EPO and its ingredient GLA did not show overall benefit when compared with placebo (ACOG, 2014). However, there are some more up-to date evidence in favor of EPO. A more recent randomized, multicenter, controlled double-blind trial women with FCD using the formula containing GLA, iodine, and selenium experienced reduced nodularity and in those women who took over-the-counter breast pain medication, a decrease in the quantity of pain medication was observed (Mansel et al., 2018). Similarly, in a recent large-scaled study (1015 patients), effects of EPO versus paracetamol was investigated. EPO was significantly more effective than paracetamol. Co-existing situations like hormone replacement therapy, IUD with-levonorgestrel, iron deficiency, overt hypothyroidism, and Hashimoto thyroiditis were reported to interfere with the effectiveness of EPO (Balci et al., 2020).

Another factor which is center of research as etiopathogenetic factor for mastalgia is consumption of methylxanthine containing substances. Black tea, coffee and most of the instant beverages contain methylxanthines. This was first proposed by Minton in 1979 depending on an observation that biopsy specimens of women with mastalgia contained greater numbers of cyclic nucleotides, such as adenosine monophosphate (c-AMP) and guanosine monophosphate (c-GMP) (Minton et al., 1979). These nucleotides stimulate protein kinases which in turn causes increased proliferation of fibrous tissue and cystic fluid leading to breast pain. Subsequently they published a series that women with mastalgia consume more caffeine containing drinks. This lead to proposition that cessation of caffeine intake might relieve mastalgia. However, it was not the case. In following years this proposition could not be confirmed (Chase et al., 2011). ACOG 2016 Practice Bulletin states that none of the dietary changes such as restriction of methylxanthines and caffeine intake, have been conclusively demonstrated to reduce mastalgia (ACOG, 2014). Yet our series report higher caffeine consumption in individuals with mastalgia. Similarly, in a recent study held in our university demonstrated that methylxanthines increase the likelihood of mastalgia (Bolat et al., 2022). According to case series individuals with mastalgia consume more caffeine but on the other hand according to guidelines caffeine restriction does not relieve mastalgia. The causal link seems to be broken and probably we need to search the causal link between mastalgia and methylxanthine consumption somewhere else. The authors of this study argue that both

mastalgia and high methylxanthine consumption might be the result of a certain life style. The relation of anxiety, depressive symptoms, life style and cyclic mastalgia has been demonstrated (Fox et al., 1997; Kanat et al., 2016; Preece et al., 1978; Ramirez et al., 1995). Breast pain has anciently been attributed to an irritable and suggestive nature as well as a psychosomatic disorder (Preece et al., 1978). The leading concern in patients with mastalgia is the fear of breast cancer. According to the Practice Bulletin of ACOG, the first line therapy in mastalgia patients is reassurance. Non-randomized trials demonstrated that 70% of patient with mastalgia require no further intervention with normal physical finding and reassurance (ACOG, 2014; Kataria et al., 2014).

The results of this study demonstrate that individuals with mastalgia consume significantly more black tea, coffee and instant beverages while significantly less raw nuts than individuals without mastalgia. Individuals with cyclic mastalgia might benefit from changes in dietary habits, yet causal relationship cannot be established from these results. Especially, the significantly low consumption of raw nuts in cyclic mastalgia group might validate the recent reports on benefits of gamma linoleic acid formulations to treat cyclic mastalgia.

References

- ACOG. (2014). Practice bullet in benign breast disorders. *Acog*, *123*(5), 1118–1132.
- Ader, D. N., South-Paul, J., Adera, T., & Deuster, P. A. (2001). Cyclical mastalgia: Prevalence and associated health and behavioral factors. *Journal of Psychosomatic Obstetrics and Gynecology*. <https://doi.org/10.3109/01674820109049956>
- Balci, F. L., Uras, C., & Feldman, S. (2020). Clinical Factors Affecting the Therapeutic Efficacy of Evening Primrose Oil on Mastalgia. *Annals of Surgical Oncology*, *27*(12), 4844–4852. <https://doi.org/10.1245/s10434-020-08949-x>
- Bolat, H., Aşçı, Ö., Kocaöz, S., & Kocaöz, S. (2022). Noncyclical and cyclical mastalgia in Turkish women: Prevalence, risk factors, health-care seeking and quality of life. *Health Care for Women International*, *43*(1–3), 160–175. <https://doi.org/10.1080/07399332.2021.1887194>
- Chase, C., Wells, J., & Eley, S. (2011). Caffeine and Breast Pain. *Nursing for Women's Health*, *15*(4), 286–294. <https://doi.org/10.1111/J.1751-486X.2011.01649.X>
- Cohen, J. (2015). Things I have learned (so far). In *Methodological issues and strategies in clinical research (4th ed.)*. American Psychological Association. <https://doi.org/10.1037/14805-017>
- Fox, H., Walker, L. G., Heys, S. D., Ah-See, A. K., & Eremin, O. (1997). Are patients with mastalgia anxious, and does relaxation therapy help? *Breast*, *6*(3), 138–142. [https://doi.org/10.1016/S0960-9776\(97\)90554-3](https://doi.org/10.1016/S0960-9776(97)90554-3)
- Gateley, C. A., Miers, M., Mansel, R. E., & Hughes, L. E. (1992). Drug treatments for mastalgia: 17 years experience in the Cardiff Mastalgia Clinic. *Journal of the Royal Society of Medicine*, *85*(1), 12. <https://doi.org/10.1177/014107689208500105>
- Goyal, A., & Mansel, R. E. (2005). A randomized multicenter study of gamolenic acid (Efamast) with and without antioxidant vitamins and minerals in the management of mastalgia. *Breast Journal*, *11*(1), 41–47. <https://doi.org/10.1111/j.1075-122X.2005.21492.x>
- Hafiz, S. P., Barnes, N. L. P., & Kirwan, C. C. (2018). Clinical management of idiopathic mastalgia: A systematic review. *Journal of Primary Health Care*, *10*(4), 312–323. <https://doi.org/10.1071/HC18026>
- Idiz, C., Cakir, C., Ulusoy, A. İ., & Idiz, U. O. (2018). The Role of Nutrition in Women with Benign Cyclic Mastalgia: A Case-Control Study. *European Journal of Breast Health*, December 2015, 156–159.

<https://doi.org/10.5152/ejbh.2018.3827>

Kanat, B. H., Atmaca, M., Girgin, M., Ilhan, Y. S., Bozdağ, A., Özkan, Z., Yazar, F. M., & Emir, S. (2016). Effects of Mastalgia in Young Women on Quality of Life, Depression, and Anxiety Levels. *Indian Journal of Surgery*. <https://doi.org/10.1007/s12262-015-1325-5>

Kataria, K., Dhar, A., Srivastava, A., Kumar, S., & Goyal, A. (2014). A Systematic Review of Current Understanding and Management of Mastalgia. *Indian Journal of Surgery*, 76(3), 217–222. <https://doi.org/10.1007/s12262-013-0813-8>

Lenhard, W., & Lenhard, A. (2016). *Computation of effect sizes*. Psychometrica. <https://doi.org/10.13140/RG.2.2.17823.92329>

Mansel, R. E., Das, T., Baggs, G. E., Noss, M. J., Jennings, W. P., Cohen, J., Portman, D., Cohen, M., & Voss, A. C. (2018). A Randomized Controlled Multicenter Trial of an Investigational Liquid Nutritional Formula in Women with Cyclic Breast Pain Associated with Fibrocystic Breast Changes. *Journal of Women's Health*. <https://doi.org/10.1089/jwh.2017.6406>

Minton, J. P., Foecking, M. K., Webster, D. J. T., & Matthews, R. H. (1979). Caffeine, cyclic nucleotides, and breast disease. *Surgery*, 86(1), 105–109. <http://www.surgjournal.com/article/0039606079901363/fulltext>

Preece, P. E., Mansel, R. E., & Hughes, L. E. (1978). Mastalgia: Psychoneurosis or organic disease? *British Medical Journal*, 1(6104), 29–30. <https://doi.org/10.1136/bmj.1.6104.29>

Ramirez, A. J., Jarrett, S. R., Hamed, H., Smith, P., & Fentiman, I. S. (1995). Psychosocial adjustment of women with mastalgia. *The Breast*, 4(1), 48–51. [https://doi.org/10.1016/0960-9776\(95\)90029-2](https://doi.org/10.1016/0960-9776(95)90029-2)

Salzman, B., Collins, E., & Hersh, L. (2019). Common breast problems. *American Family Physician*, 99(8), 505-514A. <https://doi.org/10.1258/1362180042721355>

Smith, R. L., Pruthi, S., & Fitzpatrick, L. A. (2004). Evaluation and Management of Breast Pain. *Mayo Clinic Proceedings*, 79(3), 353–372. <https://doi.org/10.4065/79.3.353>

Srivastava, A., Mansel, R. E., Arvind, N., Prasad, K., Dhar, A., & Chabra, A. (2007). Evidence-based management of Mastalgia: A meta-analysis of randomised trials. *Breast*, 16(5), 503–512. <https://doi.org/10.1016/j.breast.2007.03.003>

Tabachnick, B., & Fidell, L. (2013). *Using Multivariate Statistics (sixth ed.)* Pearson, Boston. Tabachnick and Fidell.

Vaziri, F., Zamani Lari, M., Samsami Dehaghani, A., Salehi, M., Sadeghpour, H., Akbarzadeh, M., & Zare, N. (2014). Comparing the Effects of Dietary Flaxseed and Omega-3 Fatty Acids Supplement on Cyclical Mastalgia in Iranian Women: A Randomized Clinical Trial. *International Journal of Family Medicine*, 2014, 1–7. <https://doi.org/10.1155/2014/174532>

Table 1. Descriptive characteristics of the study population

	Mastalgia (n=100)	Control (n=100)	Total	p
	Mean±SD	Mean±SD	Mean±SD	
Age (years)	35.65±7.00	34.91±6.91	35.3±6.9	0.453
BMI (kg/m ²)	25.78±4.69	25.59±4.24	25.7±4.5	0.760

	n (%)	n (%)	n (%)	
Employed	32 (%32)	31 (31%)	63 (31.5)	0.879
Lactation •	85	91 (91%)	176 (88)	0.192
FCD ••	21	17 (17%)	38 (19)	0.471
smoking	9	11 (11%)	20 (10)	0.637

- presence of previous
- fibrocystic disease

Table 2. Comparison of consumption of different food groups between study groups

	Mastalgia (n=100)	Control (n=100)	<i>p</i>	Cohen's d	95% C.I
	Mean±SD	Mean±SD			
Red meat	3.71±1.62	4.31±0.94	0.002	0.453	0.172-0.734
Poultry products	3.48±1.31	3.60±1.44	0.538		
Fish	1.77±1.38	2.39±1.57	0.003	0.419	0.139-0.700
Egg	5.41±1.60	5.20±1.65	0.363		
Legumes (bean, pea, chick-pea,)	4.18±4.99	3.91±1.28	0.601		
Bread	6.7±1.64	6.54±2.22	0.563		
Pasta	3.29±1.16	2.93±1.34	0.046	0.287	0.566-0.009
Wheat containing food (others)	3.75±1.19	3.57±1.37	0.323		
Rice	3.86±1.15	3.71±1.12	0.353		
Potato	4.14±1.04	4.61±5.32	0.387		
Vegetables	4.8±1.51	5.47±3.93	0.113		
Fruits	6.41±1.36	6.97±7.13	0.441		
Nuts (almond, walnut, hazelnut and peanut)	4.12±1.78	5.66±1.58	<0.001	0.505	0.223-0.786
Milk	3.20±2.15	3.31±2.28	0.723		
Yogurt	5.59±3.91	5.26±1.84	0.446		
Cheese	6.22±1.15	5.96±1.67	0.201		

Margarine	1.17±1.68	1.32±1.86	0.550		
Butter	4.82±1.99	4.91±2.22	0.763		
Olive oil	5.98±2.00	5.82±1.87	0.560		
Sun seed oil	4.73±2.59	4.56±2.18	0.616		
Packaged chcoloate	3.73±2.13	3.16±1.91	0.048	0.282	0.56-0.003
Packaged other food	2.58±2.19	2.37±1.97	0.477		
Instant beverages	2.37±2.29	1.32±1.64	<0.001	0.527	0.809-0.245
Coffee	4.64±2.45	2.68±2.06	<0.001	0.866	1.156-0.576
Black tea	7.78±1.12	6.54±2.04	<0.001	0.754	1.04-0.467

CO-INFECTION OF *ESCHERICHIA COLI* PATHOTYPES WITH INTESTINAL PARASITES AMONG CHILDREN LESS THAN FIVE YEARS IN DUHOK CITY, IRAQ

Haveen Khalid Hasan

Department of Biology, University of Polytechnique, Duhok, Kurdistan Region, Iraq

Souzan Hussain Eassa

Assistant professor, Dept of Medical Microbiology, College of Medicine, University of Duhok, Iraq
BioMed Division, School of medicine, University Kurdistan Hewler, Erbil, Kurdistan Region, Iraq.

Najim Abdalla Yaseen

Assistant professor, Dept of Medical Microbiology, College of Medicine, University of Duhok,
Kurdistan Region, Iraq

ABSTRACT

Background: A variety of recognized microorganisms can be associated with diarrhea in children, including: Diarrheogenic *Escherichia coli* and intestinal parasites.

Objectives: Prevalence and molecular detection of co-infections caused by certain diarrheogenic *Escherichia coli* pathotypes together with intestinal parasites among children less than five years had diarrhea admitted at Heevi pediatric Hospital/Duhok city, Iraq.

Methods: A total of 400 diarrheic stool samples were collected between May 2018 to April 2019 and differences of ages, sex, residency and diarrheal type were recorded. Stool sample examined directly for identifying intestinal parasites species and modified Ziehl-Neelsen (MZN) then cultured on both MacConkey agar and MacConkey sorbitol agar for identifying diarrheogenic *E.coli* that identified by bacteriological tests and VITEK machine. Antibiotic susceptibility test and PCR assay targeting associated virulence genes (*elt* , *eaec*, *stx1* and *stx2*) for differentiation of *E coli* pathotypes were determined.

Results: About 366 (91. 5%) stool samples contained bacterial and parasites agents, single infection with parasites was 4.25%, mixed infection with *E. coli* was 32.5%, and single infection with *E. coli* was 54.5%. *Entamoeba histolytica* was common 20.25% followed by *Cryptosporidium* 19%, *Giardia lamblia* was low 1.25%, *Hymenolepis nana* 0.25%. PCR assay applied on 50 phenotypic identified *E coli*, 13 (26%) was ETEC, 5 EHEC (10%) and none EPEC was detected. Co infection was detected with molecularly characterized diarrheogenic *E. coli* pathotypes and parasitic agents in 8% (4 out of 50 cases). Two ETEC pathotypes were associated with parasites, first with *Cryptosporidium* and the second with both *Cryptosporidium* and *G. lamblia* together. Two EHEC was with *E. histolytica* and another was with *Cryptosporidium*. The maximum co-infection of *E. coli* was *Cryptosporidium* 6%; while with *E. histolytica* was 2% and with *G. lamblia* 2%.

Conclusion: pathotypes of *E. coli* especially ETEC was common pathogen caused diarrhea, co infection with parasites seen in about one third of the total examined stools. Infection with parasites species alone had low rate; *Entameoba histolytica* was frequent parasite followed by *Cryptosporidium*.

Keywords: Diarrhea, Diarrheogenic *Escherichia coli* pathotypes, Intestinal parasites, PCR, Stool.

**BIOACTIVITY SCREENING OF BACTERIAL COMMUNITIES ASSOCIATED WITH THE
OCTOCORAL GORGONIAN *Plexaura sp.*: ANTIPATHOGENIC ACTIVITY AGAINST
NOSOCOMIAL PATHOGEN *Acinetobacter baumannii***

Stefanie J.H. LARASATI,

Marine Science Department, Fisheries and Marine Science Faculty, Diponegoro University, Semarang,
Indonesia

Ocky Karna RADJASA

The National Research and Innovation Agency, Research Organization for Earth Sciences and
Maritime, Jakarta, Indonesia

Agus TRIANTO

Marine Science Department, Fisheries and Marine Science Faculty, Diponegoro University, Semarang,
Indonesia

Rizky WULANDARI

Marine Science Department, Fisheries and Marine Science Faculty, Diponegoro University, Semarang,
Indonesia

Agus SABDONO

Marine Science Department, Fisheries and Marine Science Faculty, Diponegoro University, Semarang,
Indonesia

ABSTRACT

Chronic infectious diseases caused by biofilm-forming pathogenic bacteria are the second rank causes of death in Indonesia after heart and blood vessel diseases. The emergence of antibiotic-resistant *Acinetobacter baumannii* pathogenic bacteria worldwide poses the main medicinal challenge to the search for new antibiotics. This study aimed to investigate gorgonian *Plexaura sp.*-associated bacteria that have the potential as anti-nosocomial pathogenic *A. baumannii*. A total of 29 bacterial strains were assayed for their prospective antipathogenic compounds against nosocomial pathogenic *A. baumannii*. The 5 bacterial isolates exhibited antipathogenic activity against at least one bacterial pathogen. The RA17-2 isolate showed the highest diameter size of the inhibition zone. Analyzing the gene of 16S rRNA discovered that these 5 isolates were associated with 3 genera of phyla Firmicutes and Proteobacteria, including *Bacillus*, *Virgibacillus*, and *Nitratireductor*. Two of the 5 antipathogenic isolates possess PKS-I, three strains PKS-II, five strains possess NRPS and 2 isolates possess both PKS and NRPS genes. These results demonstrated that gorgonian octocoral species *Plexauridae sp* harbor varied communities of bacteria and propose that many gorgonian-associated bacteria have the prospective for the advancement of broad-spectrum antibiotics.

Keywords: Gorgonian, antipathogen, biofilm-forming infectious pathogens, *Plexauridae sp*

ASSOCIATION OF RENAL TUBULAR INJURY BIOMARKER, MARKERS OF CHRONIC INFLAMMATION, AND ENDOTHELIAL DYSFUNCTION WITH CKD

Shalala Ismayilova

Azerbaijan Medical University, Department of Internal Medicine
<https://orcid.org/0000-0002-2151-1243>

Irada Mammadova

Azerbaijan Medical University, Department of Family Medicine

Afet Nesibli

Azerbaijan Medical University, Department of Family Medicine

Fidan Ahadova

Azerbaijan Medical University, Department of Family Medicine

ABSTRACT

Although the pathological mechanisms involved in the development of chronic kidney disease (CKD) are not well understood, both endothelial dysfunction and inflammation play an important pathogenetic role. Various studies have provided solid supporting evidence for the clinical significance of biomarkers of inflammation and endothelial dysfunction as predictors of multiple complications which lead to CKD, including albuminuria, and cardiovascular disease. Researchers found that the combination of increased levels of C-reactive protein (CRP), and interleukin-6 (IL-6), is associated with albuminuria, and CKD. The current study aimed to determine whether markers of inflammation and endothelial dysfunction are associated with the development of renal dysfunction in the short term.

Material and methods: We enrolled 167 patients with patients CKD. The CKD stage is set according to the KDOGI classification (2002). At the baseline, each participant underwent a physical examination, medical history, and routine laboratory analysis that included serum creatinine, lipid profile, and HbA1c. Creatinine clearance and albumin excretion rate were determined in 24-h urine collection specimens and the estimated glomerular filtration rate (eGFR) was calculated based on annual serum creatinine levels and was measured every 3 months. Concentrations of En-1, VEGF, NO, CRP TNF- α , NGAL, IL-18, and IL-6 were also determined to study the functional state of the endothelium and inflammation level and Array Vision software was used for data analysis.

Results: 53.4% of participants with available samples were male, and 46.6%) were female. At the beginning of biomarker sample collection, the mean age was 48.1 ± 11.3 years, and the mean duration of primary disease diabetes was 12.8 (6.7) years. A short-term -3 years to monitor outcomes, the risk of progression to CKD associated with increased markers of inflammation and endothelial dysfunction was strong. Increased markers of thrombosis were also associated with an increased risk of progression to CKD. TNF α levels were similarly associated with CKD progression for both the year and the 3-year, despite the reduced character for the 3-year period

Conclusion: The main goal of this study was to determine whether biomarkers of inflammation and endothelial dysfunction are associated with an increased risk of developing CKD. The choice of biomarkers was based on previously published findings on biomarkers of inflammation, thrombosis, and

endothelial dysfunction, and how they are associated with CKD progression. Most of the studied biomarkers correlate with renal function deterioration in patients with stage 1-2 CKD and seem to have long-term predictive value. However, only a limited number of these biomarkers can predict the onset of chronic disease closer to the development of the outcomes considered in this study. Of these markers, NGAL, and TNF α Il-16 seem to be the most useful for inclusion in clinical trials of relatively short duration.

PREDICTIVE SERUM BIOMARKERS OF CARDIOVASCULAR DISEASE IN PATIENTS WITH CKD

Manzar Novruzova

Azerbaijan Medical University, Department of Family Medicine

Samira Muradova

Azerbaijan Medical University, Department of Internal Medicine

Shafag Ibrahimova

Azerbaijan Medical University, Department of Internal Medicine

Natavan Huseynova

Azerbaijan Medical University, Department of Internal Medicine

Shalala Ismayilova

Azerbaijan Medical University, Department of Internal Medicine

<https://orcid.org/0000-0002-2151-1243>

ABSTRACT

The frequency of occurrence of combined damage of the kidneys and heart is very high. Renal dysfunction determines high cardiac morbidity and mortality even with an initial decline in kidney function. Cardiac pathology is 64% higher in patients with impaired renal function than in healthy population. According to the ARIC study, new cardiac complications in patients with stage 2 CKD account for 4.8% and at the stages 3-4 of CKD, their frequency almost doubles.

In this regard, the determination of biomarkers in these patients for prognostic purposes is becoming increasingly important.

This study aimed to evaluate the contribution of biomarkers of such as creatinine, microalbuminuria, IL-18, kidney injury molecule (KIM-1), cystatin C, neutrophil gelatinase-associated lipocaine (NGAL) and basic clinical, laboratory and instrumental indicators in determining clinical outcomes in patients with chronic heart failure.

Methods and Results: 67 patients with chronic heart failure were studied, 29 of them were with cardiorenal syndrome. Levels of TNF- α , NGAL, IL-18 in plasma were evaluated in both groups and compared with 25 healthy controls. In 1st group (CRS) IL-18, NGAL levels were significantly higher than 2nd group and healthy control group ($p < 0.01$). TNF- α were higher in both groups compared with control group but no significant differences were found between heart failure and cardiorenal syndrome group. The inflammatory pathway could be proved as a necessary contribution of the development of cardiorenal syndrome in chronic heart failure.

Conclusion: Due to the global scope of CKD and the high prevalence of CVD in these settings, great efforts are currently ongoing with the aim of reducing residual cardiovascular risk. One important strategy that can be used to achieve this goal is to develop reliable prognostic biomarkers.

Keywords: cardiorenal syndrome, heart failure, IL-18, TNF- α

NEXT GENERATION PHENOTYPING METHODS FOR CONSERVATION OF BIODIVERSITY AND GENETIC RESOURCES

Ayşe Gul Ince

Vocational School of Technical Sciences, Akdeniz University, Antalya, 07059 Turkey
ORCID No: <https://orcid.org/0000-0002-9015-6580>

Mehmet Karaca

Department of Field Crops, Faculty of Agriculture, Akdeniz University, Antalya, 07059 Turkey
ORCID No: <https://orcid.org/0000-0003-3219-9109>

ABSTRACT

Biodiversity and genetic resources could be preserved via phenotyping and monitoring technology. Satellite, aerial, and close-range techniques are among these technologies, as well as spectrum laboratories and phenomics. In this study, enhanced generation phenotyping techniques for protecting plant genetic diversity and resources were examined. Images from satellites, manned planes, and unmanned planes are frequently used for phenotyping. These photographs often lack the fine features required for the protection of biodiversity and genetic resources because to their low spatial resolution (in the context of both in situ and ex situ conservation), poor sensitivity when it is cloudy, delayed data transmission, and expensive expenses. For phenotyping, many depth scales can be used, such as high or low resolution and high or low throughput volumes. Since high-throughput methods frequently analyze the entire plant at medium-low resolution, they are suitable for preserving biodiversity and enhancing genetic resolution. Automated systems could nondestructively screen hundreds of accessions per day if it were used in ex situ and in situ fields for phenotyping and crop monitoring. Given that the fusion of phenomics and genomics has the potential to revolutionize plant breeding, this high throughput method can be used to conserve genetic resources and biodiversity. High throughput phenotyping, which combines increasingly potent and thorough sensors and cameras with large-scale and inexpensive phenotype difference manufacturing, is the driving force behind phenomics. Plant phenomics tries to characterize every possible phenotypic for a specific genotype under different environmental circumstances. Therefore, phenomics includes structural, physiological, and performance-related characteristics and requires phenotyping at several organizational levels (from cellular components to entire plants and canopy). Even though they are efficient, modern plant phenotyping platforms, such as phenotowers, blimps, and phenomobiles with GPS navigation and sensors, are quite expensive in terms of investments, data management, and the need for skilled personnel.

Keywords: crop monitoring, GPS navigation, high-throughput methods, phenomobiles, plant canopy, sensors

1. Introduction

Utilizing plant genetic resources in breeding programs more effectively is necessary given demographic trends and climatic changes. The technique for safeguarding genetic resources depends on the kind of material being saved, the conservation goal, and the scope of conservation. The sort of material that has been preserved is determined by the length of the life cycle, the mode of reproduction, the size of the

individuals, and the ecological context (Lin, 2015). In fact, agricultural genetic erosion and loss of diversity have been brought on by the introduction of high-yielding variants. As a result, several food quality criteria have decreased and vulnerability to extreme stress has increased. One of the main obstacles to more germplasm being used for ex situ conservation is the absence of accession-level data on conserved genetic material. The majority of conserved genetic resources are only represented by basic germplasm descriptor records, such passport information, in the gene banks around the world. Most people lack knowledge of biochemical characteristics and disease resistance. Furthermore, the use of contemporary technologies could enhance in situ conservation methods. The exploration of "gene space" and the provision of high-resolution nucleotide variation profiling inside germplasm collections are two growing applications of next generation sequencing (NGS) technologies. However, improvements in high-throughput phenotyping are closing the genotype-to-phenotype selection gap in crops. An essential step in crop development projects is plant phenotyping, which is the evaluation of expressed traits (as impacted by genetic make-up and environmental changes). The dynamic and local interactions of phenotypes with the above- and below-ground environment occur to produce the plant phenotype. Genome-wide association studies are aiding the identification of genetic loci that are related with important agronomic variables by combining allelic and phenotypic data sets. Through computer image analysis, next-generation phenotyping of plant breeding and genetic resources has arisen to produce high-quality phenotypic and environmental information (Walter et al., 2015; Afonnikov et al., 2016). Although the information contained in the sequence of genomic DNA is cryptic and does not clearly explain the variations between cells and all plant phenotypes, it does provide a comprehensive view of genetic potential. On the other hand, some phenotypic features offer more precise information than genomic data regarding the growth and health of plants.

2. SUITABLE SPECTRAL CHARACTERS FOR PRESERVING BIODIVERSITY AND GENETIC RESOURCES

Plant height, leaf color, leaf area index, chlorophyll content, biomass, yield, growth period length, flowering, crop canopy cover, and canopy spectral texture are some of design and morphogenetic characteristics parameters. Chlorophyll, pigment and carotene content, pigment indices for photosynthesis, protein content, biomass, malnutrition, crop vigor, and water status are some of physical characteristics of plants. Qualities and plant yields characteristics include total oil, protein, starch, moisture content, and compositions of the amino acids and fatty acids. Using spectral data at various crop growth phases, yield prediction is described as developing the relationship between the canopy spectra and crop yield based on the biological properties of crops. Crop height, vegetation cover fraction, fraction of radiation intercepted, leaf area, leaf area index, lodging, 3D structure, leaf angle distribution, tiller density, and emergence are some of geometric plants features. Abiotic and biotic stress on plants characteristics include senescence index, stomatal conductance, canopy temperature differential, low temperature, high temperature, high salinity, environmental pollution, susceptibility to pests and diseases, and water stress and deficiency. Metabolomic characteristics include taste, volatile chemicals, phenolic, vitamins, carbohydrates, and organic acids. In evaluating genotypic and phenotypic variety in plants, identifying biochemical alterations related to developmental changes during plant growth, and increasingly in compositional comparisons, metabolomics plays a significant role (Gascuel et al., 2017; Ubbens and Stavness, 2017). The fatty acid and amino acid compositions, fiber quality, nitrogen concentration, protein content, and seed features like total oil, protein, starch, and moisture content are

all examples of quality traits. Ground canopy protection is a crucial factor in the photosynthesis and transpiration of the crop. It can be used to research how crop types react to abiotic/biotic stress because it is dynamic during the crop growth phases and is reduced as a result of leaf rolling or withering under drought stress circumstances. Selection and qualification characteristics include counting leaves, pods, and fruits, grading vigor, assessing injuries, identifying diseases, estimating age, and classifying mutants. Modern plant phenotyping depends on two fast evolving pillars: i) non-destructive measurements to track a characteristic over time; and ii) high-throughput measurements to screen a large number of genotypes under identical conditions. As a developing science, phenotyping will tell us about how genetics, epigenetics, environmental factors, and crop management (farming) influence plant phenotypes and direct selection toward environmentally appropriate, productive plants. However, it must continue to advance, and in order to do so, there is a critical need for specialized infrastructures that offer the necessary tools and resources for phenotyping the available, priceless genomic data. Creation, automation, and usage of sensors, as well as -omics in a wide sense, plant ecology, physiology, disease, and interactions with other species, as well as (bio)informatics and statistics, have all been necessary. The idea of phenotyping can now be expanded to include both molecular mechanisms (proteomics and metabolomics) and all intermediate layers that lead to macroscopic physiological and phenological features as a consequence of recent improvements in phenotyping methodologies (Gascuel et al., 2017; Thompson et al., 2018; Ubbens and Stavness, 2017).

3. Several sensing and imaging methods in next-generation phenotyping

Different depth scales, such as high or low resolution and high or low throughput volumes, can be used for phenotyping. High-throughput approaches often analyze the entire plant at medium-low resolution; as a result, they are appropriate for maintaining biodiversity and improving genetic resolution. It might be applied to in situ and ex situ fields for phenotyping and crop monitoring, enabling automated systems to nondestructively screen hundreds of accessions every day. This high throughput approach can be utilized to conserve genetic resources and biodiversity, as the merging of phenomics and genomics has the potential to transform plant breeding. Phenomics is driven by high throughput phenotyping, which combines more powerful and thorough sensors and cameras with large-scale and affordable phenotype difference production. Plant phenomics aims to characterize all potential phenotypes for a particular genotype under various environmental conditions. For that reason, phenomics consists of structural, physiological, and performance-related features and involves phenotyping at many levels of organization (from cellular components to entire plants and canopy) (Walter et al., 2015; Crain et al., 2018; Thompson et al., 2018; Roth et al., 2022).

The development of satellite imaging technologies has made data collection for numerous agricultural applications a very helpful tool. The main drawbacks of employing the present satellite sensors are their expensive cost, the inability to identify desired qualities due to a lack of spatial resolution, the possibility of foggy sceneries, and the lengthy revisit intervals. For high-throughput phenotyping, numerous field-based high-throughput phenotyping techniques and systems have been created (Crain et al., 2016; Holman et al., 2016). Some of the platforms make use of aerial vehicles, tractor mounted devices, and push carts. Even though they work effectively, advanced plant phenotyping platforms like phenomobiles, phenotowers, and blimps with GPS navigation systems and sensors are highly expensive in terms of capital, data collecting and handling, and the requirement for specialist personnel (Habib et al., 2018; Tripodi et al., 2018). Because of this, these platforms are difficult to afford in many underdeveloped

nations, where they are most needed. Manual measurements of crop attributes have considerable limits and downsides, including being labor-intensive, time-consuming, and prone to human mistake due to weariness and distractions during data collection, even though they are still often utilized in practical phenotyping (Yang et al., 2017; Jimenez-Berni et al., 2018).

Technologies for phenotyping and monitoring could be utilized to protect genetic resources and biodiversity. These include satellite, aerial, and close-range techniques, as well as phenomics and spectrum laboratories (Jimenez-Berni et al., 2018). Images from satellites, manned aircraft, and unmanned aircraft systems are often expensive, have poor sensitivity in foggy situations, and low spatial resolution (with relation to in situ and ex situ conservation). Because of this, they fall short of fully capturing the minute details required for the preservation of biodiversity and genetic resources. Facilities are offered for biochemical-biophysical analysis, structural factors in organs (roots, leaves, and stems), whole trees, and plant phenomics. Therefore, phenomics and spectrum laboratory capabilities may be used to identify biochemical-biophysical and morphological traits. While close-range remote sensing methods or platforms do not provide taxonomic, phylogenetic, genomic, epigenetic, or morphological-functional traits, next-generation unmanned aerial vehicles (UAVs), wireless sensor networks, towers, and field spectrometers do (Busemeyer et al., 2013; Thompson et al., 2018).

Proximal sensing carts and unmanned aerial vehicles (UAV), both of which can be referred to as "phenomobiles" among phenotyping and monitoring technologies, are appropriate for use in the application of biodiversity and genetic resource conservation. In order to quickly and non-destructively acquire high-resolution images, UAVs are outfitted with a variety of sensors, including visible light imaging sensors, spectral sensors, infrared thermal sensors, fluorescence sensors, digital cameras (RGB), multispectral cameras, infrared thermal imagers, hyperspectral cameras, LIDAR, three-dimensional cameras, and synthetic aperture radar (SAR). According on the intended usage and available funds, common UAVs used for phenomics include multirotors, helicopters, fixed-wing aircraft, blimps, and flying wing aircraft (Busemeyer et al., 2013; Virlet et al., 2017).

Phenotyping technology have advanced during the last three decades. Next-generation phenotyping methods, often known as multi-sensor approaches, are those phenotyping techniques that use high-throughput and high resolution. It has been demonstrated that spectral traits are influenced by sensor properties (spatial, radiometric, spectral, temporal, or angular resolution) and sensing methods (hyperspectral, multispectral, digital (RGB), Light Detection and Ranging (LiDAR), Synthetic Aperture RADAR (SAR), and passive microwave sensors), which results in a different level of discrimination between different species, populations, communities, and habitats. The pattern and spatial distribution and diversity of plant species and communities, as well as natural disasters and disturbance regimes, such as volcano eruptions, wildfires, beetle infestations, and the global carbon cycles, could all be distinguished and monitored by advanced phenotyping methods and platforms based on multi-sensor remote sensing (Virlet et al., 2017).

Destructive sampling has been challenged by recent advances in remote and proximal sensing for high-throughput field phenotyping, which have included the use of digital photography and sensors across many scales, employing both aircraft and ground platforms. Next-generation high-throughput phenotyping involves gathering enormous amounts of picture data, storing it safely, working quickly and efficiently, performing time- and money-saving analyses, and dissecting objective data (without influence of human perception). Abiotic and biotic stresses, adaptation to abiotic and biotic limiting conditions, metabolomics traits and quality traits, physiological traits, and plant structure and

morphogenetic traits are among the high-throughput phenotyping spectral traits that are appropriate for biodiversity conservation and genetic resource preservation (White et al., 2012; Yang et al., 2017; Jimenez-Berni et al., 2018).

The crop canopy temperature may be swiftly and non-destructively acquired using next-generation phenomobiles equipped with infrared thermal imagers, which can efficiently discern temperature variations in the crop canopy under various environmental conditions. When there is a substantial positive association between lower canopy temperature and higher yield under conditions of high temperature and drought, the canopy temperature can be utilized to predict plant production. Since stomatal closure leads to a rise in leaf temperature under osmotic stress brought on by excessive salt and high temperatures, leaf water potential could be evaluated. Additionally, stomatal conductance and photosynthesis can be affected in the similar ways by salinity and drought (Tripodi et al., 2018).

Next generation phenotyping techniques like phenomobiles could be used to measure the crop output of ex situ conserved genetic resources. The canopy air temperature difference, which is the ratio of the canopy temperature and air temperature, can be used to estimate crop yield because the canopy air temperature difference and plant yield are significantly inversely correlated, as is the case with sorghum. Under water stress, it has been observed that there is a strong positive link between air temperature differential and wheat yield in wheat. To assess the water state of crop leaves and gauge stomatal conductance, one can utilize the water deficit index derived from thermal imaging data (Crain et al., 2018; Tripodi et al., 2018).

Using next-generation phenotyping techniques, cell architectures might be estimated. Chlorophyll, carotene, and lutein concentrations in the palisade tissue have an impact on the reflectance of plant leaves in visible light (about 390 to 700 nm). As a result of its strong relationship to cell structure, the reflectance of plant leaves in the near-infrared (NIR) band can be used to assess a number of spectral properties, including ground canopy cover and physiological traits of plants (Espina et al., 2018; Jimenez-Berni et al., 2018). Using plant cell structures based on the latest phenotyping methods and platforms, such as phenomobiles, biodiversity and genetic resources could be verified, tracked, or conserved (White et al., 2012).

The crop leaves' different spectral band absorption and reflection properties—high absorption in the visible band and significant reflection in the near-infrared band—provide the physical underpinnings for remote sensing crop growth monitoring. Using charge-coupled device (CCD) or complementary metal oxide semiconductor (CMOS) silicon-made sensors, digital cameras in the visible spectrum (400-700 nm, VIS) are able to capture 2D images in which raw data are recorded in the red (about 600 nm), green (about 550 nm), and blue (about 450 nm) array. Therefore, 3D images are recommended for the assessment of plant biomass, leaf area and leaf area index, and plant morphology. This type of 2D photos exhibit several limitations, particularly when utilized for plants that have a high degree of structural complexity. Drawing complex models for the reconstruction of plant structures is made possible by the use of stereo cameras and computer programs that produce 3D images gathered from numerous angulations. However, the most extensively used methods are based on light detection and ranging (LiDAR) by using laser-scanner sensors for the specific goal of plant structure and biomass analysis. Digital cameras also offer additional qualities that deal with plant color analysis. LiDAR offers precise measurements of organ distribution and canopy architecture that are used to calculate plant volume, leaf area index, and biomass. LiDAR enables analysis of plant growth throughout the vegetative and

reproductive stages (Tripodi et al., 2018).

The fact that ultraviolet (UV) light with discrete wavelengths in the range of 340–360 nm is reflected by various plant components has led to the widespread use of fluorescence imaging in experimental setups. The fluorescence of chlorophyll emits red and far-red light (690–740 nm). Chlorophyll fluorescence imaging (CFI), made possible by the use of CCD cameras, is a development in fluorescence analysis. A digital camera that measures fluorescence at various wavelengths in the common spectral ranges of blue (440 nm), green (520–550 nm), red (690 nm), far-red (740 nm), and NIR is used in CFI to monitor the plant response (800 nm). To assess biotic and abiotic stressors, tissue chemical composition and characterisation, and various plant physiological states, fluorescence imaging can be used in crop phenotyping (Tripodi et al., 2018; Virlet et al., 2017; Yang et al., 2017).

In plant phenotyping, thermography is a frequently used method. Depending on the kind of photosynthetic metabolism a plant has, it will respond to environmental signals and the circadian rhythm by opening its stomata. Thermography can be used with this imaging technique to quantify evapotranspiration at many scales, including a leaf, a tree, a field, or an entire region. Where all the specimens are located under strict control conditions, thermography imaging allows for monitoring and detecting water stress, irrigation management, and plant diseases. However, temperature, wind speed, irradiance, leaf angle, and canopy leaf structures are potential obstacles to the acquisition of high-quality images. Thermographic and fluorescent images both capture a single component, and while images are conceptually simple to evaluate, high-level data analysis techniques are needed to produce reliable results. Nevertheless, this is a new problem that is being addressed (Li et al., 2014; Tripodi et al., 2018; Pabuayon et al., 2019).

Synthetic Aperture RADAR (SAR) is an imaging radar used to gather high-resolution data by conducting coherent processing of the received echo in various field or area locations. Active microwave sensors like SAR can produce high-resolution images in a manner akin to optical. RADAR data can be acquired in a variety of ways, such as standard polarizations (horizontal (H)- vertical (V), HH, VV, VH), polarimetric, and interferometric way (two signals at slightly different incident angles). This technique can obtain images in extremely low visibility weather conditions and can work around the clock, and it can be used for crop identification, crop acreage monitoring, key crop trait estimation, and yield prediction, offering strong technical support (Thompson et al., 2018; Tripodi et al., 2018).

Infrared radiation energy is detected by thermal infrared imaging sensors with infrared detectors and optical imaging lenses, which can then create time series or single-time point analyses (Gonzalez-Dugo et al., 2015). Since photosynthetic properties, transpiration rate, and stomatal conductance are all intimately related to canopy temperature. Infrared thermal imaging technology can be used to measure canopy temperature to evaluate how crops respond to stress, to calculate leaf water potential and stomatal conductance, to detect cell structure, and to calculate plant physiological trait, geometric trait, and ground canopy cover (Thompson et al., 2018; Tripodi et al., 2018).

Field-based phenotyping has made extensive use of digital cameras, multispectral cameras, hyperspectral cameras, thermal infrared imagers, and LiDAR. Since phenomobiles offer the benefits of high operation efficiency, cheap cost, appropriateness for challenging field situations, and high resolution, their use in studies of conservation of biodiversity and genetic resources will increase our capacity to protect and expand genetic resources on Earth (Watanabe et al., 2017).

The lack of methods and researchers for quick data processing and models for estimating complex traits under different environmental conditions, low payload, and short endurance in the air are some of the

factors limiting phenomobile-based phenotyping for the conservation of biodiversity and genetic resources. Future trends include enhancing phenomobiles using machine learning techniques, lowering sensor costs, accelerating data processing, and creating methods for using remote sensing to analyze crop phenotypic. Fortunately, it is anticipated that there will be possibilities for more applications of the phenomobile-based phenotyping as phenomobiles develop with greater payload and longer endurance, low-cost sensors, enhanced image processing methods, and effective airspace controls (Messina et al., 2018).

4. CONCLUDING REMARKS

Plant phenotyping is a field that is now undergoing rapid development. In addition to basic science, crop breeding, and precision agriculture, image-based plant phenotyping is starting to show its utility by offering a quantitative basis for the description of plant-environment interactions. As phenomics enters the big data era, it has high throughput, multidimensionality, and multi-scale. The success is largely due to the simplicity and applicability of contemporary image processing techniques that are used at various phases of crop growth, enabling high-throughput phenotyping at the right ontogenetic stages. In response to growing problems, new procedures and techniques based on artificial intelligence will be introduced to advance image-based phenotyping. An automated phenotyping system and platform's many digital properties must be verified by large sample statistics and association analysis with traditional agronomic traits. The multi-domain, multi-level, and multi-scale phenotypic data must be promptly subjected to the most recent advances in artificial intelligence. Researchers employed deep learning, data fusion, hybrid intelligence, and swarm intelligence to construct big-data management systems for supporting data integration, interoperability, ontologies, shareability, and globality. Modeling is a useful method for understanding genotype, environment, and phenotype interactions and pinpointing crucial characteristics for target environments. The scientific subject of plant phenotyping is predicted to continue expanding in the years to come since the potential of image analysis in the context of plant phenotyping is still far from being fully realized.

REFERENCES

- Afonnikov, D., Genaev, M. A., Doroshkov, A. V., Komyshev, E., & Pshenichnikova, T. A. (2016). Methods of high-throughput plant phenotyping for large-scale breeding and genetic experiments. *Russian Journal of Genetics*, 52(7), 688-701. <https://doi.org/10.1134/S1022795416070024>
- Busemeyer, L., Mentrup, L., Möller, K., Wunder, K., Alheit, K., et al. (2013). A multi-sensor platform for non-destructive field-based phenotyping in plant breeding. *Sensors (Basel)* 13(3), 2830-2847. <https://doi.org/10.3390/s130302830>
- Crain, J. L., Wei, Y., Barker, J., Thompson, S. M., Alderman, P. D., Reynolds, M., et al. (2016). Development and deployment of a portable field phenotyping platform. *Crop Science*, 56, 965-975. <https://doi.org/10.2135/cropsci2015.05.0290>
- Crain, J., Mondal, S., Rutkoski, J., Singh, R. P., & Poland, J. (2018). Combining high-throughput phenotyping and genomic information to increase prediction and selection accuracy in wheat breeding. *The Plant Genome*, 11, 1-14. <https://doi.org/10.3835/plantgenome2017.05.0043>
- Espina, M. J., Ahmed, C. M. S, Bernardini, A., Adeleke, E., Yadegari, Z., Arelli, P., Pantalone, V., & Taheri, A. (2018). Development and phenotypic screening of an ethyl methane sulfonate mutant population in soybean. *Frontiers Plant Science*, 9, 394. <https://doi.org/10.3389/fpls.2018.00394>

- Gascuel, Q., Diretto, G., Monforte, A.J., Fortes, A.M., & Granell, A. (2017) Use of natural diversity and biotechnology to increase the quality and nutritional content of tomato and grape. *Frontiers Plant Science*, 8, 652. <https://doi.org/10.3389/fpls.2017.00652>
- Gonzalez-Dugo, V., Hernandez, P., Solis, I., & Zarco-Tejada, P. J. (2015). Using high-resolution hyperspectral and thermal airborne imagery to assess physiological condition in the context of wheat phenotyping. *Remote Sensing*, 7, 13586-13605. <https://doi.org/10.3390/rs71013586>
- Habib A., Zhou T., Masjedi A., Zhang Z., Evan Flatt J., & Crawford M. (2018). Boresight calibration of GNSS/INS-assisted push-broom hyperspectral scanners on UAV platforms. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 11, 1734-1749. <https://doi.org/10.1109/JSTARS.2018.2813263>
- Holman, F. H., Riche, A. B., Michalski, A., Castle, M., Wooster, M. J., & Hawkesford, M. J. (2016). High throughput field phenotyping of wheat plant height and growth rate in field plot trials using UAV based remote sensing. *Remote Sensing*, 8, 1031. <https://doi.org/10.3390/rs8121031>
- Jimenez-Berni J. A., Deery D. M., Rozas-Larraondo P., Condon A. T. G., Rebetzke G. J., James R. A., et al. (2018). High throughput determination of plant height, ground cover, and above-ground biomass in wheat with LiDAR. *Frontiers Plant Science*, 9, 237. <https://doi.org/10.3389/fpls.2018.00237>
- Li, L., Zhang, Q., & Huang, D. F. (2014). A review of imaging techniques for plant phenotyping. *Sensors*, 14, 20078–20111. <https://doi.org/10.3390/s141120078>
- Lin, Y. (2015). LiDAR: An important tool for next-generation phenotyping technology of high potential for plant phenomics? *Computers and Electronics in Agriculture*, 119, 61-73. <https://doi.org/10.1016/j.compag.2015.10.011>
- Messina, C.D., Technow, F., Tang, T., Totir, R., Gho, C., & Cooper, M. (2018). Leveraging biological insight and environmental variation to improve phenotypic prediction: Integrating crop growth models (CGM) with whole genome prediction (WGP). *European Journal of Agronomy*, 100, 151-162. <https://doi.org/10.1016/j.eja.2018.01.007>
- Pabuayon, I., Sun, Y., Guo, W. et al. (2019). High-throughput phenotyping in cotton: a review. *Journal of Cotton Research*, 2, 18. <https://doi.org/10.1186/s42397-019-0035-0>
- Roth, L., Barendregt, C., Betrix, C. A., Hunda, A., Walter, A. (2022). High-throughput field phenotyping of soybean: Spotting an ideotype. *Remote Sensing of Environment*, 269, 112797. <https://doi.org/10.1016/j.rse.2021.112797>
- Thompson, A. L., Conrad, A., Conley, M. M., Shrock, H., et al. (2018). Professor: A motorized field-based phenotyping cart. *HardwareX*, 4, e00025. <https://doi.org/10.1016/j.ohx.2018.e00025>
- Tripodi, P., Massa, D., Venezia, A., & Cardi, T. (2018). Sensing technologies for precision phenotyping in vegetable crops: Current status and future challenges. *Agronomy*, 8, 57. <https://doi.org/10.3390/agronomy8040057>
- Ubbens, J. R. & Stavness, I. (2018). Corrigendum: Deep plant phenomics: A deep learning platform for complex plant phenotyping tasks. *Frontiers Plant Science*, 8, 2245. <https://doi.org/10.3389/fpls.2017.01190>
- Virlet, N., Sabermanesh, K., Sadeghi-Tehran, P., & Hawkesford, M. J. (2017). Field scanalyzer: an automated robotic field phenotyping platform for detailed crop monitoring. *Functional Plant Biology*, 44, 143-153. <https://doi.org/10.1071/FP16163>
- Walter, A., Liebisch, F., & Hund, A. (2015). Plant phenotyping: from bean weighing to image analysis. *Plant Methods*, 11(1), 14. <https://doi.org/10.1186/s13007-015-0056-8>

- White, J. W., Andrade-Sanchez, P., Gorea-Kevin, A. M., Terry, F. B., et al. (2012). Field-based phenomics for plant genetics research. *Field Crops Research*, 133, 101-112. <https://doi.org/10.1016/j.fcr.2012.04.003>
- Watanabe, K., Guo, W., Arai, K., Takanashi, H., Kajiya-Kanegae, H., et al. (2017). High-throughput phenotyping of sorghum plant height using an unmanned aerial vehicle and its application to genomic prediction modeling. *Frontiers Plant Science*, 8, 421. <https://doi.org/10.3389/fpls.2017.00421>
- Yang, G., Liu, J., Zhao, C., Li, Z., Huang, Y., Yu, H., Xu, B., et al. (2017). Unmanned aerial vehicle remote sensing for yield-based crop phenotyping: Current status and perspectives. *Frontiers Plant Science*, 8, 1111. <https://doi.org/10.3389/fpls.2017.01111>

SYSTEMS AND TECHNIQUES FOR SUSTAINABLE AGRICULTURE

Ayşe Gul Ince

Vocational School of Technical Sciences, Akdeniz University, Antalya, 07059 Turkey

ORCID No: <https://orcid.org/0000-0002-9015-6580>

Mehmet Karaca

Department of Field Crops, Faculty of Agriculture, Akdeniz University, Antalya, 07059 Turkey

ORCID No: <https://orcid.org/0000-0003-3219-9109>

ABSTRACT

Several various systems/methods were created to maintain agriculture in the present without jeopardizing the ability of future generations to meet their food needs, in order to make industrial agriculture less damaging. The main goals of these systems/methods are to decrease, and ultimately eliminate, the use of pesticides and inorganic fertilizers, greenhouse gases, and increase carbon content of the land in order to regain environmentally sustainable agriculture by safeguarding soils and the planet's natural resources; safeguarding biodiversity; and finally, enhancing the standard of living and health of farm workers. Some of these techniques were developed through engineering, others were learned from nature or industrial agriculture. In this study, various sustainable agricultural methods and systems are examined. Systems might include a variety of sustainable agriculture practices. Organic farming, permaculture, agroforestry, and regenerative agriculture are the four main types of sustainable agriculture. Crop rotation, polycultures, ecological aquaculture, biodynamic agriculture, hydroponics and aquaponics, natural animal husbandry, natural pest management, grazing management, border plants for pollinator habitat, heirloom growth, silvopasture, soil food web, grafting, re-growing vegetables, alternative food networks, soil enrichment, keyline subsoiling, and efficient input use are some of the techniques.

Keywords: biodynamic agriculture, grafting, regenerative agriculture, re-growing vegetables, permaculture

Introduction

The fundamental tenet of sustainability is that we must satisfy our wants while protecting ecosystems so that future generations can satisfy their own needs. Resources, both natural and human, must be engineered to manage sustainability (Aavik et al., 2017; Manhaes et al., 2018). However, it should be mentioned at the outset of this chapter that a population that is aggressively increased in comparison to all other living creatures harms the ecosystem. People who are currently older than fifty years old might easily claim to have witnessed the start of climate change. We also know that the National Environment Health Association believes that the single greatest hazard to human health in the twenty-first century is global climate change. This hazard is a result of industrial agriculture, forestry, fishing, and other industries, especially mining, war, and petroleum. Over the next ten years, humanity will be impacted by several environmental challenges in addition to the major one of global climate change, including overcrowding, pollution, biodiversity loss, waste disposal, ocean and marine pollution/acidification, deforestation, and ozone layer depletion (Gascuel et al., 2017; Vlk and Repkova, 2017).

The type of agricultural techniques that are meant to meet society's current needs for food and textiles do

not jeopardize the capacity of future generations to meet their own needs. Industrial agriculture, which increases food production, lowers consumer costs, encourages innovation and scientific advancement, creates jobs, and extends the shelf life of food, makes up most of the agriculture on Earth today. However, industrial agriculture is a significant driver of deforestation, biodiversity loss, air, water, and soil pollution, as well as agricultural waste, and it is responsible for at least 25% of the climate change-related factors (Corlett, 2016; Timmermann and Robaey, 2016; Dorey and Walker, 2018; Chumchalova and Kubal, 2020; Rafael et al., 2020).

Earth's vegetation produces food and habitat for animals and humans, releases oxygen into the atmosphere while absorbing or fixing carbon dioxide into the soil and controls the water cycle in the natural ecosystem. There are no waste products produced during these operations, and carbon dioxide levels in the soil and the air are continually restored. However, after the Industrial and Green Revolutions, industrial agriculture took over and expanded the amount of arable land, the usage of pesticides and fertilizers, and the number of animals raised. These actions harmed soil structure, water cycles, and carbon dioxide cycles. For instance, while the amount of carbon dioxide in the air increased, soil began to absorb less of it (Mani and Kumar, 2014; Sridhar et al., 2022).

Plant and animal production are rising in response to the needs of civilization as the number of humans increases. Tons of manure are produced each year, particularly when animals are raised in small spaces. It should be noted that industrial agriculture's production of manure is one of the major contributors to air pollution in addition to having an effect on the safety and quality of the water. Industrial agriculture has a significant negative impact on the environment and society, which includes altering the hydrologic cycle, introducing harmful chemicals, fertilizers, and infections, reducing and changing wildlife habitats, and introducing invasive species. The impacts of air pollution on people are significant, according to the WHO. For instance, air pollution is responsible for 29% of all lung disease fatalities worldwide, 24% of all stroke deaths worldwide, and 17% of all global deaths and diseases related to acute lower respiratory infections. Due to these drawbacks of the strategy, there has been a gradual shift in industrialized nations toward the implementation of sustainable farming practices during the past few decades. Several various systems/methods, such as organic agriculture, regenerative agriculture, and permaculture, were developed to make industrial agriculture less destructive in order to continue farming in the present without jeopardizing the ability of future generations to meet their food needs. The main goals of these systems/methods are to decrease, and ultimately eliminate, the use of pesticides and inorganic fertilizers, greenhouse gases, and increase carbon content of the land in order to regain environmentally sustainable agriculture by safeguarding soils and the planet's natural resources; safeguarding biodiversity; and finally, enhancing the standard of living and health of farm workers. Some of these techniques were developed through engineering, others were learned from nature or industrial agriculture (Mani and Kumar, 2014; Sridhar et al., 2022; Tamm et al., 2022).

Types of Some Sustainable Agriculture Systems and Methods

We divided sustainable farming into systems and techniques. Systems might include a variety of sustainable agriculture practices. For instance, silvopasture is a technique that gives livestock animals tree cover. Native species suffer because of the shelter and food that livestock receive. The silvopasture method could be applied to a sustainable agriculture system based on permaculture or agroforestry. Organic farming, permaculture, agroforestry, and regenerative agriculture are the four main types of sustainable agriculture. Crop rotation, polycultures, ecological aquaculture, biodynamic agriculture,

hydroponics and aquaponics, natural animal husbandry, natural pest management, grazing management, border plants for pollinator habitat, heirloom growth, silvopasture, soil food web, grafting, re-growing vegetables, alternative food networks, soil enrichment, keyline subsoiling, and efficient input use are some of the techniques.

Organic Agriculture

Organic farming is a variant of industrial agriculture that forbids the use of artificial fertilizers or pesticides. The National Organic Program of the USDA, which controls the permitted use of pesticides and fertilizers, has set rules that producers of organic food in the US must adhere to. Non-transgenic crops and crop rotations are used in this system. Instead of using chemical fertilizers and pesticides, farmers use green manure, composting, or reduced tillage techniques. Different crops are cultivated on a plot at different times of the year as part of the technique of crop rotation, which aims to keep weed and pest species from accumulating (Lamonaca et al., 2022; Pawlewicz et al., 2022).

Biodynamic Farming

The first organic farming in the modern era is biodynamic farming. The concept of biodynamic farming was inspired by industrial farming, which revealed deteriorating soil conditions and a decline in the health and quality of soil, crops, and livestock as a result of the use of chemical fertilizer. It includes ecological and holistic growing techniques and emphasizes the use of techniques like composting, the application of animal manure from farmed animals, cover crops, or rotating complementary crops to create the necessary health and soil fertility (preventing soil degradation and soil erosion, and improving carbon sequestration), and preserve biodiversity and natural resources while increasing yields for food production. Producers can build shelters to house natural pest eliminators like bats and birds that work to keep pests away, as well as a variety of border plants that attract pollinating insects like bees and butterflies. When a drought is in effect, rainwater gathering technologies can be utilised. It could be advantageous to grow plants and fish in the same place. Rice-fish aquaculture in China, where keeping fish in the same ponds as rice encourages the growth of both, may be a successful illustration of such a system. There may be a number of advantages to converting depleted agriculture to pasture. Even while grazing cattle still emits greenhouse gases, industrial agriculture may be better for the environment and animal welfare than grass-fed animals. Additionally, there is proof that better livestock management can increase soil health and carbon sequestration (Brooker et al., 2020; Fonteyne et al., 2022).

Permaculture

A long-term coexistence in harmony between people, animals, plants, natural resources, the land, and the environment is made possible by a sustainable agricultural system. Permaculture imitates how plants operate in a natural ecosystem. In other words, permaculture designers research ecosystems and attempt to translate their capacity for self-sufficiency to artificial environments. This approach ought to improve production effectiveness while decreasing resource waste. The polyculture and continuous succession planting techniques used in the permaculture system. To mirror the diversity of nature and enhance soil health and pest resistance, two or more plant or animal species are raised in the same area at the same time in a polyculture. When crops are planted one after the other, they are planted in full-time succession, giving the soil continual cover without tillage. Full-time succession planting reduces soil erosion while increasing the soil's capacity to hold carbon (Ferguson and Lovell, 2014; de Tombeur et al., 2018).

Regenerative Agriculture

By enhancing soil's organic matter and restoring its biodiversity, which supports the water cycle and carbon sequestration, regenerative agriculture aims to reverse climate change. It is founded on the following tenets: minimizing soil disturbance, reducing chemical inputs, increasing above- and below-ground biodiversity, including microorganisms, maintaining a long-term crop cover on the soil, and utilizing plant species that are best suited to the local environment. Regenerative agriculture promotes methods intended to undo the harmful effects of industrial agriculture and rejuvenate the soil by working in harmony with the natural world. The ecological compatibility that regenerative agriculture promotes could be a crucial weapon in the fight against climate change, even though it is insufficient on its own to prevent ecological collapse (Lal, 2020).

Practices like cultivating border plants, cover crops, and intercropping are all part of regenerative agriculture. Through photosynthesis, these extra crops can help sequester carbon while also fostering biodiversity and ecosystems. Regenerative agriculture is thought to be able to reduce carbon emissions by over 10%, which is what the planet needs in order to prevent a two-degree temperature increase. Although the majority of scientists concur that regenerative agriculture helps carbon capture, carbon sequestration may actually be occurring in the topsoil. Low quantities of carbon have been detected in deeper layers of soil, suggesting that no-till may merely shift the carbon around rather than causing more to be sequestered. However, perennial trees, intercropping, and cover crops appear to be more successful at capturing. The topsoil's carbon, though, could be released if later disturbed. The effectiveness of regenerative agriculture as a long-term carbon capture approach has thus been called into question (Rosa-Schleich et al., 2019; Giller et al., 2021).

Agroforestry

In dry areas with soils prone to desertification, agroforestry is the process of incorporating trees onto fields used for raising crops or raising cattle. Agroforestry combines agriculture and forestry practices for long-lasting, fruitful, and diverse land use by allowing trees and shrubs to grow alongside crops or grazing area. Controlling erosion, offering shade and wind protection, and sustaining native animals are all advantages of agroforestry. Deeply embedded tree roots release carbon dioxide into the soil while also enhancing its health. The water is recycled into shallow groundwater by staying in the soil and plant roots rather than running off because healthy soils can store more water. These water sources are hence more durable and utilized sustainably. Tree roots also shield the soil from wind and rain erosion, which could otherwise result in stream contamination. With the potential for product diversification, trees on agricultural land also offer natural habitats for wildlife and extra sources of revenue for farmers. Agroforestry enterprises that combine crops and cattle have several benefits. For example, limiting the growth of row crops to land that is more level, used for grazing, or on steeper slopes will assist prevent soil erosion. Additionally, rotational fodder crops improve soil quality, and livestock excrement adds to the fertility of the soil. Workforce productivity is increased when crops and livestock are integrated into a single farming operation (Castle et al., 2022; Paudel et al., 2022).

Planting Cover Crops

Cover crops are planted to enhance soil health, reduce weeds, increase water availability, help with pest control, prevent sun damage, and minimize erosion when a farmer is not growing his or her commercial crops there. They provide the soil with a much-needed rest and are cultivated in succession with other

crops, which can increase productivity and attract more pollinators. By cultivating cover crops like oats or clover, an agricultural producer can reduce soil erosion, control the spread of weeds, and enhance the quality of the soil. The need for fertilizers and other chemicals can be reduced by using cover crops. When soil is exposed, rain, wind, and sunlight may all affect the soil and its irreplaceable ecosystems. Keep the soil's surface covered with a canopy of growing plants, stubble, or any leftover debris from harvested crops (Shirriff et al., 2022).

Intercropping design

Intercropping can take many different forms, including two species planted in the same field without a clear pattern, two species grown in alternate rows, and two species grown in alternate strips, at least one of which contains more than one row (Yu et al., 2015). Intercrops are either harvested simultaneously or separately after harvest, while occasionally mixture components are introduced just for the neighbors they benefit while remaining outside of the final crop. The "double high" approach, which focuses on achieving both high crop productivity and high resource use efficiency through optimal crop system design and management, high nutrient use efficiency, improving soil quality, and minimizing the ecological footprint, is a more contemporary method of delivering and enhancing the benefits of multi-species cropping systems (Brooker et al. 2020).

Reducing Tillage

Upsetting the soil by excavating, stirring, or turning it over is known as tillage. Industrial agriculture damages soil structure and alters soil structure, leaving land prone to wind and water erosion. Tillage can hasten soil erosion, loss of fertility and organic matter, extinction of soil life, and disruption of the cycles of water, organic carbon, and plant nutrients. Reduced tillage boosts soil health, enhances water quality, and reduces soil erosion. One of the major carbon storage areas on Earth are soils. By reducing tillage, carbon can be captured and kept from evaporating into the sky. However, one-third of cropland has been degraded by overfarming, overcultivation, overgrazing, and forest conversion. The carbon content of the soil and related agroecosystems is impacted by land degradation. Keyline subsoiling can be used to reduce tillage. It is a method of plowing that can result in higher soil water retention and, as a result, better defense against drought, flood, and erratic weather patterns (Chetan et al., 2022; Cordeiro et al., 2022).

Rotating Crops

Rotating Crops is one of the most effective sustainable farming methods. The purpose of rotating crops is to avoid the problems that arise from continually using the same crops in the same soil. Crop rotation improves soil biodiversity, which enhances soil health and production. By disrupting the pests' reproductive cycles, it can also aid in the reduction of pest issues. In order to replenish plant nutrients, lessen the need for artificial fertilizers, and control weeds, diseases, and insect pests, farmers might plant certain crops throughout rotation. Additionally, by preserving soil moisture with mowed or standing dead mulches, increasing the rate of water infiltration and soil water holding capacity, and other methods, cover crops help stabilize soil and nutrients in situ (Tian et al., 2021; Montgomery et al., 2022).

Soil Enrichment and Management

The foundation of both agriculture and ecosystems is soil. When overused pesticides are applied to

healthy soil, the life there can be killed. Both yields and the vigor of crops can be increased by having healthy soil. There are various strategies to preserve and improve the soil's quality and stop soil erosion, which poses a severe threat to our capacity to continue producing enough food. Several instances include. Using cover crops, compost, and/or manures, decreasing or eliminating tillage, regulating irrigation to reduce runoff, limiting traffic on wet soils, and keeping the soil covered with plants and/or mulches are all ways to improve and protect the productivity of the soil. Increased inputs of water, nutrients, pesticides, and/or energy are frequently necessary for tillage to maintain yields in soil that has been damaged. Soil needs to be nourished and preserved in order to ensure the stability of sustainable systems. Regularly adding organic matter or using cover crops can promote soil stability and microbial diversity. Porous and more capable of storing more water are characteristics of healthier soils. As a result, after a storm, more water will stay in the soil and be absorbed by the crops rather than evaporating through the soil and contaminating rivers by bringing potentially hazardous nutrients. Due to the roots' ability to maintain the soil compact and resistant to erosion, water or wind erosion is greatly hampered. Plant roots are crucial to the soil food webs because they provide food for bacteria, fungus, and single-celled organisms in the soil. The chain of consumption in a soil ecosystem, from organic matter to bacteria, plants, worms, arthropods, and burrowing animals, is represented by a soil food web. A healthy ecosystem, richer soil, greater carbon sequestration, and increased crop output all result from a robust soil food web (Babla et al., 2022; Montgomery et al., 2022).

Grafting for Sustainable Agriculture

Grafting is an old method of plant reproduction that occasionally occurs in the natural world. Since it is viewed as a natural technique of plant propagation, it may be used in organic agriculture if organic inputs are provided (Flores-Leon et al. 2021). For the first 4,000 years, grafting was used, first in Mesopotamia and then in prehistoric China. There are numerous grafting methods appropriate for different species. These techniques include cleft, bark, side-veneer, splice, whip and tongue, saddle, bridge, inarch, and bud grafting, to name a few. Vegetative grafting studies involve joining the shoot of one plant to the root of another. The part of the combination known as the stock provides the root, whereas the scion is the other element. The majority of grafting experiments are carried out to increase tolerance to acidity, water deficiency, salt, and other abiotic environmental conditions as well as to improve biomass accumulation, fruit quality, and give resistance to biotic pressures including soil-borne pests and diseases. (Karaca et al., 2020).

Urban Agriculture

Climate change and urban sprawl continue to outcompete farmland, necessitating innovative approaches to food production, distribution, and consumption in response to a growing global population. Urban agriculture clearly has direct economic benefits, such as job creation and real estate growth. Restoring biodiversity, soil, and air quality, as well as decontaminating urban areas, are among the environmental advantages of urban agriculture. Certain actors, such as municipalities, are motivated by these non-economic benefits to invest in projects that defy the logic of economic profitability. According to some researchers, 80 percent of the world's population will be urban by 2050, and urban agriculture will be required to feed them. (Specht et al., 2014; Mead et al., 2021; Salomon and Cavagnaro, 2022).

Concluding Remarks

Healthy food production and consumption are made possible by sustainable agriculture, which preserves the potential of future generations to do the same. Finding the ideal balance between the requirement for food production and the protection of environmental ecosystems is essential for sustainable agriculture. In order to build a sustainable food system, consumers can make a significant contribution. They strongly convey to producers, merchants, and other players in the system what they believe to be significant through their purchases. Cost and nutritional value of food have traditionally affected customer decisions. New institutions and rules must be established at the same time to allow producers that use sustainable practices to sell their products to a larger audience. Consumers and merchants may make better choices about the food they buy and the growers they engage with by enhancing openness through ideas like environmental labeling. In order to inform consumers about the origin of the items they buy, mandatory labeling of agricultural products could be one strategy for promoting sustainable agriculture. This might compel food manufacturers to promote ecologically friendly food, leading to the development of a food system that is better for the environment and our health.

REFERENCES

- Aavik, T., Talve, T., Thetloff, M., Uuemaa, E., & Oja, T. (2017). Genetic consequences of landscape change for rare endemic plants – A case study of *Rhinanthus osiliensis*. *Biological Conservation*, 210, 125-135. <https://doi.org/10.1016/j.biocon.2017.04.016>
- Babla, M., Katwal, U., Yong, M. T., Jahandari, S., Rahme, M., Chen, Z. H., & Tao, Z. (2022). Value-added products as soil conditioners for sustainable agriculture. *Resources, Conservation & Recycling*, 178, 106079. <https://doi.org/10.1016/j.resconrec.2021.106079>
- Brooker, M. A., de Lestang, S., Fairclough, D. V., McLean, D., Slawinski, D., Pember, M. B., & Langlois, T. J. (2020). Environmental and anthropogenic factors affect fish abundance: relationships revealed by automated cameras deployed by fishers. *Frontiers in Marine Science*, 7, 279. <https://doi.org/10.3389/fmars.2020.00279>
- Castle, S. E., Miller, D. C., Merten, N., Ordonez, P. J., & Baylis, K. (2022). Evidence for the impacts of agroforestry on ecosystem services and human well-being in high-income countries: a systematic map. *Environmental Evidence*, 11, 10. <https://doi.org/10.1186/s13750-022-00260-4>
- Chetan, F., Chetan, C., Bogdan, I., Moraru, P. I., Pop, A. I., & Rusu, T. (2022). Use of vegetable residues and cover crops in the cultivation of maize grown in different tillage systems. *Sustainability*, 14, 3609. <https://doi.org/10.3390/su14063609>
- Chumchalova, J., & Kubal, M. (2020). Laboratory tests for aerobic bioremediation of the contaminated sites in the Czech Republic. *Plant Soil Environment*, 66, 191-199. <https://doi.org/10.17221/673/2019-PSE>
- Cordeiro, C. F. S., Rodrigues, D. R., Rorato, A. F. S., & Echer, F. R. (2022). Cover crops and controlled-release urea decrease nitrogen mobility and improve nitrogen stock in a tropical sandy soil with cotton cultivation. *Revista Brasileira de Ciencia do Solo*, 46, e0210113. <https://doi.org/10.36783/18069657rbc20210113>
- Corlett, R. T. (2016). Restoration, reintroduction, and rewilding in a changing world. *Trends in Ecology & Evolution*, 31, 453-462. <https://doi.org/10.1016/j.tree.2016.02.017>
- de Tombeur, F., Sohy, V., Chenu, C., Colinet, G., & Cornelis, J. T. (2018). Effects of permaculture

- practices on soil physicochemical properties and organic matter distribution in aggregates: A case study of the Bec-Hellouin Farm (France). *Frontier Environment Science*, 6, 116. <https://doi.org/10.3389/fenvs.2018.00116>
- Dorey, K., & Walker, T. R. (2018). Limitations of threatened species lists in Canada: A federal and provincial perspective. *Biological Conservation*, 217, 259-268. <https://doi.org/10.1016/j.biocon.2017.11.018>
- Ferguson, R. S., & Lovell, S. T. (2014). Permaculture for agroecology: design, movement, practice, and worldview. *Agronomy for Sustainable Development*, 34, 251-274. <https://doi.org/10.1007/s13593-013-0181-6>
- Flores-Leon, A., Garcia-Martinez, S., Gonzalez, V., et al. (2021). Grafting snake melon [*Cucumis melo* L. subsp. *melo* var. *flexuosus* (L.) Naudin] in organic farming: Effects on agronomic performance; resistance to pathogens; sugar, acid, and VOC profiles; and consumer acceptance. *Frontiers in Plant Science*, 12, 613845. <https://doi.org/10.3389/fpls.2021.613845>
- Fonteyne, S., Silva-Avendano, C., Ramos-Sanchez, A., Torres-Zambrano, J. P., et al. (2022). Innovating traditional production systems through on-farm conservation agriculture and agroforestry. *Research Frontier Agronomy*, 3, 787507. <https://doi.org/10.3389/fagro.2021.787507>
- Giller, K. E., Hijbeek, R., Andersson, J. A., & Sumberg, J. (2021). Regenerative agriculture: An agronomic perspective. *Outlook on Agriculture*, 1-13. <https://doi.org/10.1177/0030727021998063>
- Karaca, M., Ince, A. G., & Reddy, U. K. (2020). Interspecific grafting between *Gossypium hirsutum*, *G. barbadense* and *G. herbaceum* lines. *Scientific Reports*, 10, 18649. <https://doi.org/10.1038/s41598-020-75679-1>
- Lal, R. (2020). Regenerative agriculture for food and climate. *Journal of Soil And Water Conservation*, 75, 123A-124A. <https://doi.org/10.2489/jswc.2020.0620A>
- Lamonaca, E., Cafarelli, B., Calculli, C., & Tricase, C. (2022). Consumer perception of attributes of organic food in Italy: A CUB model study. *Heliyon*, 8, e09007. <https://doi.org/10.1016/j.heliyon.2022.e09007>
- Manhaes, A. P., Loyola, R., Mazzochini, G. G., Ganade, G., Oliveira-Filho, T., & Carvalho, A. R. (2018). Low-cost strategies for protecting ecosystem services and biodiversity. *Biological Conservation*, 217, 187-194. <https://doi.org/10.1016/j.biocon.2017.11.009>
- Mani, D., & Kumar, C. (2014). Biotechnological advances in bioremediation of heavy metals contaminated ecosystems: an overview with special reference to phytoremediation. *International Journal of Environmental Science and Technology*, 11, 843-872. <https://doi.org/10.1007/s13762-013-0299-8>
- Mead, B. R., Davies, J. A. C., Falagan, N., et al. (2021). Urban agriculture in times of crisis: the role of home food growing in perceived food insecurity and well-being during the early COVID-19 lockdown. *Emerald Open Research*, 3, 7. <https://doi.org/10.35241/emeraldopenres.14186.1>
- Montgomery, D. R., Bikle, A., Archuleta, R., Brown, P., & Jordan, J. (2022). Soil health and nutrient density: preliminary comparison of regenerative and conventional farming. *PeerJ*, 10, e12848. <https://doi.org/10.7717/peerj.12848>
- Paudel, S., Baral, H., Rojario, A., Bhatta, K. P., & Artati, Y. (2022). Agroforestry: Opportunities and challenges in Timor-Leste. *Forests*, 13, 41. <https://doi.org/10.3390/f13010041>
- Pawlewicz, A., Gotkiewicz, W., Brodzińska, K., Pawlewicz, K., Mickiewicz, B., & Kluczek, P. (2022). Organic Farming as an alternative maintenance strategy in the opinion of farmers from natura 2000 areas. *International Journal of Environmental Research and Public Health*, 19, 3793.

<https://doi.org/10.3390/ijerph19073793>

Rafael, S., Correia, L. P., Lopes, D., Bandeira, J., Coelho, M. C., Andrade, M., Borrego, C., & Miranda, A. I. (2020). Autonomous vehicles opportunities for cities air quality. *Science of the Total Environment*, 712, 136546. <https://doi.org/10.1016/j.scitotenv.2020.136546>

Rosa-Schleich, J., Loos, J., Mußhoff, O., & Tschardtke, T. (2019). Ecological-economic trade-offs of Diversified Farming Systems – A review. *Ecological Economics*, 160, 251-263. <https://doi.org/10.1016/j.ecolecon.2019.03.002>

Salomon, M. J. & Cavagnaro, T. R. (2022). Healthy soils: The backbone of productive, safe and sustainable urban agriculture. *Journal of Cleaner Production*, 341, 130808. <https://doi.org/10.1016/j.jclepro.2022.130808>

Shirriff, K., Bahadur, K. C., & Berg, A. (2022). Evaluation of agrobiodiversity and cover crop adoption in Southern Ontario field crops. *Agronomy*, 12, 415. <https://doi.org/10.3390/agronomy12020415>

Specht, K., Siebert, R., Hartmann, I., Freisinger, U. B., et al. (2014). Urban agriculture of the future: an overview of sustainability aspects of food production in and on buildings. *Agriculture and Human Values*, 31, 33-51. <https://doi.org/10.1007/s10460-013-9448-4>

Sridhar, A., Balakrishnan, A., Jacob, M. M., Sillanpaa, M., & Dayanandan, N. (2022). Global impact of COVID-19 on agriculture: role of sustainable agriculture and digital farming. *Environmental Science and Pollution Research*, 8, 1-17. <https://doi.org/10.1007/s11356-022-19358-w>

Tamm, L., Thuerig, B., Apostolov, S., Blogg, H., Borgo, E., Corneo, P. E., et al. (2022). Use of copper-based fungicides in organic agriculture in twelve European countries. *Agronomy*, 12, 673. <https://doi.org/10.3390/agronomy12030673>

Tian, Z., Wang, J.W., Li, J., & Han, B. (2021). Designing future crops: challenges and strategies for sustainable agriculture. *The Plant Journal*, 105, 1165-1178. <https://doi.org/10.1111/tpj.15107>

Timmermann, C. & Robaey, Z. (2016). Agrobiodiversity under different property regimes. *Journal of Agriculture and Environmental Ethics*, 29, 285-303. <https://doi.org/10.1007/s10806-016-9602-2>

Yu, H., Chin, M., Yuan, T., Bian, H., et al. (2015). The fertilizing role of African dust in the Amazon rainforest: A first multiyear assessment based on data from Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations, *Geophys. Research Letter*, 42, 1984-1991. <https://doi.org/10.1002/2015GL063040>

FIRST REPORT OF DODDER (*CUSCUTA* SPP.) PARASITIZING CUCUMBER, OKRA, ALFALFA AND BASIL IN IRAQ

Bashar K. H. Al-Gburi and Saba A.K. Al-Falooji

Department of Plant Protection, Faculty of Agriculture, University of Kufa, Najaf, Iraq.

ABSTRACT

Dodder (*Cuscuta* spp.) is a real threat to many vegetable crops and causes yield limitation in all infected plants. Samples of dodder were obtained from diverse infected plants including okra, cucumber, alfalfa and basil in some fields of Al-Abassiya in 2019 to set morphological and molecular studies. Phenotypic diagnosis was characterized using several distinct morphological characteristics and DNA extraction was done for all tested samples. Current study was identified four isolates of *Cuscuta australis* which was registered in NCBI as new strains for the first time in Iraq.

Nomenclature: Dodder, *Cuscuta australis*; Cucumber, *Cucumis sativus*; Okra, *Abelmoschus esculentus*; Alfalfa, *Medicago sativa* and Basil, *Ocimum basilicum*.

Keywords: Dodder, *C. australis*, Phylogenetic tree, Iraq.

Dodder (*Cuscuta* spp.) is flowering parasitic weed belonging to Cuscutaceae and has a wide range of parasitism on diverse vegetable plants. In Iraq, this parasitic plant is considered extremely dangerous on crops due to its harmful consequences on plant host and therefore economic yield losses (Goldwasser et al. 2012a, Smith et al. 2013, Al-Gburi and Mohammed, 2019). Till date, *Cuscuta australis* has not been reported parasitizing hosts from Cucurbitaceae, Malvaceae, Fabaceae and Lamiaceae in Iraq. In May 2019, dodder was observed parasitizing cucumber, okra, alfalfa and basil fields in Al-Abassiya (44.36 E °, 32.11N°, 176 m elevation from sea level and area of 1051 ha), Najaf province, Iraq. Yu et al. (2011) procedure was used to assess 8 fields (2 dunum area for each field) in Al-Abassiya. The infection rates ranged from (67.3 to 44.8%, 83.6 to 58.2%, 79.2 to 51.3% and 73.8 to 47.5%) were recorded on okra, alfalfa, cucumber and basil respectively. The phenotypic diagnosis of dodder samples was performed according to Jayasinghe et al. (2004); and it was characterized by several distinct morphological characteristics including filiform stems yellow to orange, flower length 1.9-2.03 mm, 8-12 mm across, corolla lobes obtuse sometimes reddish glandular on capsule, distinct crater between styles and infrastaminal scales bifid, calyx lobes not strongly overlapping, stigma surface irregular lobed or wrinkled, capsule 1.9-2.05 mm and seed form spherical-inverted oval (1-1.6 mm) (Fig.1). DNA of four samples from filamentous stems and flowers was extracted and molecular diagnosis was performed following the manufacturer's instructions (FAVORGENR Biotech Corp, Plant DNA Extraction Mini kit), ITS1 and ITS4 primers were used for PCR and sequencing, then sequences of four samples from filamentous stems and flowers were amplified for both directions according to Alsaadi et al. (2016). GenBank *Cuscuta* spp. accessions MT587666, DQ924581, KY020431, AY554406, DQ924623, KT383153, KT383267, LC457028, HQ728499 and KY020430 were retrieved from the database and compared with the four studied sequences. A neighbour-joining tree was built using Geneious tree builder, the sequence *Nicotiana tabacum* MH566979 from GenBank was used as the out-group (Fig.2). Results of the diagnosis of morphological and molecular properties have proven the identity of dodder after submitting to the GenBank database using the submission portal

(<https://submit.ncbi.nlm.nih.gov/subs/genbank/>) to be *C. australis* which recorded for the first time on the above hosts. *C. australis* strains have been registered in NCBI with particular accession numbers (MT363348) on cucumber, (MT363349) on okra, (MT363350) on alfalfa and (MT363351) on basil. This is the first report of *C. australis* parasitizing cucumber, okra, alfalfa and basil; it would be an interesting finding due to the harmful effects of *C. australis* on the quality and quantity of yield. Therefore, this report can expand and develop effective strategies to control this pest in Iraq.

References

Alsaadi A, Saif M, Yasser M et al (2016) Identification of *Cuscuta Campestris* yuncker in UAE: Study of bar code loci-rbcl, matk and trnh-psbain the Uae and Egyptian cultivars and in the respective host plants basil and jute. Inter J Res Scie 2: 9-15.

Al-Gburi, BKH, Mohammed, AE (2019) Evaluate the efficiency of Bonanza weedicide to control *Cuscuta pentagona* on eggplant. IOP Conference Series: Ear Env Scie 388: 1–8.

Goldwasser Y, Miranda Sazo MR, Lanini WT (2012a) Control of field dodder (*Cuscuta campestris*) parasitizing tomato with ALS-inhibiting herbicides. Weed Tech 26 (4): 740-746.

Jayasinghe C, Wijesundara DSA, Tennekoon KU, Marambe B (2004) *Cuscuta* species in the lowlands of Sri Lanka, their host range and host-parasite association. Trop Agri Res 16: 223-241.

Smith JD, Mescher MC, De Moraes CM et al (2013) Implications of bioactive solute transfer from hosts to parasitic plants. Curr Opin Plant Bio 16: 464-472.

Yu H, Liu J, He WM et al (2011) *Cuscuta australis* restrains three exotic invasive plants and benefits native species. Bio Inv 13: 747-756.

"The authors declare no conflicts of interest"

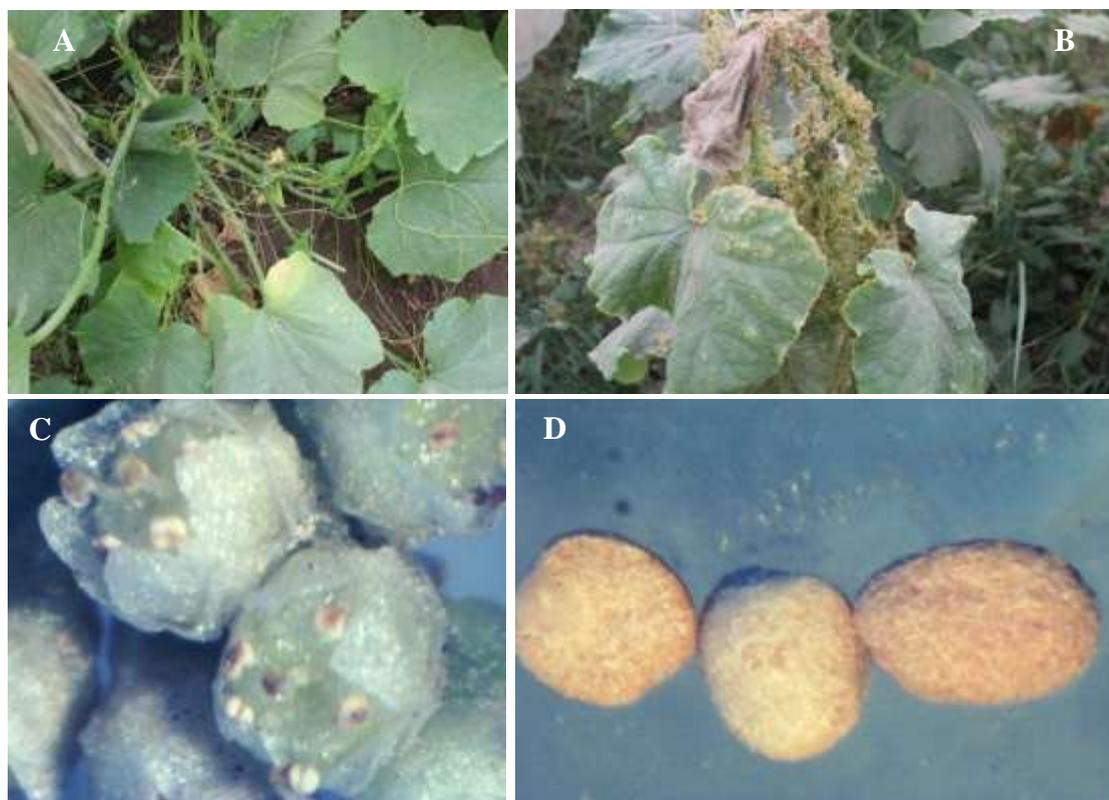


Fig. 1. A and B cucumber infected with *C. australis*, C and D flowers and seeds of *C. australis*

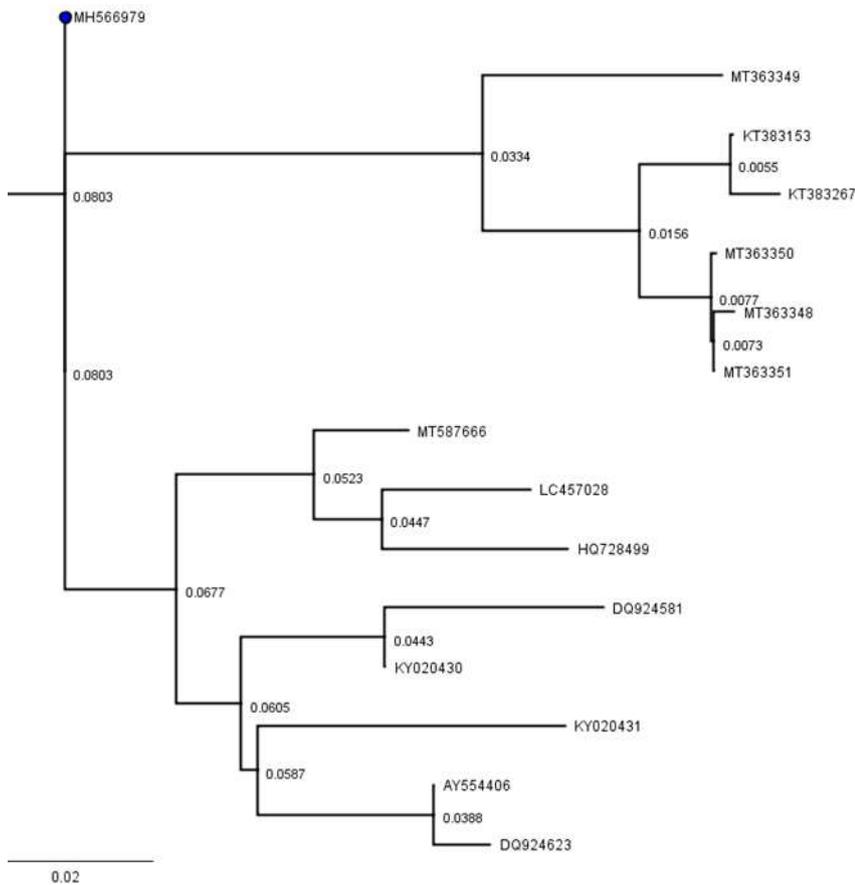


Fig. 2. Neighbour joining tree showing the phylogenetic relationships between the four studied sequences of *Cuscuta australis* and ten reference strains of *Cuscuta* spp. from GenBank (MT587666, DQ924581, KY020431, AY554406, DQ924623, KT383153, KT383267, LC457028, HQ728499 and KY020430) based on their internal transcribed spacer sequences as generated by GENEIOUS with Tamura-Nei genetic distance model. Bootstrap values of 1500 replications are shown for the major nodes. *Nicotiana tabacum* strain (MH566979 from GenBank) was used as the out-group.

EFFECT OF THE CONDITIONS OF CULTURE ON THE GERMINATION AND THE GROWTH OF THE ARGAN TREE (ARGANIA SPINOSA (L.) SKEELS)

EL QADMI, I, ZIRI, R, AKHRIF F, ABID N, BRHADDA, N

Ibn Tofail University, Faculty of Science, Kenitra, Laboratory:

Plant, Animal and Agroindustry Productions.

ABSTRACT

Problem: The argan tree (*Argania spinosa* (L.) Skeels), an important species of southwest Morocco, is the pivot of socio-economic development in Morocco. However, due to difficult climatic conditions, overgrazing and excessive harvesting of seeds for oil extraction, the argan tree is threatened by the limitation or no natural regeneration and also by embryonic and integumentary dormancy of the seeds.

Objective: The purpose of the tests is to improve the germination of the argan tree by comparing semi seeds in greenhouse, *in vitro* and in petri dishes of four genotypes namely Bouizakarne, Agadir, Admine and Ighrem.

Methods: For the germination in greenhouse, the seeds of argan tree are put in culture in plates filled with soil and peat. For germination in petri dishes and *in vitro*, the seeds are scarified to release the kernels which are previously disinfected and put in culture on petri dishes or on modified MS medium placed in a culture chamber. The seed count is done daily while observing the emergence of the radicle considered the indicator of germination.

Results: The results obtained show that the average germination rate is significantly different according to the incubation condition and the genotype tested. Indeed, the *in vitro* culture was the most favorable condition compared to the other conditions. Moreover, it has not only attribute to the improvement of the germination rate but also to the reduction of the lag phase and to the quality of the vitroplants. This is valid for all genotypes but it is very notable in Ighrem the most recent genotype.

Conclusion: Our work has shown that the establishment of *in vitro* protocols is very promising for the argan tree. Moreover, the *in vitro* germination capacity is improved only by the mechanical scarification of seeds promoting the inhibition of the tegument.

Keywords: *Argania spinosa* (L.); germination; *in vitro* culture; Morocco.

МОЛОЧНАЯ СЫВОРОТКА, СВОЙСТВА И ПРИМЕНЕНИЕ

Саалиева Алтынай

Научно-исследовательский химико-технологический институт Кыргызского государственного технического университета им. И. Раззакова, г. Бишкек, Кыргызстан,
<https://orcid.org/0000-0002-8367-4080>

Усубалиева Айгуль

Кыргызско-Турецкий университет «Манас», г. Бишкек, Кыргызстан,
<https://orcid.org/0000-0001-6597-4234>

Айнагуль Сыбырбекова

Научно-исследовательский химико-технологический институт Кыргызского государственного технического университета им. И. Раззакова, г. Бишкек, Кыргызстан

АННОТАЦИЯ

Производство молочных продуктов, таких как масло, творога и сыров, сопровождается, как правило, получением отходов производства, а именно пахты, молочной сыворотки в больших объемах.

В молочную сыворотку, в зависимости от производимого продукта, переходят почти половина питательных веществ молока, это и растворимые белки (20%), молочный сахар, минералы и витамины. Молочная сыворотка содержит минимум калорий и максимальную биологическую ценность. Это позволяет рассматривать сыворотку и продукты, полученные из нее, как продукцию с диетическими и лечебно-профилактическими свойствами [1]. Сыворотка содержит усиливающие иммунитет компоненты, как лактоферин, иммуноглобулин, полный набор витаминов группы В, а также витамин С, никотиновую кислоту, холин, витамин А, витамин Е и биотин, микро- и макроэлементы такие, как Са, К, Р, Fe, Zn. В молочной сыворотке содержатся все незаменимые аминокислоты [2].

Таким образом молочная сыворотка – ценнейший продукт питания, который необходимо не утилизировать, как чаще всего делают молочные предприятия, а использовать вторично. Слив данного уникального вторичного сырья вместе сточными производственными водами может привести к экологическим загрязнениям окружающей среды, которые пагубно влияют на рост сельскохозяйственных культур.

Целью данной работы является изучить основные физико-химические показатели молочной сыворотки, получаемой при производстве молочных продуктов из молока яка и пути применения вторичного сырья

Для реализации поставленной цели была изучена сыворотка твороженная, полученная при изготовлении творога из молока яка. Образцы молока яка собраны в высокогорных пастбищах Нарынской области Кыргызстана. Были изучены следующие физико-химические показатели сыворотки: плотность, кислотность и массовая доля сухих веществ. Отбор и анализы проведены в соответствии с Госстандартами. Исследования проведены на базе лабораторий Научно-исследовательского химико-технологического института при КГТУ им. И. Раззакова и КТУ «Манас».

Ключевые слова: молочная сыворотка, молоко яка, вторичное сырьё

MILK WHEY, PROPERTIES AND APPLICATIONS

Altynai Saalieva

Research Institute of Chemistry and Technology, Food Technology Department, Kyrgyz State
Technical University named after I. Razzakov, Bishkek, Kyrgyz Republic
<https://orcid.org/0000-0002-8367-4080>

Aigul Usubalieva

Food Engineering Department, Engineering Faculty, Kyrgyz-Turkish Manas University,
Bishkek, Kyrgyz Republic
<https://orcid.org/0000-0001-6597-4234>

Aynagul Sabirbekova

Research Institute of Chemistry and Technology, Food Technology Department, Kyrgyz State
Technical University named after I. Razzakov, Bishkek, Kyrgyz Republic

ABSTRACT

The production of dairy products, such as butter, cottage cheese and cheese, is usually accompanied by the production of production waste, namely buttermilk, whey in large volumes. In milk whey, depending on the product produced, almost half of the nutrients of milk pass, these are soluble proteins (20%), milk sugar, minerals and vitamins. Milk whey contains a minimum of calories and a maximum biological value. This allows us to consider serum and products derived from it as products with dietary and therapeutic properties. The milk whey contains immune-enhancing components such as lactoferrin, immunoglobulin, a complete set of B vitamins, as well as vitamin C, nicotinic acid, choline, vitamin A, vitamin E and biotin, micro and macro elements such as Ca, K, P, Fe, Zn. Milk whey contains all the essential amino acids. Thus, milk whey is the most valuable food product that must not be disposed of, as dairy enterprises most often do, but reused. The discharge of this unique secondary raw material along with industrial wastewater can lead to environmental pollution that adversely affects the growth of crops. The purpose of this work is to study the main physical and chemical indicators of whey obtained in the production of dairy products from yak milk and ways to use secondary raw materials.

To achieve this goal, curd whey obtained in the manufacture of cottage cheese from yak milk was studied. Samples of yak milk were collected in the highland pastures of the Naryn region of Kyrgyz Republic. The following physicochemical parameters of whey were studied: density, acidity and mass fraction of solids. The selection and analyzes were carried out in accordance with the State Standards. The studies were carried out on the basis of the laboratories of the Research Institute of Chemical Technology at KSTU. I. Razzakov and KTU "Manas".

Keywords: milk whey, yak milk, secondary raw materials

Введение

В настоящее время молочная промышленность в Кыргызстане объединяет более 150 предприятий. Ежегодно растет выработка молока, так по данным Статистического комитета Кыргызской Республики на 2021 год производство молока составило 1696,9 тыс.тонн [3].

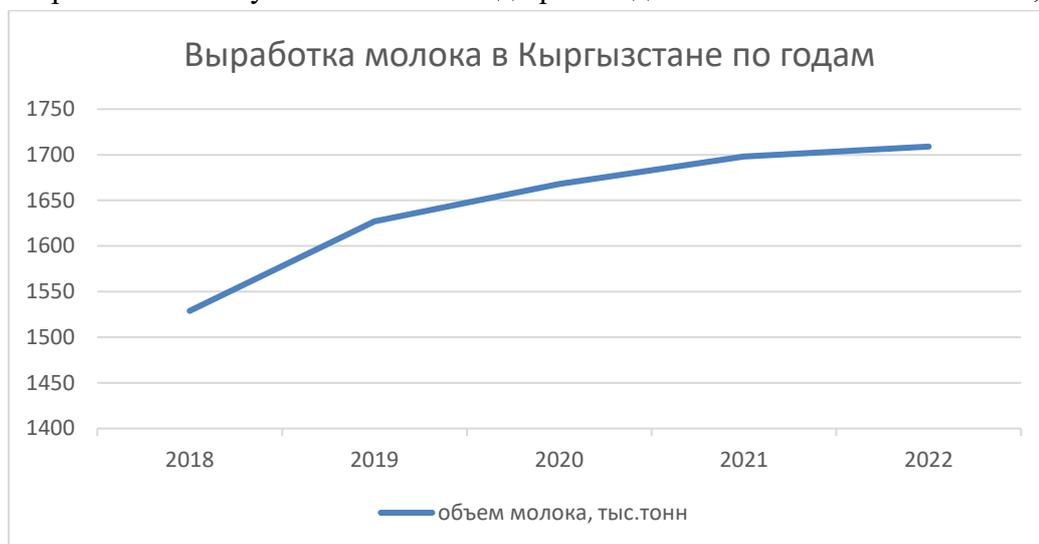


Рисунок 1. Производство молока за 5 лет в Кыргызстане в тыс.тоннах

Молочные предприятия выпускают разнообразную молочную продукцию, пользующаяся большим спросом у населения как во внутреннем рынке, так и во внешнем. Однако, на современном этапе не все предприятия имеют соответствующую материально-техническую базу производить высококачественную конкурентноспособную продукцию, и тем более внедрять безотходные технологии.

К отходам молочного производства относят пахту, обезжиренное молоко и молочную сыворотку, получаемые при выработке масла, творога, сыров. Объемы побочного продукта составляет практически 2/3 перерабатываемого молока.

Молочная сыворотка, уникальный побочный продукт молочного производства. В среднем в молочную сыворотку переходит около половины сухих веществ молока. Состав молочной твороженной сыворотки колеблется в значительных пределах и зависит от способа производства творога и его жирности. В ней большое количества содержания лактозы. Особенностью лактозы является ее замедленный гидролиз в кишечнике, в связи с чем ограничиваются процессы брожения, нормализуется жизнедеятельность полезной кишечной микрофлоры, замедляются гнилостные процессы и газообразование. Сывороточные белки оптимально сбалансированы по аминокислотному набору, особенно серосодержащих аминокислот – цистеина, метионина, что создает хорошие возможности для регенерации белков печени, гемоглобина и белков плазмы крови [4]. Минеральные соли сыворотки почти идентичны цельному молоку и содержат защитные комплексы антисклеротического действия. Таким образом молочная сыворотка с точки зрения физиологии хорошо усвояемый, питательный и менее калорийный продукт, в отличии от цельного молока, и вполне может использоваться в производстве функциональных молочных продуктов.

Также молочная сыворотка обладает лечебными свойствами, такими как противомикробными, противораковыми, иммуностимулирующими, пребиотическими свойствами, является хорошим профилактическим средством при сердечно-сосудистых, желудочно-кишечных заболеваниях и

ряд других заболеваний [5].

В ходе исследования были изучены физико-химические показатели твороженной сыворотки, полученной в лабораторных условиях при приготовлении творога из ячьего молока. Молоко яка – это экологически чистое молочное сырье, так как яки обитают только на высокогорных пастбищах и питаются подножным кормом.

На современном этапе яководство в Кыргызстане достаточно хорошо развиваемый вид животноводства, в республике имеется более 1 миллиона гектаров высокогорных труднодоступных пастбищных угодий, которые могут использоваться исключительно для разведения яков. В связи с чем изучение ячьего молока и продуктов из него имеет интерес и актуальность. На данный момент научными сотрудниками Научно-исследовательского химико-технологического института при КГТУ им.И.Раззакова проводятся такого рода исследования, в том числе изучается состав и свойства молочной сыворотки.

Органолептические показатели твороженной сыворотки из молока яка определялись визуально и органолептически при температуре 22 °С, результаты приведены в табл.1.

Таблица 1 – Органолептические показатели твороженной сыворотки

Наименование показателя	Сыворотка из ячьего молока
Внешний вид и консистенция	Однородная жидкость и наличием белковых хлопьев и осадка
Цвет	Прозрачная жидкость с светло-зеленым оттенком
Вкус и запах	Слегка сладко-кисловатый, свойственный молочной сыворотке

Определение физико-химических показателей твороженной сыворотки проводили в соответствии с стандартными методами исследования [ГОСТ 33957-2016]. Результаты исследований даны в табл. 2.

Таблица 2 – Физико-химические показатели твороженной сыворотки

Показатели	Плотность, кг/м ³	Титруемая кислотность, °Т	рН	Массовая доля, %			
				Сухих веществ	Белка	Жира	Лактозы
Твороженная сыворотка из ячьего молока	1066	59,3	5,59	7,5	1,1	0,4	4,8
Твороженная сыворотка из коровьего молока	1026	75	4,9	6,2	0,9	0,1	4,7

Как видно из табл. 2 твороженная сыворотка, полученная при приготовлении творога из ячьего молока, имеет более лучшие показатели и высокую биологическую ценность, по сравнению с молочной сывороткой из коровьего молока. Такую сыворотку целесообразно использовать для

производства продуктов лечебно-профилактического и диетического питания. В ней основной сахар, лактоза, которая быстро усваивается организмом человека, практически нет жиров, значит сыворотку можно употреблять в качестве напитка для похудения. К тому же она помогает утолить голод и уменьшает желание съесть что-то сладкое [6]. Рекомендуется употреблять сыворотку людям, у которых есть проблемы с пищеварительной системой. Она улучшает микрофлору кишечника, уменьшает скорость распространения гнилостных процессов и газообразования. Кроме этого, сыворотка помогает вывести из организма лишнюю жидкость, токсины и продукты распада. При регулярном потреблении молочной сыворотки увеличивается выработка гормона серотонина, который отвечает за хорошее настроение. Кроме этого, этот продукт улучшает деятельность нервной системы, благодаря наличию витаминов группы В, а также улучшает кровообращение. Рекомендуется включать этот продукт в свой рацион питания людям с атеросклерозом, ревматизмом и с проблемами сердца [7].

Единственным недостатком использования молочной сыворотки, специфический вкус и запах. Данная проблема решается путем внесения в сыворотку плодово-ягодных соков, сиропов и ароматических пряностей [8]. На европейском рынке существуют различные алкогольные напитки и безалкогольные на основе молочной сыворотки. Напитки производят с различными фруктовыми или овощными наполнителями, такими как гранатовый сок, экстракты апельсина и маракуя, мякоти манго и др. [9].

Выводы

В ходе проведения исследования были определены свойства твороженной сыворотки, полученной из молока яка. По органолептическим свойствам исследуемая сыворотка соответствует стандартам, обладает однородной консистенцией, светло-зеленого цвета, вкус и запах чистый, свойственный молочной сыворотке. Физико-химические показатели, как плотность и кислотность молочной сыворотки соответствуют требованиям нормативно-технической документации на этот вид сырья. Таким образом исследуемую сыворотку можно рекомендовать, в качестве сырья для производства различных сывороточных напитков. Для улучшения и ослабления специфического вкуса твороженной сыворотки рекомендуется комбинировать ее с фруктовыми или овощными наполнителями, для придания заданного химического состава в сывороточный напиток можно добавить настои лечебных трав, различные пряности.

Список литературы

- [1]. Храмцов, А.Г. (2006) Рыночная концепция полного и рационального использования молочной сыворотки. Молочная промышленность, 6, 7–11.
- [2]. Пищиков, Г.Б. & Зенкова Е.А. (2017) Ценность молочной сыворотки и перспективы ее использования. Молодежь и наука, 3, 43-44.
- [3]. Производство основных видов животноводческой деятельности. – Бишкек: Национальный статистический комитет Кыргызской Республики, 2022.
- [4]. Лукин А.А. (2015) Применение молочной сыворотки в технологии продуктов питания. Наука ЮУрГУ: материалы 67-й научной конференции, 523-528
- [6]. Gupta C.& Prakash D. (2017) Therapeutic Potential of Milk Whey. Beverages. 3(3):31. <https://doi.org/10.3390/beverages3030031>.
- [7]. Махмудов, Л. Э., Азимов Ж.Ш., Шойимов Ш.Ш., &Джураев К.А. (2016) Молочная сыворотка: побочный продукт или дополнительный доход? Молодой ученый. 7 (111). 278-282.

- [8]. Храмцов А.Г. (2011) Феномен молочной сыворотки. СПб. : Профессия.
- [9]. Демченко С.В., Барашкина Е.В., Малеева О.Л.& Стрельникова Е.В. (2008) Новые технологии производства функциональных напитков на основе молочной сыворотки. Известие высших учебных заведений. Пищевая технология. (2-3). 20-23.
- [10]. Semin Altuntas & Hale Napoglu. (2019) 7 - Kefir-Type Drinks From Whey. Non-Alcoholic Beverages, Woodhead Publishing. 185-226, ISBN 9780128152706, <https://doi.org/10.1016/B978-0-12-815270-6.00007-4>.

UTILIZATION AND IMPORTANCE OF HONEYBEE PRODUCTS

Bardha Ibishi

Faculty of Biotechnical Sciences - Bitola, University “St. Kliment Ohridski”, N. Macedonia

Amr Ahmed Elsayed

²Food Science Department, Faculty of Agriculture, Zagazig University, Egypt, 0000-0002-2264-7273

Zekai Aydin

³Eskisehir Provincial Directorate of Disaster and Emergency (AFAD), Turkey

Vesna Karapetkovska - Hristova

Faculty of Biotechnical Sciences - Bitola, Department of Biotechnology, University “St. Kliment Ohridski”, N. Macedonia, ORCID: 0000-0002-5056-8003

ABSTRACT

Honeybee products have been recognized for their nutritional value, therapeutic and health-improving qualities. Honey, propolis, bee wax, pollen, royal jelly, perga and bee venom are instances of bee products that have been known and used since ancient and the Middle Ages. For instance, bee pollen was used as a cosmetic ingredient in ancient China to help whiten skin. These compounds are currently used in Apitherapy, a subspecialty of complementary and alternative medicine. The natural antioxidants flavonoids, phenolic acids, and terpenoids are thought to be present in bee products. Currently, there is a continuing interest in natural compounds that can mitigate the harmful effects of various harmful agents and medications as well as the effects of oxidative stress, which underlies the pathogenesis of many diseases, including cancer, diabetes, atherosclerosis, cancer, and many others. Given the significance of obtaining medications from natural sources, the objective of this study is to update our understanding of the possible therapeutic uses for propolis, bee pollen, and royal jelly as functional foods as well as their potential health, economic, and therapeutic benefits. The knowledge of the mechanisms underlying the antioxidant effects of bee products has also received special focus.

Keywords: Honeybee products, Functional food, Apitherapy, Economic benefits.

Introduction

Honey, bee pollen, beebread, royal jelly, propolis, bee venom, and wax are the most essential bee products. These products serve many functions in the bee family and in the human diet. Because of its high biological activity, honey, bee pollen, beebread, and royal jelly are mostly used as dietary supplements, while propolis and bee venom are used to cure a variety of ailments (Bobiş et al. 2010).

Honey is the most significant bee product in terms of both quantity and economic value. It is also the first bee product utilized by man in thousands of years. Honey is mostly made up of sugars and water (about 90%), with the rest made up of enzymes, minerals, amino acids, organic acids, polyphenols, and other compounds (Perez et al., 2007; Mărghitaş et al., 2009). Because nectar is the primary raw material used in the production of floral honey, its chemical composition in physiologically active chemicals is influenced by a variety of factors, including botanical origin as well as the meteorological and geographic

circumstances in which the honey is generated. Honey always "borrows" the functional qualities of the plant from which the bee collects nectar and pollen. Polyphenols (secondary metabolites from plants) are well recognized as one of the primary components responsible for honey's biological action.

Propolis, often known as bee glue, is an essential bee product that is widely used in traditional medicine and apitherapy. Propolis is made up of various resins and vegetable balms, etheric oils, macro and microelements, flavonoids, bee secretions, and wax. Because the predominant plant species is represented by poplar buds, Romanian propolis is classified as a poplar type propolis. Polyphenols, particularly flavonoids (Bankova et al., 1997) and fatty acids are the major classes of chemical components responsible for propolis' bioactive qualities (Polyakov et al., 1988).

Bee pollen is a complex combination of flower pollen, nectar, and bee secretions that vary in color depending on the floral source. Bees harvest pollen to make bee bread, the hive's proteic diet. Pollen sugars include glucose, fructose, and sucrose, as well as starch and cellulose from the flower pollen. Freshly harvested bee pollen is highly rich in vitamins (B group, but also significant concentrations of C vitamin), minerals (Zn, Ca, Mg, K, Na), or carotenoids, which account for the wide variety of hues (yellow, orange, red), or anthocyanin, which account for the violet color. Unsaturated fatty acids (omega 3 and omega 6) make up a significant portion of the chemical makeup (Yang et al., 2013; Mărgăoan et al., 2014). Because bees seldom ingest pollen as it is obtained from flowers, it is transformed in the hive to bee bread, a fermented food manufactured by the bees to make it more available for their own use. Because of the bacterial loading of the pollen, the high temperature in the hive, the enzymes present in the pollen, and the additional lactobacilli from bee stomach and uncapped honey cells, this process occurs naturally in the hive. Pollen exine is broken down by fermentation, and all pollen components become easily assimilables. Bee bread is the bee food's fat and protein source.

Royal jelly is a worker bee secretion that is used to feed bee larvae for the first three days of life and to nourish the queen for the rest of her life. This material truly is a "royal" product since it includes all of the chemical ingredients required by an organism to grow and develop, acquire strength, and live a long life.

Royal jelly has high water content (60-70%), making it the bee product with the largest water content, with its dry weight comprised of carbohydrates, proteins, lipids, fatty acids, amino acids, vitamins, enzymes, and hormones. The predominant dry weight constituents are proteins and peptides. Proline and lysine are the most common free amino acids. The majority of lipids are fatty acids, followed by neutral lipids, sterols, and hydrocarbons. Organic acids typically include 8 or 10 carbon atoms, with the most significant fatty acid being 10-hydroxidecenoic acid, which is a sign of validity. This chemical has a significant antibacterial activity (Garcia-Amoedo and Almeida-Muradian, 2009; Bărnăuțiu et al., 2011), which contributes to the product's low bacterial load.

Apitherapy employs bee products to prevent and treat specific ailments, as well as to promote a healthy lifestyle. The name "apitherapy" is derived from the Greek words *apis* (bee) and *therapy* (treatment). Apitherapy claims to be useful against a variety of conditions, ranging from arthritis and chronic pain to more serious illnesses such as cancer and stroke. Although there is no scientific proof to back many of apitherapists' claims, apitherapy remains one of the most prominent aspects of alternative medicine. To be utilized in apitherapy, all bee products must have certain qualities, a well-known chemical makeup, and, most importantly, be free of contaminants.

The purpose of this study is to update our understanding of the possible therapeutic uses for honey, propolis, bee pollen, and royal jelly as functional foods as well as their potential health, economic, and

therapeutic benefits.

Neuroprotection – Bee Products

A wide variety of chemical, biological and environmental factors will cause harmful effects within the brain. The protecting action of bee products against toxins of multiple origins has been recognized in an exceedingly wide range of *in vitro* studies. During this regard, the neurotoxicity induced by oxidative stress was according to be ameliorated by water extract of Brazilian green propolis (WEP) and its active constituents (3,4-di-O-caffeoylquinic acid, 3,5-di-O-caffeoylquinic acid, chlorogenic acid, and p-coumaric acid) in cultured retinal ganglion structure (Nakajima, Shimazawa, Mishima, & Hara, 2007) (Table 1). Moreover, pinocembrin (a major flavonoid component of propolis) prevents glutamate-induced apoptosis in SH-SY5Y neuronal cells by decreasing the bax/bcl-2 ratio (Gao, Zhang, Liu, Hu, & Liu, 2008). Another study revealed that Chinese propolis and one amongst its components (chrysin) ameliorated the neurotoxic effect of tunicamycin by inhibiting the mitochondrial apoptosis pathway in SH-SY5Y cells (Izuta et al., 2008). In a more recent study, the ethanol extract of Brazilian green propolis protected hippocampal cell line from oxytosis/ferroptosis (non-apoptotic cell death mechanisms), an action attributed to artemillin C, kaempferide, and kaempferol (Takashima, Ichihara, & Hirata, 2019). Apart from protecting neurons, whole honey (*Apis mellifera* L.) was also reported to protect the nonneuronal cell i.e., cultured cortical astrocytes against hydrogen peroxide (oxidative stress) induced damage (Ali & Kunugi, 2019). A study conducted on human neuronal SH-SY5Y cells revealed that Brazilian green propolis is endowed with the ability to promote growth and developments of brain via upregulating the expression of BDNF, a neurotrophic factor (Ni et al., 2017). In conformity with aforementioned reports, the pre-clinical knowledge revealed that oral administration of royal jelly facilitated the mRNA expression of neurotrophic factors and neurofilament H in the hippocampus of the mouse brain, further supporting the idea that bee products promote brain health (Hashimoto et al., 2005). Histological evaluation revealed that Malaysian Tualang honey (*Apis dorsata*) reduces neurodegeneration in the rat cerebral cortex following administration of kainic acid, a well-known neurotoxicant (Sairazi et al., 2017). Along similar lines, royal jelly was reported to reduce secondary neuronal damage in traumatic brain injury (TBI) by inhibiting apoptosis and oxidative stress. Moreover, northeastern Portuguese propolis protects against neurotoxicity induced by staurosporine and hydrogen peroxide in primary cortical neurons (Saxena, Phyu, Al-ani, & Talib, 2014). Royal jelly was also reported to protect neurons and dendritic spines of prefrontal cortex against morphine (Jalili, Roshankhah, Mohammadi, & Salahshoor, 2019).

Properties of honey

Several *in vitro* and *in vivo* investigations and researches have been undertaken on the antibacterial, antifungal, antiviral, and antiprotozoal effects of honey (Mohammed et al. 2017; Rani et al. 2017; Semprini et al. 2018; Guttentag et al. 2021). Honey's antibacterial potential varies greatly depending on the botanical origin of the flowers, geographic source, season, harvest, storage conditions (Irish et al. 2011; Anthimidou and Mossialos 2013), age, and bee colony health (Ibarguren et al. 2010; Aween et al. 2012a; Mathialagan et al. 2018). Honey content and physicochemical qualities fluctuate depending on the floral source utilized by the bees (Table 1) (Castro-Vázquez et al. 2009; Chang et al. 2011; Feknous et al. 2021).

Antimicrobial activity of honey

A number of studies have discovered a link between the floral origin of specific honeys and their microbiological activities (Haderbache et al. 2020), since botanical origin is important in the diverse activities of honey, according to Molan (1992). The antibacterial activity of the same floral source may differ. According to Basualdo et al. (2007), this is related to soil composition, climate, honey processing, and propolis content. According to their chemical makeup, honeys from varied geographical and floral sources can have varying antibacterial characteristics (Irish et al. 2011; Moussa et al. 2012). According to Lusby et al. (2002), these honeys are named after the geographical location where they have been produced, the floral source or according to trees where the beehives are located. It has been pointed out by Molan (1992) that honey is active on over 60 bacterial species with positive and negative Gram (aerobic or anaerobic). Gram-positive (Gram+) bacteria are more vulnerable to honey's antibacterial activity (including Manuka honey) than Gram-negative (Gram-) bacteria (Mandal and Mandal 2011). The latter have an outer membrane in their wall structure that protects the peptidoglycan of the bacterial cell by preventing antimicrobial agents from entering (Madigan et al. 2015). According to Shenoy et al. (2012) and Ahmadi-Motamayel et al. (2013), honey has a broad spectrum of activities against Gram+ bacteria such as *Streptococcus pyogenes* (Maddocks et al. 2012) and *Mycobacterium* (Asadi-Pooya et al. 2003; Eteraf-Oskouei and Najafi 2013) as well as against Gram- bacteria like *Escherichia coli* (Adebolu 2005; Voidarou et al. 2011; Hegazi et al. 2017), *Pseudomonas aeruginosa* (Shenoy et al. 2012), *Salmonella typhi*, *Salmonella paratyphi*, *Salmonella enterocolitis*, *Shigella dysenteriae* (Cortopassi-Laurino and Gelli 1991; Adebolu 2005; Voidarou et al. 2011) and *Helicobacter pylori* (Atrott and Henle 2009; Lyudmila et al. 2015). Honey has been found to have significant antibacterial and antibiofilm potential against methicillin-resistant *Staphylococcus aureus*, multiresistant *Mycobacterium tuberculosis*, multiresistant *S. typhi*, and carbapenem-resistant *P. aeruginosa*, according to several reviews (Sherlock et al. 2010, Huttunen et al. 2013, Lu et al. 2014, Jantakee and Tragoolpua 2015, (Cooper et al. 2014; Dimitrios et al. 2018). In veterinary medicine, honey is an alternate treatment for udder infections. By suppressing *Streptococcus agalactiae*, *S. aureus*, and *Klebsiella pneumoniae*, Ahmed and Othman (2013) demonstrated the efficiency of honey against bacteria that cause mastitis in cows (Table 1). According to Bansal et al. (2005) and Sanz et al. (2005), its use as a natural sweetener in probiotic products like fermented dairy products promotes the growth of lactic bacteria like *Streptococcus thermophilus*, *Bifidobacterium bifidum*, *Lactobacillus acidophilus*, and *Lactobacillus delbrueckii* while inhibiting the growth of pathogenic bacteria like *Shigella*, *Listeria mono* (Chen et al. 2000; Bansal et al. 2005; Feknous et al. 2021).

Antiviral activity of honey.

Honey's antiviral qualities have been acknowledged on a global scale ever since the 19th century (Küçük et al. 2007). Honey has been shown to have antiviral properties against influenza (Watanabe et al. 2014), dengue virus (Soroy et al. 2014), viral hepatitis (Abdulrhman et al. 2016), rabies (Igado et al. 2010), poliovirus type 1 (Bfalo et al. 2009), gingivitis (Abdel-Naby Awad and Hamad 2018 (Behbahani 2014). Methylglyoxal (MGO), which is contained in Iranian honey in large quantities, has been shown by Behbahani (2014) to be a potent anti-HIV agent.

Antifungal activity of honey.

Aspergillus and *Penicillium* species are known to be resistant to some honeys' antifungal properties, as are several yeasts belonging to the *Candida* genus, including *Candida albicans*, *Candida glabrata*, *Candida dubliniensis*, *Candida tropicalis*, *Candida krusei*, and *Candida parapsilosis* (Obaseiki- Ebor and

Afonya 1984; Bansal et al. 2005; Irish et al. 2006; Bulgasem et al. 2016; Fernandes et al. 2020). Al-Waili and Haq (2004) assert that honey prevents the growth of fungi and that honey in a diluted form can prevent the formation of toxins. According to Mulu et al. (2010), HIV-positive patients' resistant *C. albicans* strains were treated with Ethiopian honey. Guttentag et al. (2021) disclosed in them in-vitro assays that Australian honey (Table 1) inhibits conidial germination and damages the structure of hyphae in *Trichophyton rubrum*. Some Egyptian single- -flower honeys (Table 1) have shown some antifungal and antimycotic properties against *Epidermophyton* species, *Trichosporon* and *Microsporum* (El-Gendy 2010).

Antiparasitic activity of honey.

The antiparasitic qualities of several honeys were described by other writers. Mohammed et al. (2017) demonstrated the antiprotozoal activity of certain honeys against *Giardia lamblia* and *Entamoeba histolytica* in their experiments (Table 1). Aksoy et al. (2020) revealed that after 48 hours of incubation on promastigote forms in *Leishmania tropica*, honey contained an antileishmanial activity. They felt this natural product can be employed as an alternative treatment for cutaneous leishmaniasis.

Factors affecting honey's antibacterial activity and how they act

According to Rami et al. (2017), honey's H_2O_2 , naturally low pH, high osmolarity, and bioactive components such defensin-1, MGO, lysozymes, flavonoids, aromatic, and volatile chemicals all have antibacterial characteristics (Martinotti and Ranzato 2018). These elements work together or alone to provide this impact (Alvarez—Suarez et al. 2010). Low pH. Every kind of honey contains acid. The presence of 31 organic acids contributes to this acidity (Amenu 2013), the primary one being gluconic acid, which lowers the pH of honey (Bansal et al. 2005; Bogdanov et al. 2008). Honeys made from nectar have a pH of 3.5 to 4.5, but honeys made from honeydew have a pH of 5.0 to 5.5. (Mbogning 2011). This prevents harmful bacteria from growing (Abdulrhman et al. 2013); the ideal pH is between 7.2 and 7.4. (Osamojola 2002). Osmotic pressure and water activity Honey has a water activity (a_w) ranging between 0.56 and 0.62, as well as a high osmolarity due to its high sugar content (Belhadj et al. 2015). As a result, it is a hypertonic solution with very little free water for microbe growth (Bogdanov and Blumer 2001; Olaitan et al. 2007). Hydrogen peroxide (H_2O_2). Hydrogen peroxide, often known as oxygenated water (H_2O_2), is a potent disinfectant (Goetz 2009). H_2O_2 is found in variable amounts in all varieties of honey (Di Girolamo et al. 2012; Chua et al. 2015). Adcock established the first relationship between H_2O_2 concentration and antibacterial activities in 1962. (1962). During the enzymatic oxidation of glucose, glucose oxidase (Figure 1) produces H_2O_2 (Kus et al. 2016). The major inhibin present in most honeys is this antibacterial component (Nolan et al. 2019). It should be noted that this inhibin is only found in unripe honey (Bogdanov and Blumer 2001). In ripe honey, the process is stalled. If honey is diluted, it can be reactivated, though ripe honey contains only small quantities of H_2O_2 impending just slightly the bacterial growth (Bogdanov and Blumer 2001). Oxygenated water thus synthesized has a dual origin: vegetal as long as glucose comes from the foraged nectar and animal given that glucose oxidase is secreted through the hypo pharyngeal glands of the worker bee during the conversion of nectar into honey (Desmouliere et al. 2013). Furthermore, the formed gluconic acid (Figure 1) increases honey acidity, thus limiting the growth of pathogenic bacteria (Olaitan et al. 2007; Mandal and Mandal 2011; Kwakman and Zaat 2012). The antibacterial properties result from the action of the free radicals regarded as very powerful cytotoxic oxidants able to break down bacterial deoxyribonucleic acid (DNA) strands

(Brudzynski and Lannigan 2012). Most of the antibacterial activity of honey reported in the research in Table 1 is due to H₂O₂ (Temaru et al. 2007). These honeys have a wide range of therapeutic activities (Irish et al. 2006). To reach an optimal antibacterial activity, honey must be placed in a cool dark area and consumed fresh (Al-Waili et al. 2011). The process of heating honey will reduce the activity of H₂O₂ (Matzen et al. 2018). Storage at 4 °C and at 25 °C entails a loss of peroxide activity with a greater loss observed at 25 °C (Knight 2013). Some honeys have a 'non-peroxidasic' activity, which means they retain a considerable antibacterial effect even when their peroxidasic activity is neutralised by catalase or heating. Methylglyoxal (MGO). MGO (CH₃-CO-CH=O or C₃H₄O₂) is a protein glycation agent found naturally in honey. MGO is the primary antibacterial component of Manuka monofloral honey, which is sourced from the *Leptospermum scoparium* tree in New Zealand (Daniels et al. 2016). Manuka honey is well-known for its potent 'non-peroxide' antibacterial activities (Daniels et al. 2016), also known as non-peroxide activity (NPA) (Lusby et al. 2005; Mavric et al. 2008), which is highly associated with its MGO concentration (Figure 2), molecule identified by Atrott and Henle (2009) as being the active compound of this honey. MGO concentration is there up to one hundred times higher compared to other honeys (Atrott and Henle 2009) ranging from 38 mg kg⁻¹ to 1 541 mg kg⁻¹. It was reported by Kwakman and Zaat (2012) that MGO is also present in other honeys but the concentration did not exceed 24 mg kg⁻¹. The collected nectar on *Leptospermum* sp. contains variable dihydroxyacetone (DHA) levels but no measurable MGO (Adams et al. 2009). MGO occurs with time, during the ripening and storage of honey (Adams et al. 2009) by converting DHA, a compound naturally found in high quantities in the nectar of Manuka flowers. MGO is a bacteria-killing substance which induces the alteration of bacterial flagella thus impeding adhesion to the surfaces and accordingly suppressing the formation of bacterial biofilms (Goetz 2009; Rabie et al. 2016). Kilty et al. (2011) demonstrated the efficacy of Manuka honey against biofilms of methicillin-resistant *S. aureus* and *Pseudomonas* sp. in vitro. MGO has antiviral effect against influenza (flu), similar to neuraminidase inhibitor therapy (Charyasriwong et al. 2015). Royalisin or defensin-1. Defensin-1 is one of four antimicrobial peptides released by bees (apidaecin, abaecin, hymenoptaecin, and defensin) (Ilyasov et al. 2012). Kwakman et al. (2010) referred to it as royalisin, and it was originally isolated in royal jelly before showing up in honey. It is a peptide secreted from the hypopharyngeal and mandibular glands of bees, consisting of 51 amino acids (Figure 3) having a molecular weight of 5.52 kDa (Bulet and Stocklin 2005). The antibacterial activity of defensin-1 was highlighted after consecutive neutralisations of bacteria-killing factors already known in honey (Kwakman et al. 2010). Bees secrete this protein in order to protect the brood by exerting a bacteria-killing action against Gram⁺ bacteria such as *Bacillus subtilis*, *S. aureus*, and *Paenibacillus* larvae (Kwakman and Zaat 2012). Defensin-1 has cytotoxic activity against Gram⁺ bacteria (Bulet and Stocklin 2005), Gram⁻ bacteria (Mandrioli et al. 2003) and against species of the genus *Aspergillus* (*flavus* and *niger*), *C. albicans*, and *Aurobasidium pullulans* (Aronstein et al. 2010). According to Majtan et al. (2014) and Sojka et al. (2016), defensin-1 and honey MGO destroy the bacterial biofilms as well. Polyphenols. Honey is a source of several bioactive compounds among which the phenolic compounds (Liu et al. 2013). The main source of phenols supplied by the bee comes from nectar and vegetal secretions (Cimpoiou et al. 2013). These compounds are involved in pathogenic defence in plants (Dai and Mumper 2010). It was reported by Isla et al. (2011) and Montenegro and Mejias (2013) that polyphenols found in nectar from flowers inhibit a broad range of Gram⁻ and Gram⁺ bacteria. These compounds have high therapeutic values (Djossou et al. 2013). This is a diverse group of chemical products distinguished by phenolic structures and containing flavonoids and phenolic acids.

Honey comprises a lot of phenolic acids: gallic acid, p-hydroxybenzoic acid, caffeic acid, syringic acid, cinnamic acid, ferulic acid, vanillic acid, p-coumaric acid, chlorogenic acid, rosmarinic acid, and their derivatives (Khan et al. 2017; Waheed et al. 2018). Among the identified structures in honey (Figure 4), that have an antibacterial activity, are syringic, ferulic, cinnamic, benzoic and caffeic acid (Kwakman and Zaat 2012; Cooke et al. 2015; Gradvol et al. 2015; Brudzynski et al. 2017; Kivrak and Kivrak 2017). The amount of phenolic acids in honey depends on the geographic location and the botanical source of the nectar. Moreover, it is obvious that the total content of phenolic acid is also significantly impacted by the season (Almasaudi 2021). Flavonoids in honey are ranked into 4 groups (Khan et al. 2017; Waheed et al. 2018): flavanols (kaempferol, fisetin, quercetin, galangin, and myricetin), flavanones (hesperidin, pinobanksin, naringin, pinocembrin, and naringenin), flavones (luteolin, genkwanin, apigenin, wogonin, tricetin, and acacetin) and tannins (ellagic acid). Flavonoids spotted in honey are usually derived from propolis (Šedík et al. 2019). These antimicrobial molecules are (Figure 5) kaempferol, quercetin, pinobanksin, chrysin, galangin, and pinocembrin (Couquet et al. 2013). A Manuka honey extract was separated chromatographically into six fractions (M1–M6); El-Malek et al. (2017) discovered four phenolic compounds in M6 fraction: luteolin, isoferulic acid, kaempferol and chrysin. This fraction was the most active against *S. aureus*, *S. pyogenes*, *Acinetobacter baumannii*, *P. aeruginosa*, and *Proteus mirabilis*. Candiracci et al. (2011) gathered evidence that flavonoids like quercetin, kaempferol, chrysin, galantol and apigenin may be involved in the activity of honey against *C. albicans*.

Alzheimer's Disease (AD)

Alzheimer's disease (AD) is a neurodegenerative disorder and a major cause of dementia globally (Alzheimer's Association, 2015). More recently, an in-vitro study in cultured neurons revealed that royal jelly peptides (*Apis mellifera* L.) inhibited β -secretase, an important enzyme responsible for the synthesis of neurotoxic amyloid- β peptide involved in the pathogenesis of AD (Zhang et al., 2016). Furthermore, the phenolic constituents in several Algerian honeys were also reported to be the inhibitor of acetylcholinesterase enzyme, a potential pharmacological target of anti-AD drugs (Zaidi et al., 2019). A number of pre-clinical studies revealed that bee product presents itself as a potential candidate for anti-AD drug development through diverse mechanisms. Proteostasis is the physiological mechanism that maintains the cellular proteome and, thus, cell health (Alzheimer's Association, 2015). One study revealed that royal jelly supplementation significantly delayed body paralysis in a *Caenorhabditis elegans* model of AD and that royal jelly further offered protection by promoting DAF-16-mediated Proteostasis (Wang, Cao, & Dong, 2016). Treatment with bee venom phospholipase A2 (bvPLA2) was also reported to attenuate learning and memory deficits and exert anti-neuroinflammatory effects in transgenic (3xTg-AD) mice (Ye et al., 2016). It is of note that coadministration of propolis with donepezil (a drug used for AD) caused remarkable improvements in both short- and long-term memory compared with donepezil (acetylcholinesterase inhibitor) alone in wild-type *Drosophila melanogaster* (Ayikobua et al., 2018). Bee venom inhibited lipopolysaccharide (LPS)-induced memory loss and inhibited LPS-induced increases in the levels of A β , β - and γ -secretase activity; the expression and DNA-binding activity of NF- κ B; and the expression of APP, BACE1, and neuroinflammatory proteins (COX-2, iNOS, GFAP and IBA-1) in the mouse brain (Gu et al., 2015). In support of pre-clinical study, clinical trial reports that the oral administration of royal jelly alone or combined with Ginkgo biloba extract (trade name: Memo®) is beneficial in treating the cognitive decline that occurs during the ageing process as well as in the early

phases of cognitive disorders (Hafezparast et al., 2003; Yakoot, & Salem, 2013). The ingestion of propolis (> 12 months) protected elderly people living at high altitudes from cognitive decline, thereby reducing the risk of AD (Zhu et al., 2018).

Parkinson's Disease (PD)

PD is a neurodegenerative disease characterized primarily by motor deficits due to loss of dopaminergic neurons in the substantia nigra (Ferreira & Massano, 2017). Search of literature revealed ample evidence of therapeutic potential of bee products at pre-clinical level. In a PD model, bee venom caused neuroprotection via reduction of astrocyte activation (Kim et al., 2016), inhibition of Jun activation (Doo et al., 2012), modulation of peripheral tolerance by regulatory T cells (Tregs) (Chung et al., 2012), and diminution of apoptosis and PI3K/Akt signaling (Doo et al., 2012). In the 1-methyl-4-phenyl-1,2,4,5-tetrahydropyridine (MPTP)/probenecid chronic mouse model of PD, bee venom provides sustained protection against the degenerative process (Alvarez-Fischer et al., 2013). Bee venom was also reported to normalize neuro-inflammatory, apoptotic markers and restore brain neurochemistry after rotenone injury (Khalil, Assaf, Elshebiny, & Salem, 2015). Hence, venom appeared to be the main bee product endowed with the ability to fight PD. Moreover, subcutaneous injection of bvPLA2 exerts neuroprotective effects on the MPTP-induced PD mouse model by controlling the generation of two regulatory T cells (subpopulation T cells that modulate immune system and prevent autoimmune disease) i.e. CD4+ and CD25+ (Baek, Jang, Jeon, & Bae, 2018). Apart from bee venom, one of the important component of propolis i.e. chrysin was reported to possess therapeutic potential against PD through mechanisms such as protection of dopaminergic neurons and elevation of dopamine levels (Angelopoulou, Pyrgelis, & Piperi, 2020). In accordance with aforementioned studies, few clinical trials also demonstrated that anti-Parkinson potential of bee venom. In a pilot study, bee venom acupuncture showed promising results as adjuvant therapy in idiopathic PD patients (Cho et al., 2012). Another prospective open-label study drew a similar conclusion (Doo et al., 2012).

Propolis, also known as bee glue, is an important bee product that is widely used in traditional medicine and apitherapy. Propolis is made up of various resins and vegetal balms, etheric oils, macro and microelements, flavonoids, bee secretions, and wax. Because the main plant species is represented by poplar buds, Romanian propolis is classified as a poplar type propolis. Polyphenols, particularly flavonoids (Bankova et al., 1997), and fatty acids are the primary chemical compounds responsible for propolis' bioactive properties (Polyakov et al., 1988).

Bee pollen is a complex mixture of flower pollen, nectar, and bee secretions that vary in color depending on the floral source. Bees collect pollen to make bee bread, the hive's proteic food. Pollen sugars include glucose, fructose, and sucrose, as well as starch and cellulose from the flower pollen. Freshly collected bee pollen is very rich in vitamins (B group, but also high amounts of C vitamin), minerals (Zn, Ca, Mg, K, Na), or carotenoids, which account for the wide range of colors (yellow, orange, red), or anthocyanins, which account for the violet color. Unsaturated fatty acids (omega 3 and omega 6) make up a significant portion of the chemical composition (Yang et al., 2013; Mărgăoan et al., 2014). Because bees rarely consume pollen as it is collected from flowers, it is converted in the hive to bee bread, a fermented product made by the bees to make it more available for their own consumption.

Because of the bacterial loading of the pollen, the high temperature in the hive, the enzymes present in the pollen, and the added lactobacilli from bee stomach and uncapped honey cells, this process occurs naturally in the hive. Pollen exine is broken down by fermentation, and all pollen components become

easily assimilable. Bee bread is the bee food's lipid and protein source.

Royal jelly is a worker bee secretion that is used to feed bee larvae for the first three days of life and to feed the queen for the rest of her life. This substance truly is a "royal" product because it contains all of the chemical compounds required by an organism to grow and develop, gain strength, and live a long life. Royal jelly has a high-water content (60-70%), making it the bee product with the highest water content, with its dry weight consisting of sugars, proteins, lipids, fatty acids, amino acids, vitamins, enzymes, and hormones. The main dry weight constituents are proteins and peptides. Proline and lysine are the most common free amino acids. Fatty acids are the main fraction of the lipid class, followed by neutral lipids, sterols and hydrocarbons. Organic acids have generally 8 or 10 atoms of carbon, the most important fatty acid being 10-hydroxidecenoic acid, which is a marker of authenticity. This compound has a high antibacterial activity (Garcia-Amoedo and Almeida-Muradian, 2009; Bărnăușiu *et al.* 2011), contributing to the small bacterial load of the product.

Apitherapy employs bee products to prevent and heal certain illnesses, as well as to promote a healthy lifestyle. The term "apitherapy" is derived from the Greek words *apis* (bee) and *therapy* (treatment). Apitherapy claims to be effective against a variety of diseases, ranging from arthritis and chronic pain to more serious illnesses such as cancer and stroke. Although there is little scientific evidence to support many of apitherapists' claims, apitherapy remains one of the most important aspects of alternative medicine. To be used in apitherapy, all bee products must have specific characteristics, a well-known chemical composition, and, most importantly, be free of contaminants.

Conclusion

The purpose of this study is to identify the major properties required for bee products used as supplements and adjuvants in Apitherapy, or as components in the development of novel goods or treatments. Due to the importance of obtaining medicines from natural sources, the study has updated the understanding of the potential therapeutic uses of propolis, bee pollen, and royal jelly as functional foods as well as their potential health, economic, and therapeutic benefits. Particular attention was also paid to knowledge of the mechanisms underlying the antioxidant effects of bee products has also received special focus.

References

1. Abd El-Moaty H.I. (2010): Essential oil and iridoide glycosides of *Nepeta septemcrenata* Erenb. *Journal of Natural Products*, 3: 103–111.
2. Abdel-Naby Awad O.G., Hamad A.M.H. (2018): Honey can help in herpes simplex gingivostomatitis in children: Prospective randomized double blind placebo controlled clinical trial. *American Journal of Otolaryngology*, 39: 759–763.
3. Abdulrhman M.A., Shatla R.H., Mohamed S.A. (2016): The effects of honey supplementation on Egyptian children with hepatitis A: A randomized double blinded placebo- -controlled pilot study. *Journal of Apitherapy*, 1: 23.
4. Adams C.J., Manley-Harris M., Molan P.C. (2009): The origin of methylglyoxal in New Zealand Manuka (*Leptospermum scoparium*) honey. *Carbohydrate Research*, 344: 1050–1053.
5. Adcock D. (1962): The effect of catalase on inhibine and peroxide values of various honeys. *Journal of Apicultural Research*, 1: 38–40.
6. Adebolu T. (2005): Effect of natural honey on local isolates of diarrhea-causing bacteria in southwestern Nigeria. *African Journal of Biotechnology*, 4: 1172–1174.

7. Ahmadi-Motamayel F., Hendi S.S., Alikhani M.Y., Khamverdi Z. (2013): Antibacterial activity of honey on cariogenic bacteria. *Journal of Dental (Tehran)*, 10: 10–15.
8. Ahmed A.K., Hoekstra M.J., Hage J., Karim R.B. (2003): Honey-medicated dressing: Transformation of an ancient remedy into modern therapy. *Annals of Plastic Surgery*, 50: 143–148.
9. Ahmed S., Othman H.N. (2013): Review of the medicinal effects of Tualang honey and a comparison with Manuka honey. *Malaysian Journal of Medical Sciences*, 20: 6–13.
10. Aksoy T., Sivcan E., Doğan F., Çetin S., Yar T.M. (2020): Investigation of anti-leishmanial effects of bee products (honey, propolis) on *Leishmania tropica* promastigotes. *Mikrobiyoloji Bülteni*, 54: 479–489.
11. Almasaudi S. (2021): The antibacterial activities of honey. *Saudi Journal of Biological Sciences*, 28: 2188–2196.
12. Alvarez-Suarez J.M., Gasparrini M., Forbes-Hernández T.Y., Mazzoni L., Giampieri F. (2014): The composition and biological activity of honey: A focus on Manuka honey. *Foods*, 3: 420–432.
13. Alvarez-Suarez J.M., Tulipani S., Diaz D., Estevez Y., Romandini S., Giampieri F., Damiani E., Astolfi P., Bompadre S., Battino M. (2010): Antioxidant and antimicrobial capacity of several monofloral Cuban honeys and their correlation with color, polyphenol content and other chemical compounds. *Food and Chemical Toxicology*, 48: 2490–2499.
14. Al-Waili N.S., Haq A. (2004): Effect of honey on antibody production against thymus-dependent and thymus- -independent antigens in primary and secondary immune responses. *Journal of Medicinal Food*, 7: 491–494.
15. Al-Waili N.S., Salom K., Butler G., Al Ghamdi A.A. (2011): Honey and microbial infections: A review supporting the use of honey for microbial control. *Journal of Medicinal Food*, 14: 1079–1096.
16. Amenu D. (2013): The antibacterial activity of honey. *International Journal of Current Research and Academic Review*, 1: 102–116.
17. Anthimidou E., Mossialos D. (2013): Antibacterial activity of Greek and Cypriot honeys against *Staphylococcus aureus* and *Pseudomonas aeruginosa* in comparison to Manuka honey. *Journal of Medicinal Food*, 16: 42–47.
18. Aronstein K.A., Murray K.D., Saldivar E. (2010): Transcriptional responses in honey bees larvae infected with chalkbrood fungus. *BMC Genomics*, 11: 1–12.
19. Asadi-Pooya A., Pnjehshahin M., Beheshti S. (2003): The antimycobacterial effect of honey: An *in vitro* study. *Rivista di Biologia*, 66: 491–496.
20. Atrott J., Henle T. (2009): Methylglyoxal in Manuka honey – Correlation with antibacterial properties. *Czech Journal of Food Sciences*, 27: S163–S165.
21. Aween M.M., Hassan Z., Muhialdin B.J., Noor H.M., Eljamel Y.A. (2012a): Evaluation on antibacterial activity of *Lactobacillus acidophilus* strains isolated from honey. *American Journal of Applied Sciences*, 9: 807–817.
22. Aween M.M., Zaiton H., Belal J.M., Yossra A.E., Asma S.W., Al-Mabrok M., Nizam L. (2012b): Antibacterial activity of *Lactobacillus acidophilus* strains isolated from honey marketed in Malaysia against selected multiple antibiotic resistant (MAR) Gram-positive bacteria. *Journal of Food Science*, 77: 364–371.
23. Bahiru B., Mehari T., Ashenafi M. (2006): Yeast and lactic acid flora of tej, an indigenous Ethiopian honey wine: Variations within and between production units. *Food Microbiology*, 23: 277–282.

24. Bankova V, Christov R, Hegazi AG, Abd El Hady FK, Popov S (1997). Chemical composition of propolis from poplar buds. *Int Symp on Apitherapy*, Cairo, Egypt.
25. Bansal V., Medhi B., Pandhi P. (2005): Honey – A remedy discovered and its therapeutic utility. *Kathmandu University Medical Journal*, 3: 305–309.
26. Bărnuțiu LI, Mărghitaș LA, Dezmirean DS, Mihai CM, Bobiș O (2011). Chemical composition and antimicrobial activity of Royal Jelly – Review. *Scientific Papers: Animal Sciences and Biotechnologies* 44: 67-72.
27. Basualdo C., Sgroy V.N., Finola M.S., Marioli J.M. (2007): Comparison of the antibacterial activity of honey from different provenance against bacteria usually isolated from skin wounds. *Veterinary Microbiology*, 124: 375–81.
28. Behbahani M. (2014): Anti-HIV-1 activity of eight monofloral Iranian honey types. *PLoS One*, 9: e108195.
29. Belhaj O., Oumato J., Zrira S. (2015): Physico-chemical study of some types of Moroccan honey (Etude physico- -chimiques de quelques types de miels Marocains). *Revue Marocaine des Sciences Agronomiques et Vétérinaires*, 3: 71–75. (in French)
30. Bobiș O, Mărghitaș LA, Dezmirean D. Bonta V, Mihai CM (2010). Beehive products: source of nutrients and naturally biologically active compounds. *J Agroalim Proc Technol* 16(2):104-109.
31. Bogdanov S., Blumer P. (2001): Natural Antibiotic Properties of Honey (Propriétés Antibiotiques Naturelles du Miel). Bern, Switzerland, Centre Suisse de Recherche Apicoles: 1–8. (in French)
32. Bogdanov S., Jurendic T., Sieber R., Gallmann P. (2008): Honey for nutrition and health: A review. *Journal of the American College of Nutrition*, 27: 677–689. Bourlioux P. (2013): What alternatives does our anti-infective therapeutic arsenal have against multi-resistant bacteria? (De quelles alternatives notre arsenal thérapeutique anti- -infectieux dispose-t-il face aux bactéries multi-résistantes?). *Annales Pharmaceutiques Françaises*, 71: 150–158. (in French)
33. Brudzynski K., Lannigan R. (2012): Mechanism of honey bacteriostatic action against MRSA and VRE involves hydroxyl radicals generated from honey's hydrogen peroxide. *Frontiers in Microbiology*, 3: 36.
34. Brudzynski K., Miotto D., Kim L., Sjaarda C., Maldonado-Alvarez L., Fukš H. (2017): Active macromolecules of honey form colloidal particles essential for honey antibacterial activity and hydrogen peroxide production. *Scientific Reports*, 7: 7637.
35. Bruneau E. (2006): Antibiotics in honey (Antibiotiques dans le miel). *Abeille and Cie*, 110: 26–28. (in French)
36. Bucekova M., Jardekova L., Juricova V., Bugarova V., Di Mar-co G., Gismondi A., Leonardi D., Farkasovska J., Godocikova J., Laho M., Klaudiny J., Majtan V., Canini A., Majtan J. (2019): Antibacterial activity of different blossom honeys: New findings. *Molecules*, 24: 1573.
37. Búfalo M.C., Figueiredo A.S., de Sousa J.P., Candeias J.M., Bastos J.K., Sforcin J.M. (2009): Anti-poliovirus activity of *Baccharis dracunculifolia* and propolis by cell viability determination and real-time PCR. *Journal of Applied Microbiology*, 107: 1669–1680.
38. Bulet P., Stocklin R. (2005): Insect antimicrobial peptides: Structures, properties and gene regulation. *Protein and Peptide Letters*, 12: 3–11.
39. Bulgasem Y., Bulgasem M., Nizam L., Zaiton H., Wan M., Wan Y., Sumaya G.F. (2016): Antifungal activity of lactic acid bacteria strains isolated from natural honey against pathogenic *Candida* species. *Mycobiology*, 44: 302–309.

40. Candiracci M., Citterio B., Diamantini G., Blasa M., Accorsi A., Piatti E. (2011): Honey flavonoids, natural antifungal agents against *Candida albicans*. *International Journal of Food Properties*, 14: 799–808.
41. Castro-Vázquez L., Díaz-Maroto M.C., González-Viñas M.A., Pérez-Coello M.S. (2009): Differentiation of monofloral citrus, rosemary, eucalyptus, lavender, thyme and heather honeys based on volatile composition and sensory descriptive analysis. *Food Chemistry*, 112: 1022–1030.
42. Castro-Vázquez L.M., Díaz-Maroto M.C., Guchu E., Pérez-Coello M.S. (2006): Analysis of volatile compounds of eucalypt honey by solid phase extraction followed by gas chromatography coupled to mass spectrometry. *European Food Research and Technology*, 224: 27–31.
43. Cavanagh D., Beazley J., Ostapowicz F. (1970): Radical operation for carcinoma of the vulva. A new approach to wound healing. *Journal of Obstetrics and Gynaecology of the British Commonwealth*, 77: 1037–1040.
44. Chang X., Wang J., Yang S., Chen S., Song Y. (2011): Antioxidative, antibrowning and antibacterial activities of sixteen floral honeys. *Food and Function*, 2: 541–546.
45. Charyasriwong S., Watanabe K., Rahmasari R., Matsunaga A., Haruyama T., Kobayashi N. (2015): *In vitro* evaluation of synergistic inhibitory effects of neuraminidase inhibitors and methylglyoxal against influenza virus infection. *Archives of Medical Research*, 46: 8–16.
46. Chemspider (2022): Database of Chemical Structures. [Dataset]. *Royal Society of Chemistry, ChemSpider: The Free Chemical Database*. Available at <http://www.chemspider.com/> (accessed May 27, 2022).
47. Chen L., Mehta A., Berenbaum M., Zangerl A.R., Engeseth N.J. (2000): Honeys from different floral sources as inhibitors of enzymatic browning in fruit and vegetable homogenates. *Journal of Agricultural and Food Chemistry*, 48: 4997–5000.
48. Chua L.S., Lee J.Y., Chan G.F. (2015): Characterization of the proteins in honey. *Analytical Letters*, 48: 697–709.
49. Cimpoi C., Hosu A., Miclaus V., Puscas A. (2013): Determination of the floral origin of some Romanian honeys on the basis of physical and biochemical properties. *Spectrochimica Acta, Part A: Molecular and Biomolecular Spectroscopy*, 100: 149–154.
50. Cooke J., Dryden M., Patton T., Brennan J., Barrett J. (2015): The antimicrobial activity of prototype modified honeys that generate reactive oxygen species (ROS) hydrogen peroxide. *BMC Research Notes*, 8: 20.
51. Cooper R., Jenkins L., Hooper S. (2014): Inhibition of biofilms of *Pseudomonas aeruginosa* by Medihoney *in vitro*. *Journal of Wound Care*, 23: 93–104.
52. Cortopassi-Laurino M., Gelli D.S. (1991): Pollen analysis, physico-chemical properties and antibacterial action of honeys from Africanized bees *Apis mellifera* and Meliponines from Brazil (Analyse pollinique, propriétés physico-chimiques et action antibactérienne des miels d'abeilles africanisées *Apis mellifera* et de Méliponinés du Brésil). *Apidologie*, 22: 61–73. (in French)
53. Couquet Y., Alexis D., Rigal M.L. (2013): The antibacterial and healing properties of honey (Les propriétés antibactériennes et cicatrisantes du miel). *Actualités Pharmaceutiques*, 52: 22–25. (In French)
54. Da Silva P.M., Gauche C., Gonzaga L.V., Costa A.C.O., Fett R. (2016): Honey: Chemical composition, stability and authenticity. *Food Chemistry*, 196: 309–323.
55. Dai J., Mumper R.J. (2010): Plant phenolics: Extraction, analysis and their antioxidant and anticancer properties. *Molecules*, 15: 7313–7352.

56. Daniels B.J., Prijic G., Meidinger S., Loomes K.M., Stephens J.M., Schlothauer R.C., Furkert D.P., Brimble M.A. (2016): Isolation, structural elucidation, and synthesis of lepteridine from Manuka (*Leptospermum scoparium*) honey. *Journal of Agricultural and Food Chemistry*, 64: 5079–5084.
57. Danila C., Tamara Yuliett F.H., Francesca G., Jiaojiao Z., Johura A., Mattia P., Josè L.Q., Jesus S.G., Maurizio B. (2020). Effect of *in vitro* gastrointestinal digestion on the bioaccessibility of phenolic compounds and antioxidant activity of Manuka honey. *eFood*, 1: 85–93.
58. De Vuyst L., Leroy F. (2007): Bacteriocins from lactic acid bacteria: Production, purification, and food applications. *Journal of Molecular Microbiology and Biotechnology*, 13: 194–199.
59. Desmouliere A., Bonte F., Couquet Y., Rigal M.L. (2013): Honey, which benefit in healing? (Le miel, quel intérêt en cicatrisation?). *Actualités Pharmaceutiques*, 52: 17–35. (in French)
60. Di Girolamo F., D'Amato A., Righetti P.G. (2012): Assessment of the floral origin of honey via proteomic tools. *Journal of Proteomics*, 75: 3688–3693.
61. Dimitrios S., Nikolaos S., Christina T., Stamatina P., Charalampos A., Alexandros N., Fani K., Soultana A.A., Konstantinos P., Demetrios A.S., Demetrios K., Dimitris M. (2018): Antibacterial and antioxidant activity of different types of honey derived from Mount Olympus in Greece. *International Journal of Molecular Medicine*, 42: 726–734.
62. Djossou J.A., Tchobo F.P., Yédomonhan H., Alitonou A.G., Soumanou M.M. (2013): Evaluation of the physico-chemical characteristics of honey marketed in Cotonou (Evaluation des caractéristiques physico-chimiques des miels commercialisés à Cotonou). *Tropicultura*, 31: 163–169. (in French)
63. Donia M.S., Fricke W.F., Partensky F., Cox J., Elshahawi S.I., White J.R., Phillippy A.M., Schatz M.C., Piel J., Haygood M.G., Ravel J., Schmidt E.W. (2011): Complex microbiome underlying secondary and primary metabolism in the tunicate-*Prochloron* symbiosis. *Proceedings of the National Academy of Sciences of USA*, 108: E1423–E1432.
64. Dortu C., Thonart P. (2009): The bacteriocins of lactic acid bacteria: Characteristics and interests for the biopreservation of food products (Les bactériocines des bactéries lactiques: Caractéristiques et intérêts pour la bioconservation des produits alimentaires). *Biotechnology, Agronomy, Society and Environment*, 13: 143–154. (in French)
65. El Sohaimy S.A., Masry S.H.D., Shehata M.G. (2015): Physicochemical characteristics of honey from different origins. *Annals of Agricultural Sciences*, 60: 279–287.
66. El-Gendy M.M.A. (2010): *In vitro*, evaluation of medicinal activity of Egyptian honey from different floral sources as anticancer and antimycotic infective agents. *Journal of Microbial and Biochemical Technology*, 2: 118–123.
67. El-Malek F.F.A., Yousef A.S., El-assar S.A. (2017): Hydrogel film loaded with new formula from Manuka honey for treatment of chronic wound infections. *Journal of Global Antimicrobial Resistance*, 11: 171–176.
68. Eteraf-Oskouei T., Najafi M. (2013): Traditional and modern uses of natural honey in human diseases: A review. *Iranian Journal of Basic Medical Sciences*, 16: 731–742.
69. Feás X., Estevinho L.M. (2011): A survey of the *in vitro* antifungal activity of heather (*Erica* sp.) organic honey. *Journal of Medicinal Food*, 14: 1284–1288.
70. Feknous N., Ouchene L.L., Boumendjel M., Mekhancha D.E., Boudida Y., Chettoum A., Boumendjel A., Messarah M. (2021): Local honey goat milk yoghurt production. Process and quality control. *Food Science and Technology*, 42: 1–10.

71. Fernandes L., Ribeiro H., Oliveira A., Sanches Silva A., Freitas A., Henriques M., Rodrigues M.E. (2020): Portuguese honeys as antimicrobial agents against *Candida* species. *Journal of Traditional and Complementary Medicine*, 11: 130–136.
72. Forsgren E., Olofsson T.C., Vázquez A., Fries I. (2010): Novel lactic acid bacteria inhibiting *Paenibacillus* larvae in honey bee larvae. *Apidologie*, 41: 99–108.
73. Frans T., Sias G., Itzhak G. (2001): The antifungal action of three South African honeys on *Candida albicans*. *Apidologie*, 32: 371–379.
74. Garcia-Amoedo JH, Almeida-Muradian LB (2007). Physicochemical composition of pure and adulterated royal jelly. *Quim Nova* 30: 257-259.
75. Giovanni C., Filippo F., Matilde M., Simona S., Barbara T., Leonora A., Antonio F., Miroslava K. (2020): Antibacterial activity of honey samples from Ukraine. *Veterinary Sciences*, 7: 181.
76. Goetz P. (2009): Honey as a local disinfectant and wound healing treatment (Le miel comme traitement local désinfectant et cicatrisant des plaies). *Phytothérapie*, 7: 91–93. (in French)
77. Gradvol V., Atlaban N., Lenart L., Pavlović H. (2015): Microbiological quality and inhibitory potential of selected Croatian apiary honeys. *Croatian Journal of Food Science and Technology*, 7: 40–46.
78. Gupta R.K., Rybroeck W., Johan W.R. (2014). *Beeking for Poverty Alleviation and Livelihood Security*. Berlin, Germany, *Springer*: 114.
79. Guttentag A., Krishnakumar K., Cokcetin N., Hainsworth S., Harry E., Carter D. (2021): Inhibition of dermatophyte fungi by Australian jarrah honey. *Pathogens*, 10: 194.
80. Haderbache L., Annou S., Mohammedi A. (2020): Antimicrobial potential of *Ziziphus* and *Euphorbia* honeys harvested in semi-arid region of Algeria and their possible use in soft medicine. *Journal of Microbiology, Biotechnology and Food Sciences*, 9: 1114–1118.
81. Hananeh W.M., Ismail Z.B., Alshehabat M.A., Mahmoud A.A., Ali J.H. (2015). Effects of Sidr honey on second-intention healing of contaminated full-thickness skin wounds in healthy dogs. *Bulletin of the Veterinary Institute in Pulawy*, 59: 433–439.
82. Hannan A., Munir S., Arshad M.U., Bashir N. (2014): *In vitro* antimycobacterial activity of Pakistani beri honey using BACTEC MGIT 960. *International Scholarly Research Notices*, 2014: 490589.
83. Hasali N.H.M., Zamri A.I., Lani M.N., Mubarak A., Suhaili Z. (2015): Identification of lactic acid bacteria from Meliponine honey and their antimicrobial activity against pathogenic bacteria. *American-Eurasian Journal of Sustainable Agriculture*, 9: 1–6.
84. Hashemipour M.A., Tavakolineghad Z., Arabzadeh S.A.M., Iranmanesh Z., Nassab S.A.H.G. (2014): Antiviral activities of honey, royal jelly, and acyclovir against HSV-1. *Wounds*, 26: 47–54.
85. Hegazi A.G., Al Guthami F.M., Al Gethami A.F., Allah F.M.A., Saleh A.A., Fouad E.A. (2017): Potential antibacterial activity of some Saudi Arabia honey. *Veterinary World*, 10: 233.
86. Hegazi Ahmed G., Al Guthami Faiz M., Al Gethami Ahmed F.M., Fouad Ehab A. (2020): Antibacterial and antioxidant activities of some Saudi Arabia honey products. *Iranian Journal of Medical Microbiology*, 14: 490–500.
87. Hern T.T., Rosliza A.R., Siew H.G., Ahmad S.H., Siti A., Hassan S., Amrah S., Kirnpal-Kaur B.S. (2009): The antibacterial properties of Malaysian tualang honey against wound and enteric microorganisms in comparison to Manuka honey. *BMC Complementary and Alternative Medicine*, 9: 34.

88. Homrani M., Dalache F., Bouzouina M., Nemiche S., Homrani A. (2019): Antibacterial activities of Algerian raw honeys and isolated *Lactobacillus* against Gram-negative bacteria. *Advances in BioResearch*, 10: 31–39.
89. Hosny I., El-Ghani S.A., Nadir A.S. (2009): Nutrient composition and microbiological quality of three unifloral honeys with emphasis on processing of honey probiotic youghurt. *Global Veterinaria*, 3: 107–112.
90. Hussain M.B., Abdul H., Naeem A., Ghulam Q.F., Muhammad I., Sidrah S., Imtiaz A.Q. (2015): Pakistani honeys against multi-drug resistant *Salmonella typhi*. *Complementary and Alternative Medicine*, 15: 32.
91. Huttunen S., Riihinen K., Kauhanen J., Tikkanen-Kaukanen C. (2013): Antimicrobial activity of different Finnish monofloral honeys against human pathogenic bacteria. *Acta Pathologica, Microbiologica et Immunologica Scandinavica*, 121: 827–34.
92. Iburguren C., Raya R.R., Apella M.C., Audisio M.C. (2010): *Enterococcus faecium* isolated from honey synthesized bacteriocin-like substances active against different *Listeria monocytogenes* strains. *Journal of Microbiology*, 48: 44–52.
93. Igado O., Omobowale T., Nottidge H. (2010): The effect of honey and vitamin C on the response of dogs to anti-rabies vaccination. *Sahel Journal of Veterinary*, 9: 32–37.
94. Ilyasov R.A., Gaifullina L.R., Saltykova E.S., Poskryakov A.V., Nikolenko A.G. (2012): Review of the expression of antimicrobial peptide defensin in honey bees *Apis mellifera* L. *Journal of Apicultural Science*, 56: 115–124.
95. Irish J., Blair S., Carter D.A. (2011): The antibacterial activity of honey derived from Australian flora. *PLoS One*, 6: e18229.
96. Irish J., Carter D.A., Shokohi T., Blair S.E. (2006): Honey has an antifungal effect against *Candida* species. *Medical Mycology*, 44: 289–291.
97. Isla M.I., Craig A., Ordoñez R., Zampini C., Sayago J., Bedascarrasbure E., Alvarez A., Salomón V., Maldonado L. (2011): Physico chemical and bioactive properties of honeys from Northwestern Argentina. *LWT – Food Science and Technology*, 44: 1922–1930.
98. Jantakee K., Tragoolpua Y. (2015): Activities of different types of Thai honey on pathogenic bacteria causing skin diseases, tyrosinase enzyme and generating free radicals. *Biological Research*, 48: 4.
99. Khan R.U., Naz S., Abudabos A.M. (2017): Towards a better understanding of the therapeutic applications and corresponding mechanisms of action of honey. *Environmental Science and Pollution Research International*, 24: 27755–27766.
100. Kilty S.J., Duval M., Chan F.T., Ferris W., Slinger R. (2011): Methylglyoxal: (Active agent of Manuka honey) *in vitro* activity against bacterial biofilms. *International Forum of Allergy and Rhinology*, 1: 348–350.
101. Kıvrak Ş., Kıvrak İ. (2017): Assessment of phenolic profile of Turkish honey. *International Journal of Food Properties*, 20: 864–876.
102. Klaenhammer T., Altermann E., Arigoni F., Bolotin A., Breidt F., Broadbent J., Cano R., Chaillou S., Deutscher J., Gasson M., van de Guchte M., Guzzo J., Hartke A., Hawkins T., Hols P., Hutkins R., Kleerebezem M., Kok J., Kuipers O., Lubbers M., Maguin E., McKay L., Mills D., Nauta A., Overbeek R., Pel H., Pridmore D., Saier M., van Sinderen D., Sorokin A., Steele J., O'Sullivan D., de Vos W.,

- Weimer B., Zagorec M., Siezen R. (2002): Discovering lactic acid bacteria by genomics. *Antonie Van Leeuwenhoek*, 82: 29–58.
103. Knight A. (2013): The therapeutic effects of honey. *The Plymouth Student Scientist*, 06: 375–385.
104. Küçük M., Kolaylı S., Karaoğlu Ş., Ulusoy E., Baltacı C., Candan F. (2007): Biological activities and chemical composition of three honeys of different types from Anatolia. *Food Chemistry*, 100: 526–536.
105. Kurek-Górecka A., Górecki M., Rzepecka-Stojko A., Balwierz R., Stojko J. (2020): Bee products in dermatology and skin care. *Molecules*, 25: 556.
106. Kus P.M., Szweda P., Jerkovic I., Tuberoso C.I.G. (2016): Activity of Polish unifloral honeys against pathogenic bacteria and its correlation with colour, phenolic content, antioxidant capacity and other parameters. *Letters in Applied Microbiology*, 62: 269–276.
107. Kwakman P.H.S., te Velde A.A., de Boer L., Speijer D., Vandenbroucke-Grauls C.M.J.E., Zaat S.A.J. (2010): How honey kills bacteria. *FASEB Journal*, 24: 2576–2582.
108. Kwakman P.H.S., Zaat S.A.J. (2012): Antibacterial components of honey. *IUBMB Life*, 64: 48–55.
109. Lashani E., Davoodabadi A., Soltan D., Mohammad M. (2020): Some probiotic properties of *Lactobacillus* species isolated from honey and their antimicrobial activity against foodborne pathogens. *Veterinary Research Forum*, 11: 121–126.
110. Lashani E., Davoodabadi A., Soltan Dallal M.M. (2018): Antimicrobial effects of *Lactobacillus plantarum* and *Lactobacillus paracasei* isolated from honey against *Staphylococcus aureus*. *Journal of Babol University of Medical Sciences*, 20: 44–49.
111. Liu J.R., Ye Y.L., Lin T.Y., Wang Y.W., Peng C.C. (2013): Effect of floral sources on the antioxidant, antimicrobial, and anti-inflammatory activities of honeys in Taiwan. *Food Chemistry*, 1: 938–943.
112. Lu J., Turnbull L., Burke C.M., Liu M., Carter D.A., Schlothauer R.C., Whitchurch C.B., Harry E.J. (2014): Manuka-type honeys can eradicate biofilms produced by *Staphylococcus aureus* strains with different biofilm-forming abilities. *PeerJ*, 2: e326.
113. Lusby P.E., Coombes A., Wilkinson J.M. (2002): Honey: A potent agent for wound healing. *Wound Ostomy Continence Nurses*, 29: 295–300.
114. Lusby P.E., Coombes A.L., Wilkinson J.M. (2005): Bactericidal activity of different honeys against pathogenic bacteria. *Archives of Medical Research*, 36: 464–467.
115. Lyudmila B., Juliana I., Galina G., Borislav V., Rossen N., Ivan M. (2015): Honey and green/black tea consumption may reduce the risk of *Helicobacter pylori* infection. *Diagnostic Microbiology and Infectious Disease*, 82: 85–86.
116. Maddocks S., Lopez M., Rowlands R., Cooper R. (2012): Manuka honey inhibits the development of *Streptococcus pyogenes* biofilms and causes reduced expression of two fibronectin binding proteins. *Microbiology*, 158: 781–790.
117. Maddocks S.E., Jenkins R.E. (2013): Honey: A sweet solution to the growing problem of antimicrobial resistance? *Future Microbiology*, 8: 1419–1429.
118. Madigan M., Martinko J., Bender K., Buckley D., Stahl D. (2015): Brock Biology of Microorganism. 14th Ed. Boston, US, Pearson: 1030.

119. Majtan J., Bohova J., Horniackova M., Klaudiny J., Majtan V. (2014): Anti-biofilm effects of honey against wound pathogens *Proteus mirabilis* and *Enterobacter cloacae*. *Phytotherapy Research*, 28: 69–75.
120. Mandal M.D., Mandal S. (2011): Honey: Its medicinal property and antibacterial activity. *Asian Pacific Journal of Tropical Biomedecine*, 1: 154–60.
121. Mandrioli M., Bugli S., Saltini S., Genedani S., Ottaviani E. (2003): Molecular characterization of a defensin in the IZD- -MB-0503 cell line derived from immunocytes of the insect *Mamestra brassicae* (Lepidoptera). *Biology of the Cell*, 95: 53–57.
122. Mărgăoan R, Mărghițaș L, Dezmirean D, Dulf F, Bunea A, Socaci AS, Bobiș O (2014). Predominant and secondary pollen botanical origin influence the carotenoid and fatty acid profile in fresh boneybee collected pollen. *J Agric Food Chem* 62:6306-6316.
123. Mărghițaș L, Dezmirean D, Moise A, Bobiș O, Laslo L, Bogdanov S (2009). Physico-chemical and bioactive properties of different floral origin honeys from Romania. *Food Chem*. 112: 863-867.
124. Maria L.E., Afonso S.E., Xesús F. (2011): Antifungal effect of lavender honey against *Candida albicans*, *Candida krusei* and *Cryptococcus neoformans*. *Journal of Food Science and Technology*, 48: 640–643.
125. Martinotti S., Ranzato E. (2018). Honey, wound repair and regenerative medicine. *Journal of Functional Biomaterials*, 9: 34.
126. Mathialagan M., Johnson Thangaraj Edward Y.S., David P.M.M., Senthilkumar M., Srinivasan M.R., Mohankumar S. (2018): Isolation, characterization and identification of probiotic lactic acid bacteria (LAB) from honey bees. *International Journal of Current Microbiology and Applied Sciences*, 7: 894–906.
127. Matzen R.D., Leth-Espensen J.Z., Jansson T., Nielsen D.S., Lund M.N., Matzen S.H. (2018): The antibacterial effect *in vitro* of honey derived from various Danish flora. *Dermatology Research and Practice*, 2018: 7021713.
128. Mavric E., Wittmann S., Barth G., Henle T. (2008): Identification and quantification of methylglyoxal as the dominant antibacterial constituent of Manuka (*Leptospermum scoparium*) honeys from New Zealand. *Molecular Nutrition and Food Research*, 52: 483–489.
129. Mbogning E., Tchoumboue J., Damesse F., Sanou Sobze M., Canini A. (2011): Physico-chemical characteristics of honeys from the Sudano-Guinean zone of the West and Adamaoua Cameroon (Caractéristiques physico-chimiques des miels de la zone Soudano-guinéenne de l'Ouest et de l'Adamaoua Cameroun). *Tropicicultura*, 29: 168–175. (in French)
130. Mc Loone P., Warnock M., Fyfe L. (2016): Honey: A realistic antimicrobial for disorders of the skin. *Journal of Microbiology, Immunology and Infection*, 49: 161–167.
131. Metabolic effects of honey in type 1 diabetes mellitus: A randomized crossover pilot study. *Journal of Medicinal Food*, 16: 66–72.
132. Mohammed S.E.A., Kabbashi A.S., Koko W.S., Rana R.M., Adgaba N., Ghamdi A.A. (2017): *In vitro* activity of some natural honeys against *Entamoeba histolytica* and *Giardia lamblia* trophozoites. *Saudi Journal of Biological Sciences*, 26: 238–243.
133. Molan P.C. (1992): The antibacterial activity of honey: 1. The nature of the antibacterial activity. *Bee World*, 73: 5–28.
134. Montenegro G., Mejias E. (2013): Biological applications of honeys produced by *Apis mellifera*. *Biological Research*, 46: 341–345.

135. Moody M.N., Landau J.M., Goldberg L.H., Marquez D., Vergilis-Kalner I.J. (2011): 595 nm long pulsed dye laser with a hydrocolloid dressing for the treatment of hyper granulation tissue on the scalp in postsurgical defects. *Dermatology Online Journal*, 17: 2.
136. Moussa D., Nouredine H.S., Mohamed M., Abdelmelek, Saad A. (2012): Antibacterial activity of various honey types of Algeria against *Staphylococcus aureus* and *Streptococcus pyogenes*. *Asian Pacific Journal of Tropical Medicine*, 5: 773–776.
137. Mulu A., Diro E., Tekleselassie H., Belyhun Y., Anagaw B., Alemayehu M., Gelaw A., Biadlegne F., Desalegn K., Yifiru S., Tiruneh M., Kassu A., Nishikawa T., Isogai E. (2010): Effect of Ethiopian multiflora honey on fluconazole-resistant *Candida* species isolated from the oral cavity of AIDS patients. *International Journal of STD and AIDS*, 21: 741–745.
138. Ng W.J., Lim M.S. (2015): Antistaphylococcal activity of melaleuca honey. *Southeast Asian Journal of Tropical Medicine and Public Health*, 46: 472–479.
139. Nolan V.C., Harrison J., Cox J.A.G. (2019): Dissecting the antimicrobial composition of honey. *Antibiotics*, 8: 251.
140. Obaseiki-Ebor E.E., Afonya T.C.A. (1984): *In vitro* evaluation of the anticandidiasis activity of honey distillate (HY-1) compared with that of some antimycotic agents. *Journal of Pharmacy and Pharmacology*, 36: 283–284.
141. Olaitan P.B., Adeleke O.E., Ola I.O. (2007): Honey: A reservoir for microorganisms and an inhibitory agent for microbes. *African Health Sciences*, 7: 159–165.
142. Olofsson T.C., Butler È., Markowicz P., Lindholm C., Larsson L., Vásquez A. (2016): Lactic acid bacterial symbionts in honeybees – An unknown key to honey's antimicrobial and therapeutic activities. *International Wound Journal*, 13: 668–679.
143. Olofsson T.C., Vásquez A. (2008): Detection and identification of a novel lactic acid bacterial flora within the honey stomach of the honeybee *Apis mellifera*. *Current Microbiology*, 57: 356–563.
144. Oluwapelumi O.B., Morayo A., Buru A.S., Richard A.Y., Funmilayo A.J., Funmi A.A. (2017): Antimicrobial activities of different honeys sold in Ado-Ekiti on bacteria associated with upper respiratory tract infections. *International Journal of Current Microbiology and Applied Sciences*, 6: 1–10.
145. Osmojasola P.F. (2002): The antibacterial effect of honey on bacteria isolated from infected wound in Ilorin, Nigeria. *Nigerian Society for Experimental Biology*, 2: 109–112.
146. Peña R.M., Barciela J., Herrero C., García-Martín S. (2004): Solid-phase microextraction gas chromatography-mass spectrometry determination of monoterpenes in honeys. *Journal of Separation Science*, 27: 1540–1544.
147. Pérez RA, Iglesias MT, Pueyo E, Gonzalez M, de Lorenzo C (2007). Amino acid composition and antioxidant capacity of Spanish honeys. *J Agric Food Chem* 55:360–365.
148. Piotr S. (2017): Antimicrobial activity of honey. In: Vagner de Alencar Arnaut de Toledo (ed.): Honey Analysis. London, United Kingdom, *IntechOpen*: 215–232.
149. Polyakov VV, Shukenova RZH, Orlov VK (1988). Fatty acids in propolis. *Pchelovodstvo* 10: 30.
150. Proaño A., Coello D., Villacrés-Granda I., Ballesteros I., Debut A., Vizuete K., Brenciani A., Álvarez-Suarez J.M. (2021): The osmotic action of sugar combined with hydrogen peroxide and bee-derived antibacterial peptide Defensin-1 is crucial for the antibiofilm activity of eucalyptus honey. *Lebensmittel-Wissenschaft and Technologie*, 136: 110379.

151. PubChem (2022): Human Defensin NP1 (Compound). *PubChem*, National Institutes of Health (NIH). Available at <https://pubchem.ncbi.nlm.nih.gov/compound/16130476#section=2D-Structure> (accessed May, 2022).
152. Rabie E., Serem J.C., Oberholzer H.M., Gaspar A.R.M., Bester M.J. (2016): How methylglyoxal kills bacteria: An ultrastructural study. *Ultrastructural Pathology*, 40: 107–111.
153. Rafael V., Flavia Z., Gloria M., Ady G. (2021): Bioactive compounds in *Apis mellifera* monofloral honeys. *Journal of Food Science*, 86: 1552–1582.
154. Rani G.N., Budumuru R., Bandaru N.R. (2017): Antimicrobial activity of honey with special reference to methicillin resistant *Staphylococcus aureus* (MRSA) and methicillin sensitive *Staphylococcus aureus* (MSSA). *Journal of Clinical and Diagnostic Research*, 11: DC05–DC08.
155. Samarghandian S., Farkhondeh T., Samini F. (2017): Honey and health: A review of recent clinical research. *Pharmacognosy Research*, 9: 121–127.
156. Sampath Kumar K.P., Bhowmik D., Chiranjib B., Chandira M.R. (2010): Medicinal uses and health benefits of honey: An overview. *Journal of Chemical and Pharmaceutical Research*, 2: 385–395.
157. Sanz M.L., Polemis N., Morales V., Corzo N., Drakoularakou A., Gibson G.R., Rastall R.A. (2005): *In vitro* investigation into the potential prebiotic activity of honey oligosaccharides. *Journal of Agricultural and Food Chemistry*, 53: 2914–2921.
158. Šedík P., Pocol C.B., Horská E., Fiore M. (2019): Honey: Food or medicine? A comparative study between Slovakia and Romania. *British Food Journal*, 121: 1281–1297.
159. Semprini A., Singer J., Braithwaite I., Shortt N., Thayabaran D., Mc Connell M., Weatherall M., Beasley R. (2018): Kanuka honey *versus* aciclovir for the topical treatment of herpes simplex labialis: A randomised controlled trial. *BMJ Open*, 9: e026201.
160. Shenoy V.P., Ballal M., Shivananda P., Bairy I. (2012): Honey as an antimicrobial agent against *Pseudomonas aeruginosa* isolated from infected wounds. *Journal of Global Infectious Diseases*, 4: 102–105.
161. Sherlock O., Dolan A., Athman R., Power A., Gethin G., Cowman S., Humphreys H. (2010): Comparison of the antimicrobial activity of Ulmo honey from Chile and Manuka honey against methicillin-resistant *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*. *BMC Complementary and Alternative Medicine*, 10: 47.
162. Sojka M., Valachova I., Bucekova M., Majtan J. (2016): Antibiofilm efficacy of honey and bee-derived defensin-1 on multispecies wound biofilm. *Journal of Medical Microbiology*, 65: 337–344.
163. Soroy L., Bagus S., Yongkie I.P., Djoko W. (2014): The effect of a unique propolis compound (Propoelix™) on clinical outcomes in patients with dengue hemorrhagic fever. *Infection and Drug Resistance*, 7: 323–329.
164. Sowa P., Grabek-Lejko D., Wesółowska M., Swacha S., Zugan M.D. (2017): Hydrogen peroxide-dependent antibacterial action of *Melilotus albus* honey. *Letters in Applied Microbiology*, 65: 82–89.
165. Temaru E., Shimura S., Amano K., Karasama T. (2007): Antimicrobial activity of honey from stingless honeybees (*Hymenopetra Apidae*; Meliponinae). *Polish Journal of Microbiology*, 56: 281–285.
166. Udvary D.W., Gontang E.A., Jones A.C., Jones C.S., Schultz A.W., Winter J.M., Yang J.Y., Beauchemin N., Capson T.L., Clark B.R., Esquenazi E., Eustáquio A.S., Freel K., Gerwick L., Gerwick W.H., Gonzalez D., Liu W.T., Malloy K.L., Maloney K.N., Nett M., Nunnery J.K., Penn K., Prieto-Davo A., Simmons T.L., Weitz S., Wilson M.C., Tisa L.S., Dorrestein P.C., Moore B.S. (2011): Significant natural product biosynthetic potential of actinorhizal symbionts of the genus *Frankia*, as

- revealed by comparative genomic and proteomic analyses. *Applied and Environmental Microbiology*, 77: 3617–3625.
167. Vásquez A., Forsgren E., Fries I., Paxton R.J., Flaberg E., Szekely L., Olofsson T.C. (2012): Symbionts as major modulators of insect health: Lactic acid bacteria and honeybees. *PLoS One*, 7: e33188.
168. Voidarou C., Alexopoulos A., Plessas S., Karapanou A., Mantzourani I., Stavropoulou E., Fotou K., Tzora A., Skoufos I., Bezirtzoglou E. (2011): Antibacterial activity of different honeys against pathogenic bacteria. *Anaerobe*, 17: 375–379.
169. Waheed M., Hussain M.B., Javed A., Mushtaq Z., Hassan S., Shariati M.A., Khan M.U., Majeed M., Nigam M., Mishra A.P., Heydari M. (2018): Honey and cancer: A mechanistic review. *Clinical Nutrition*, 38: 2499–2503.
170. Watanabe K., Rahmasari R., Matsunaga A., Haruyama T., Kobayashi N. (2014): Anti-influenza viral effects of honey *in vitro*: Potent high activity of Manuka honey. *Archives of Medical Research*, 45: 359–365.
171. Yang K, Wu D, Ye X, Liu D, Chem J, Sun P (2013). Characterization of chemical composition of bee pollen in China. *J Agric Food Chem* 61:708-718.

SCIENTIFIC AND EDUCATIONAL ROLE OF BOTANIC GARDENS: EXAMPLES FROM TÜRKİYE AND THE WORLD

Banu Karaşah

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi, ARTVİN, Orcid ID: 0000-0001-5079-5313

Emine Tarakci Eren

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi, ARTVİN, Orcid ID: 0000-0002-5595-9505

Derya Sarı

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi, ARTVİN, Orcid ID: 0000-0001-9440-7343

Hilal Surat

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi, ARTVİN, Orcid ID: 0000-0002-2471-8717

ABSTRACT

Botanic gardens are special gardens, are based on the conservation of plants, provide indirect learning to the visitors with their plant compositions, offer different education programs from 7 to 77, and enable individuals to have a positive attitude towards nature and gain environmental awareness. Nowadays, botanic gardens basically have scientific, educational, and recreational functions, although the first botanic gardens were established for scientific purposes. Priority of these functions may change. While the priority of some botanic gardens is scientific functions, education or recreation function are priority in some of them. In this study, a total of 10 botanic gardens from Türkiye and the world (1 from Germany, 1 from Japan, 1 from Singapore, 2 from the United Kingdom, 2 from Türkiye, 1 from Georgia, 1 one from Egypt and one from Taiwan) were chosen and it was aimed to reveal the scientific and educational role of these botanic gardens. Research and conservation functions within the scope of scientific functions of botanical gardens, and teaching function (direct and indirect) within the scope of educational functions are examined. In addition, total area, date founded, and country of botanic gardens are given in the study. Considering the establishment years of the botanic gardens, it has been seen that botanic gardens are quite good both scientifically and educationally, although there are deficiencies in some. Among the examples of botanic gardens discussed, it has been found that especially the Royal Botanic Garden, KEW is in good condition both scientifically and educationally, and Nezahat Gökyiğit Botanic Garden in our country is quite good both scientifically and educationally although it has a history of about 25 years. It should not be forgotten that botanic gardens, provide a wide range of services, make important contributions with their functions, and the establishment of more botanical gardens in countries with rich biodiversity should be encouraged.

Keywords: Botanic gardens, functions of botanic gardens, research and conservation, education.

BOTANİK BAHÇELERİNİN BİLİMSEL VE EĞİTSEL ROLÜ: TÜRKİYE VE DÜNYA'DAN ÖRNEKLER

Banu Karavaş

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi,
ARTVİN, Orcid ID: 0000-0001-5079-5313

Emine Tarakci Eren

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi,
ARTVİN, Orcid ID: 0000-0002-5595-9505

Derya Sarı

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi,
ARTVİN, Orcid ID: 0000-0001-9440-7343

Hilal Surat

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi,
ARTVİN, Orcid ID: 0000-0002-2471-8717

ÖZET

Botanik bahçeleri, bitkileri korumayı esas alan, barındırdığı bitki kompozisyonları ile ziyaretçilere esin kaynağı olarak dolaylı öğrenmelerini sağlayan, 7'den 77'ye farklı eğitim programları sunan, bireylerin doğaya karşı pozitif tutum sergilemelerini ve çevresel farkındalık kazanmalarını sağlayan özel bahçelerdir. İlk botanik bahçeleri bilimsel amaçlarla kurulmuş olsa da günümüzde botanik bahçeleri temel olarak bilimsel, eğitsel ve rekreasyonel işlevlere sahiptir. Bu işlevlerin öncelik sıraları değişebilmektedir. Kimi botanik bahçelerinin önceliği bilimsel işlevler iken kimi botanik bahçelerinin ise eğitim ya da rekreasyondur. Bu çalışmada da Türkiye'den ve dünyadan toplam 10 bahçesi (1 tanesi Almanya'dan, 1 tanesi Japonya'dan, 1 tanesi Singapur'dan, 2 tanesi Birleşik Krallık'tan, 2 tanesi Türkiye'den, 1 tanesi Gürcistan'dan, 1 tanesi Mısır'dan ve 1 tanesi Tayvan'dan) seçilmiştir ve bu botanik bahçelerinin bilimsel ve eğitsel rolünün ortaya konulması amaçlanmıştır. Botanik bahçelerinin bilimsel işlevleri kapsamında araştırma ve koruma işlevleri, eğitsel işlevleri kapsamında ise öğretim işlevi (doğrudan ve dolaylı) irdelenmiştir. Ayrıca çalışmada seçilen botanik bahçelerinin kuruluş yılları, kuruldukları ülke ve büyüklüklerine ilişkin bilgilerde verilmiştir. Elde edilen bulgularda bazı botanik bahçelerinde eksiklikler olsa da botanik bahçelerinin kuruluş yılları göz önüne alındığında hem bilimsel hem de eğitsel açıdan oldukça iyi olduğu görülmüştür. Ele alınan botanik bahçesi örneklerinden, yurtdışı örneklerinden özellikle Kraliyet Botanik Bahçesi, KEW'in hem bilimsel hem de eğitsel açıdan iyi durumda olduğu, ülkemizden de Nezahat Gökyiğit Botanik Bahçesi'nin yaklaşık 25 yıllık bir geçmişe sahip olmasına rağmen hem bilimsel açıdan hem de eğitsel açıdan işlevlerinin oldukça iyi olduğu tespit edilmiştir. Oldukça geniş bir yelpazede hizmet sunan botanik bahçelerinin işlevleri ile önemli katkılar sağladığı unutulmamalıdır, zengin biyoçeşitliliğe sahip ülkelerde daha fazla botanik bahçesi kurulması teşvik edilmelidir.

Anahtar kelimeler: Botanik bahçeleri, botanik bahçelerinin işlevleri, araştırma ve koruma, eğitim.

INTRODUCTION

Green areas, which are the key elements of the urban ecosystem and enable people to communicate with nature, are decreasing day by day and in contrast people's need for green areas is increasing. Botanic gardens, which are a special garden category, provide ecosystem services that can meet this need in the areas where they are established (urban or rural).

Botanic gardens, which have the mission of introducing the natural vegetation of their own regions as well as the plants grown in different parts of the world, provide information about plants to people of all age groups and contribute to the formation of environmental awareness and conservation awareness by introducing the richness of plant life (Hepcan and Özkan, 2005). Botanic garden is a special and different garden category, based on plant conservation, includes herbaceous and woody plants, presents different views throughout the seasons with its remarkable plant compositions and presents the beauties of nature, enabling people to communicate with nature and satisfying their curiosity towards nature, educating its visitors by providing information about plants and their usage areas and providing environmental awareness about conservation (Karaşah, 2014). Botanic garden is a permanent institution or a natural environment for acquiring, preserving facilities and opportunities for expertise investigation, and researching about plant and its life (Kareem and Maulood, 2021). Botanic Gardens Conservation International (BGCI) defined the botanic gardens are institutions holding documented collections of living plants for the purpose of scientific research, conservation, display, and education. In 2018, BGCI updated the criteria that define a botanic garden to have a greater emphasis on conserving rare and threatened plants, compliance with international policies, and sustainability and ethical initiatives (BGCI, 2022).

Botanic gardens have constitutively scientific (research and conservation), educational (train and culture) and recreational functions.

Botanic gardens perform a major role as research sites, reservoirs of biodiversity, tourist destinations, education, and public outreach centres, as well as by providing exposure to species and ecosystems that visitors may never otherwise experience (Wassenberg et. al., 2015; Karaşah, 2017). Botanic gardens are not necessarily learning environments focused on botany or even biology. Besides topics like adaptation or plant-animal interactions, students can there potentially also learn about for example geography or natural or human history (Willison, 2006; Wiegand et al., 2013). Their collections and libraries provide important resources to support such research and many botanic gardens have excellent research facilities either within or associated with the institution. These include laboratories, herbaria, greenhouses, and growth chambers with controlled conditions, field experimental areas, climatic, and weather stations, data management systems, and advanced equipment for molecular, and genetic studies. (Jackson and Shutterland, 2017).

Botanic gardens provide direct and indirect learning environments to the visitors with their plant compositions, offer different education programs from 7 to 77, and enable individuals to have a positive attitude towards nature and gain environmental awareness. Jackson and Shutterland (2017) stated that the education role can involve providing materials and expertise for university teaching, as well as devising and providing formal education programs for other age groups. This often involves working with schools and contributing to schools' curricula. Increasing more informal learning activities are being offered by botanic gardens. These are most often directed toward target audiences such as families, casual

visitors, young people, and decision makers.

Botanic gardens also provide many recreational opportunities for people like walking, jogging, picnic, connecting with nature etc. and other bios-especially provide a shelter for birds and wildlife-.

There are approximately 3758 botanic gardens worldwide (BGCI, 2022). In this study, it was aimed to reveal the scientific and educational role of a total of 10 botanic gardens from Türkiye and the world.

MATERIAL and METHOD

Priority of the functions of botanic gardens may change. While the priority of some botanic gardens is scientific functions, education or recreation function are priority in some of them. The first botanic gardens established for scientific purposes. In this study, scientific and educational role of botanic gardens examined. A total of 10 botanic gardens from Türkiye and the world were chosen as material of this study.

Research and conservation functions within the scope of scientific functions of botanical gardens, and teaching function (direct and indirect) within the scope of educational functions examined. In addition, total area, date founded, and country of botanic gardens given in tables.

Information about study areas was obtained from on-site observations, official websites of botanic gardens and BGCI official website.

RESULTS

Studied botanic gardens are Botanischer Garten und Botanisches Museum Berlin in Berlin, Germany, Hiroshima Botanic Garden in Japan, Royal Botanic Garden Kew, London, UK, Royal Botanic Garden Edinburgh in Edinburgh, UK, Singapore Botanic Gardens in Singapore, Batumi Botanic Garden in Georgia, Orman Botanic Garden in Cairo, Egypt, Taipei Botanic Garden in Taiwan, Gaziantep Botanic Garden in Gaziantep, Türkiye and Nezahat Gökyiğit Botanic Garden in İstanbul, Türkiye.

Botanischer Garten und Botanisches Museum Berlin

The garden established over 300 years ago in Berlin in Germany- Deutschland. Its total area is 43 hectares. Visitors can see Botanical Museum, Aquatic and Marsh Plants, Moss Garden, Fragrance and Touch Garden, Useful Plants, Medicinal Plants, Herbaceous Plants, Greenhouses, Italian Garden, and Arboretum in the garden. The garden has one of the largest greenhouses in the world. The garden has library, herbarium, conservation, and research programmes like ex-situ conservation and pollination biology. The garden also has guided tours and courses (Table 1).

Table 1. Information about and functions of the garden

 <p>URI-1, 2022</p>	Name	Date Founded	Total Area	City/Country	
	Botanischer Garten und Botanisches Museum Berlin	Over 300 years	43 hectares	Berlin/Germany-Deutschland	
	Scientific Functions		Educational Functions		
	Herbarium, Seed bank, Computer plant record system, 16 greenhouses,		Guided tours, permanent public displays, special exhibitions, courses for		



URL-2, 2022

library Conservation programmes Ex-situ conservation programme Reintroduction programme Research programmes Conservation-Biology Conservation-Genetics Ecology, Exploration, Floristics, Horticulture, Pollination biology, Restoration ecology, Seed/spore biology, systematics and taxonomy, urban environments, data management systems and information technology	children and university/college students, education programmes, monthly e-newspaper, Plant label, information panels
--	--

Hiroshima Botanic Garden

The garden established in 1976 in Hiroshima, Japan. Its total area is 18.3 hectares. It has Japanese garden, Iris Garden, Arboretum, Rose Garden, Rock Garden, Phylogenetic Garden, Bush Clover Garden, Tropical Waterlily Display House, Begonia Display House, and Cactus Display House. The garden has seed bank and research laboratory, conducted conservation and research programmes and education programmes (Table 2).

Table 2. Information about and functions of the garden

	Name	Date Founded	Total Area	City/Country
	Hiroshima Botanic Garden	1976	18.3 hectares	Hiroshima/Japan
	Scientific Functions		Educational Functions	
	Herbarium, Seed bank, micropropagation/tissue culture facilities, glasshouse, computer plant record system, research laboratory Conservation and Research programmes Ex-situ conservation programme		Guided tours, published plant catalogue, visitor/education center permanent public displays, special exhibitions, public lectures/talks, education booklets/leaflets, Plant label, information panels.	



Original, 2015

Reintroduction programme
 Conservation-Biology
 Conservation-Genetics
 Ecology, Floristics,
 Horticulture, Invasive
 species biology and
 control, systematics and
 taxonomy, data
 management systems and
 information technology,
 agriculture

Royal Botanic Garden Kew

The garden established in 1758 in London, UK. Its total area is 104 hectares. It has Temperate House - which is the world's largest Victorian glasshouse-, Mediterranean Garden and King William's Temple, Agius Evolution Garden, Bamboo Garden and Minka House, Carnivorous Plants, Arboretum, Children's Garden, Davies Alpine House, Edible Science: Kew's Kitchen Garden, Grass Garden, Great Pagoda, Japanese Landscape, Lake and Crossing, Marianne North Gallery, Mediterranean Garden and King William's Temple, Natural Area, Palm House, Princess of Wales Conservatory, Queen's Garden, Rhododendron Dell, Rock Garden, Rose Garden, Royal Treasures, Shirley Sherwood Gallery of Botanical Art, The Hive, Treetop Walkway, Waterlily House and Woodland Garden and Temple of Aeolus. The garden carries out a wide range of research and conservation projects. In addition, there are educational programs suitable for different age groups in the garden (Table 3).

Table 3. Information about and functions of the garden

	Name	Date Founded	Total Area	City/Country
  <p>Original, 2008</p>	Royal Botanic Garden Kew	1758	104 hectares	London/UK
	Scientific Functions		Educational Functions	
	Herbarium, Seed bank, Library, Temperate house Conservation and Research programmes Digitising Kew's Collections, Banking the world's seeds, Tropical Important Plant Areas, Landscape Ecology Programme, Kew– Colombia Bio Programme, Threatened Biodiversity Hotspots programme, Global Tree Seed Bank Programme, Alpine seed conservation and research network, Millennium Seed Bank, 1001 Genomes Plus, African Cyperaceae, Adapting agriculture to climate change, Annotated systematic checklist of the Compositae of Bolivia, Conserving native useful trees of Mexico to maintain its natural capital, Conserving the Endemic Flora of the Carpathian Region, Flow Cytometry Laboratory, Seed Biology Laboratories, Molecular Biology Laboratory, In Vitro Laboratory etc.		Guided tours, School programmes, Teacher training, Postgraduate taught programmes, PhD research, Continuing Professional Development, working with universities, Future Leader Fellowships in Plant and Fungal Science, Bursaries and scholarships, Kew Diploma in Horticulture, Kew specialist certificate in Arboriculture, in Display and Nursery Glasshouses, in Kitchen Garden Production, in Ornamental Horticulture and Propagation, Botanical drawing: Intermediate, Growing perennial vegetables, Pine Cones in Pen and Ink, Sensory tours, Youth Programme, Community Learning Programme, Access Scheme, Horticultural Learning, Family and Early Years Programme, Discovery and Access Programme, Plant label, information panels	

Royal Botanic Garden Edinburgh

The garden established in 1670 in Edinburgh, UK. Its total area is 32 hectares. Visitors can see the Rock

Garden, Herbaceous Border, Demonstration Garden, the Alpine Houses, Woodland Garden, Pond, the Arboretum or Tree Collection, Chinese Hillside, Rhododendron Collection, And the Scottish Native Plants Collection in the Health Garden in the garden. The garden has a rich library, herbarium, and greenhouses. Lots of conservation and research programmes conducted in the garden. There are educational programs suitable for different age groups in the garden.

Table 4. Information about and functions of the garden

	Name	Date Founded	Total Area	City/Country
	Royal Botanic Garden Edinburgh	1670	32 hectares	Edinburgh/UK
 <p>Original, 2008</p>	Scientific Functions		Educational Functions	
	Herbarium, greenhouses, library Conservation and Research programmes Taxonomy and Phylogenetics, Threatened Biomes and Environmental Change, Tropical Diversification Patterns, Morphology Development and Evolution, Conifer Conservation, Molecular Ecology, Global Environmental Change		Guided tours, Online Courses-Plants and climate change, Getting started with...Planting design, RBGE Diploma in Botanical Illustration etc.-, Schools courses, Certificate, Diploma and Degree Courses, Horticultural Internship Programme, MSc Degree and Postgraduate Diploma, Short Courses, Plant label, information panels	

Singapore Botanic Gardens

The garden established in 1859 in Singapore. Its total area is 82 hectares. It has Bandstand, Bonsai Garden, Swan Lake, Vanda Miss Joaquim as the Singapore's National Flower, Ginger Garden, Keppel Discovery Wetlands, National Orchid Garden, The Learning Forest, Evolution Garden, Healing Garden, Fragrant Garden, Palm Valley and Symphony Lake, Rain Forest, Eco-Garden And Eco-Lake, Ethnobotany Garden, Foliage Garden, Jacob Ballas Children's Garden. The garden is the first and only tropical botanic garden on the UNESCO's World Heritage List. The garden carries out a wide range of research and conservation projects and educational programs (Table 5).

Batumi Botanic Garden

The garden established in 1912 in Batumi, Georgia. Its total area is 109 hectares. It has 9 Phyto-geographical departments: East Asian, North American, New Zealand, South American, Himalayan, Mexican, Australian, Mediterranean (European) and Transcaucasia humid subtropics, lower park, upper park, fruit and berries department, citrus industrial zone, bamboo plantation, seaside park, exotic collection plants. The garden also conducted conservation and research programmes (Table 6).

Orman Botanic Garden

The garden established in 1875 in Cairo, Egypt. Its total area is 12 hectares. Visitors can see Rock Garden, Marsh Plants, Pond, and Rose Garden. It conducted scientific and educational programmes (Table 7).

Table 5. Information about and functions of the garden

	Name	Date Founded	Total Area	City/Country
	Singapore Botanic Gardens	1859	82 hectares	Singapore
	Scientific Functions		Educational Functions	
	Herbarium, library, seed bank Conservation and Research programmes Publications- The Gardens' Bulletin Singapore, Garden wise, Flora of Singapore-, Molecular Biology and Micropropagation, Orchid Breeding and Reintroductions		Guided tours, adults(individual), children and family's education, school and educator education, adults (organized groups)-nature tours, hands-on workshop-, Plant label, information panels.	
URL-3, 2022				

Table 6. Information about and functions of the garden

  Original, 2017	Name	Date Founded	Total Area	City/Country	
	Batumi Botanic Garden	1912	109 hectares	Batumi/Georgia	
	Scientific Functions		Educational Functions		
	Herbarium, Seed bank, library, greenhouses Conservation and Research programmes Ex-situ conservation programme, protection and preservation of endangered species, floristics, horticulture, invasive species biology and control, systematics and taxonomy		Guided tours, spreading agricultural and biological knowledge. Plant label, information panels, students and pupils' education programmes.		

Table 7. Information about and functions of the garden

 URL-4, 2022	Name	Date Founded	Total Area	City/Country	
	Orman Botanic Garden	1875	12 hectares	Cairo/Egypt	
	Scientific Functions		Educational Functions		
	Herbarium, Seed bank, Computer plant record system. Conservation and Research programmes Plant breeding		Guided tours, published plant catalogue, visitor/education center, Plant label, information panels.		

Taipei Botanic Garden

The garden established in 1986 in Taipei, Taiwan. Its total area is 8.2 hectares. It has Bamboo Garden, Succulent Plants Garden, Idiom Plants Garden, Taiwan Aquatic Plants Garden, Economic Crops Garden, Ethno-Plants Garden, Ginger Garden, Odes Plants Garden, Botanist Memorial Garden, Buddhism Garden, Fern Garden, Taxonomic Garden, Senses Garden, Lotus Pond, Palm Garden and Arena Glasshouse. The garden conducted conservation and research programmes. In addition, published plant catalogue, guided tours has also in the garden (Table 8).

Table 8. Information about and functions of the garden

	Name	Date Founded	Total Area	City/Country
	Taipei Botanic Garden	1896	8.2 hectares	Taipei/Taiwan
	Scientific Functions		Educational Functions	
URL-5, 2022	Herbarium, Seed bank, micropropagation/tissue culture facilities, glasshouse			
	Conservation and Research programmes		Guided tours, published plant catalogue, permanent public displays, special exhibitions, public lectures/talks, education booklets/leaflets, Plant label, information panels.	
URL-6, 2022	Ex-situ conservation programme Reintroduction programme Conservation-Biology Conservation-Genetics Ecology, Ethnobotany, Floristics, Horticulture, Molecular genetics, Pollination biology, Seed/spore biology, systematics and taxonomy, data management systems and information technology			

Gaziantep Botanic Garden

The garden established in 2009 in Gaziantep, Türkiye. Its total area is 2 hectares. Visitor can see Aquatic Plants Garden, Rose Garden, Ottoman Garden, Colour and Fragrance Garden, Rock Garden, Japanese Garden, Zen Garden, Three Dimensional Plants, Open Seed Plants Garden and Medicinal and Endemic Plants Garden. The garden has herbarium and seed bank, conducted conservation and research programmes. It has also teacher training programmes and courses for different age groups.

Table 9. Information about and functions of the garden

	Name	Date Founded	Total Area	City/Country	
	Gaziantep Botanic Garden	2009	2 hectares	Gaziantep/Türkiye	
 <p>URL-7, 2022</p>	Scientific Functions		Educational Functions		
Herbarium, Seed bank, Computer plant record system				Conservation and Research programmes Guided tours, public lectures/talks, courses for school children, university/college students and public, teacher training, ecology classroom, monthly journal, plant labels, information panels.	
Ex-situ conservation programme Reintroduction programme Plant breeding, Conservation-Biology Exploration, Horticulture, Pollination biology, systematics and taxonomy, sustainability, agriculture.					

Nezahat Gökyiğit Botanic Garden

The garden established in 1995 in İstanbul, Türkiye. Its total area is 46 hectares. It consists of nine islands- Central Island, Ertuğrul Island, Recreation Island, İstanbul Island, Arboretum Island, Oak Island, Anatolia Island and Thrace Island. The garden conducted lots of conservation and research programmes. It provides a wide range of children courses like tree identification and gardening projects (Table 10).

Table 10. Information about and functions of the garden

	Name	Date Founded	Total Area	City/Country
	Nezahat Gökyiğit Botanic Garden	1995	46 hectares	İstanbul/Türkiye
	Scientific Functions		Educational Functions	
Original, 2013	Herbarium, Seed bank, Computer plant record system, library Conservation and Research programmes Ex-situ conservation programme Reintroduction programme Medicinal plant programme Floristics, Horticulture, Pollination biology, data management systems and information technology <i>Astragalus</i> conservation project, <i>Rhaponticoides</i> conservation project, <i>Tulipa sprengeri</i> conservation project		Guided tours, permanent public displays public lectures/talks, special exhibitions, courses for children like children's discovery garden, tree identification game, children' gardening project, school programmes and adults like certificate in practical horticulture and botanical illustration, teacher training, life-long learning (conferences, workshops), weekend events (families and children), online education, monthly e-journal, books, floral series.	

CONCLUSION

Botanic gardens have multi-dimensional functions. In this study, we examined the scientific and educational functions of 10 botanic gardens. According to the total area of the botanic gardens, the largest is the Batumi Botanical Garden while the smallest is the Gaziantep Botanic Garden. Considering the establishment years of the botanic gardens, it has been seen that botanic gardens are quite good both scientifically and educationally regardless of their total area, although there are deficiencies in some. Among the examples of botanic gardens discussed, it has been found that especially the Royal Botanic Garden, KEW and Royal Botanic Garden Edinburgh are in good condition both scientifically and educationally, and Nezahat Gökyiğit Botanic Garden in Türkiye is also good both scientifically and educationally although it has a history of about 25 years. Singapore Botanic Garden is the first and only tropical botanic garden on the UNESCO's World Heritage List.

Botanic gardens are important green belts of the cities. They provide lots of formal and informal education programmes for people of all ages and serve life-long learning. They underpin the conservation and sustainable use of the world's plants and botanic gardens help stop biodiversity loss and develop

solutions to climate change and other global challenges. Being a special garden category, botanic gardens are vital with these features.

It should not be forgotten that botanic gardens, provide a wide range of services, make important contributions with their functions, and the establishment of more botanical gardens in countries with rich biodiversity should be encouraged.

REFERENCES

- BGCI (Botanic Garden Conservation International) (2022). <https://www.bgci.org/about/botanic-gardens-and-plant-conservation/>. (20.09.2022)
- Hepcan, Ç.Ç. ve Özkan, B. (2005). Botanik Bahçelerinin Kentsel Dış Mekanlar Olarak Kullanıcılara Sunduğu Olanakların Belirlenmesi, Ege Üniveristesi Ziraat Fakültesi Dergisi, 42, 3, 159-170.
- Jackson, P.W., Shutterland, L.A. (2017). Role of Botanic Gardens. Encyclopedia of Biodiversity, Elsevier.
- Kareem, K.N., Maulood, B.K. (2021). A Study into Hawler Botanical Garden (H.B.G) in Comparison to Some Other Botanical Gardens of the World. IOP Conf. Series: Earth and Environmental Science, 779, 012003.
- Karaşah, B. (2014). Botanik Bahçelerinde Görsel Peyzaj Tercihlerinin Değerlendirilmesi: Nezahat Gökyiğit Botanik Bahçesi (İstanbul) ve Kraliyet Botanik Bahçesi (Edinburgh) Örnekleri. Doktora Tezi, KTÜ Fen Bilimleri Enstitüsü, Trabzon.
- Karaşah, B. (2017). Determination Of Cultural Ecosystem Services Provided By Botanic Gardens ‘Case Of Batumi Botanical Garden, Georgia’. In: Researches On Science And Art in 21st Century Turkey, (Eds. Arapgirlioğlu, H., Atilla, A., Elliot, R.L., Turgeon, R.), Gece Publishing, 2033-2043.
- Wassenberg, C.L., Goldenberg, M.A., Soule, K.E. (2015). Benefits of Botanical Garden Visitation: A Means-End Study. Urban Forestry and Urban Greening, 14, 148–155.
- Wiegand, F., Kubisch, A., Heyne, T. (2013). Out-of-school learning in the botanical garden: Guided or self-determined learning at workstations? Studies in Educational Evaluation, 39, 161-168.
- Willison, J. (2006). Education for sustainable development: Guidelines for action in botanic gardens. Richmond: Botanic Gardens Conservation International.
- URL-1, (2022). <https://www.visitberlin.de/de/botanisches-museum>. (15.09.2022)
- URL-2, (2022). <https://www.bgbm.org/de/node/1088>. (15.09.2022)
- URL-3, (2022). <https://tr.depositphotos.com/stock-photos/singapore-botanic-gardens.html>. (17.09.2022)
- URL-4, (2022). https://www.safarway.com/en/property/orman-garden_29845. (18.09.2022)
- URL-5, (2022). <https://eng.taiwan.net.tw/m1.aspx?sNo=0002090&id=R137>. (22.09.2022)
- URL-6, (2022). <https://orogoldstores.com/explore-taiwans-botanical-treasures/>. (22.09.2022)
- URL-7, (2022). <https://gaziantepbotanik.com/Haberler/ziyaretcilerimizi-bekliyoruz/1>. (25.09.2022)

A RESEARCH ON ENVIRONMENTAL SATISFACTION MEASUREMENT IN SHORE PARKS; CASE OF FINDIKLI ATATURK PARK, RİZE

Emine Tarakci Eren

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi, ARTVİN, Orcid ID: 0000-0002-5595-9505

Banu Karaşah

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi, ARTVİN, Orcid ID: 0000-0001-5079-5313

Hilal Surat

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi, ARTVİN, Orcid ID: 0000-0002-2471-8717

Derya Sarı

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi, ARTVİN, Orcid ID: 0000-0001-9440-7343

ABSTRACT

Seashores are the places where locals prefer to spend their free time in cities or districts have coast on, even if they do not have parks in them. The designed and applicated parks on these shores aim to offer different active or passive recreational activities to citizens from all walks of life. Thus, the shores are among the values that increase the level of environmental satisfaction for the citizens with these features. The research was carried out in two stages. While the structural landscape elements and plants were examined and the activity areas were determined with on-site studies in the first stage, in the second stage, the environmental satisfaction of 130 people selected from the users was questioned and the levels were determined as a result. Accordingly, the activity areas, equipment and plant elements identified in the area are as follows; entrance gate, parking area (car, bicycle), roads (pedestrian, vehicle, bicycle, jogging/walking), skateboard track, sports areas/viewing steps, architectural sales units, toilet, cafe, restaurant, beach, changing room, shower, beach volley court, exhibition area, fountain pool, traditional housing example, picnic areas, benches, dustbins, railings, walls, lightings, trees, shrubs and groundcovers. In the questionnaire, while the satisfaction of the users with the structural landscape elements and plants of the park is questioned, the location of the park (being on the coast, being close to the main road, being in a central location, etc.), accessibility (pedestrian and vehicle transportation, park, underpass, overpass), park inner accessibility (pedestrian paths, bicycle paths, access between spaces) and design (all these features) of the park were also questioned. Results showed that most satisfied feature is the location of the park (4.35), followed by its design (4.22), access between spaces (4.12), landscape features and lastly its transportation (3,38).

Keywords: Shore Park, Environmental Satisfaction, Fındıklı, Rize.

KIYI PARKLARINDA ÇEVRESEL MEMNUNİYET ÖLÇME ÜZERİNE BİR ARAŞTIRMA; RİZE, FINDIKLI ATATÜRK PARKI ÖRNEĞİ

Emine Tarakci Eren

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi,
ARTVİN, Orcid ID: 0000-0002-5595-9505

Banu Karaşah

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi,
ARTVİN, Orcid ID: 0000-0001-5079-5313

Hilal Surat

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi,
ARTVİN, Orcid ID: 0000-0002-2471-8717

Derya Sarı

Artvin Çoruh University, Faculty of Art and Design, Department of Landscape Architecture, Arhavi,
ARTVİN, Orcid ID: 0000-0001-9440-7343

ÖZET

Denize kıyısı olan kentlerde, ya da ilçelerde bölge halkı park olmasa bile boş zamanlarından en çok vakit geçirmeyi tercih ettikleri yerler deniz kıyılarıdır. Bu kıyılarda tasarlanan ve uygulanan parklar, her kesimden kentliye farklı aktif ya da pasif rekreatif etkinlik sunmayı amaçlar. Böylece kıyıları bu özellikleri ile de kent insanı için çevresel memnuniyet düzeyini artıran değerler arasındadır. Araştırma iki aşamalı olarak yürütülmüştür. Birinci aşamada, yerinde tespit çalışmaları ile yapısal ve bitkisel peyzaj elemanları incelenmiş, etkinlik alanları tespit edilmiş, ikinci aşamada ise kullanıcılardan seçilen 130 kişiye bu alandan duydukları çevresel memnuniyetleri sorgulanmış sonuç olarak düzeyler belirlenmiştir. Buna göre alanda tespit edilen etkinlik alanları, donatılar ve bitkisel elemanlar şu şekildedir; giriş kapısı, otopark alanı (araç, bisiklet), yollar (yaya, araç, bisiklet, koşu/yürüyüş), kaykay pisti, spor sahaları/seyir basamakları, mimari satış birimleri, WC, kafe, restoran, plaj, soyunma/giyinme kabini, duş, plaj voleybolu sahası, sergi alanı, fiskiyeli havuz, geleneksel konut örneği, piknik alanları, oturma bankları, çöp kovaları, korkuluklar, duvarlar, aydınlatmalar, ağaçlar, çalılar ve yerörtücülerdir. Ankette ise, kullanıcılara parkın yapısal ve bitkisel peyzaj elemanlarından (peyzajı) duydukları memnuniyet sorgulanırken aynı zamanda parkın konumu (kıyıda olması, ana yola yakın olması, merkezi konumda olması...vb.), ulaşılabilirliği (yaya ve araç ulaşımı, parkı, altgeçit, üstgeçit), park içi erişilebilirliği (yaya yolları, bisiklet yolları, mekanlar arası erişimler) ve tasarımı (tüm bu özellikler) da sorgulanmıştır. Anketlerin sonuçlarına göre tüm bu özellikler bakımından bir sıralama yapılacak olursa kullanıcıların en yüksek düzeyde memnun oldukları özellik parkın konumu (4,35), daha sonra tasarımı (4,22), daha sonra mekanlar arası erişim (4,12), sonra peyzaj özellikleri ve en son olarak da ulaşımıdır (3,38) çıkmıştır.

Anahtar kelimeler: Kıyı Parkı, Çevresel Memnuniyet, Fındıklı, Rize.

INTRODUCTION

Waterfronts have always been preferred because of the opportunities offered by people from past to present. People who made their settlements near the waters in the early ages, nowadays they continue to use these areas by making many activity areas such as economic, commercial, recreational and transportation. At the end of the first twenty-year development period following the 1970s, the shores became the focus of economic power and the attraction power increased. On the other hand, the understanding that shores should be urban open spaces has strengthened. On the contrary, important problems that directly affect open spaces such as the transformation of the shores into private investment areas, the weakening of the spatial relations between the city and water elements, the loss of the original shore identity, and the weak public transportation and pedestrian connections have been encountered (Seçmen, 2019). In the Fındıklı district of Rize, which was chosen as the study area, the shore part was used for both settlement, transportation, and recreational purposes due to its geographical features. Carr et al. (1992) have claimed that shores which were urban barriers of the past, nowadays being attractive environments that offer recreational usage opportunities. Developed in spaces along the developing waterfront, it became the shore walkway, an urban pedestrian backbone that distributes shore to other areas of the it, and perhaps the only linear open spaces of the city. Beaches, swimming areas, fishing areas, recreational areas where water sports are done have tried to create unique coastal attraction areas. Consequently, the relationship between the social, economic, cultural, and spatial dynamics of the city, which has a wide variety of functionality nowadays, is also multifaceted. Based on the analysis of hundreds of urban open spaces in the world in titled Project for Public Spaces, it has been stated that four basic principles are needed for a high-quality urban environment (URL-1, 2022). Accordingly, these four basic principles are: (1) Access and connections which provide suitable for use, visible and easy to move, (2) Use and activities that are vivid, unique and provide a reason to be there, (3) Safe, clean, green, identity and attractive an image and comfort, (4) it is socialization that supports neighbourhood, friendship, interaction, and diversity (Güder, 2019; Coşkun, 2008; Seçen, 2019; Polat, 2011). Environmental satisfaction varies between the environment and the user, according to the characteristics of the environment and the user. Environmental satisfaction levels are related to the level of satisfaction with the features of the environment by the users (Tarakci Eren, 2018; Kellekçi & Berköz, 2010; Gündoğdu et al., 2019). Therefore, the expectations, needs and preferences of each user from the environment and their satisfaction levels are different. The place described as the environment here is Atatürk Park in the shore part of Fındıklı district of Rize province. In this research, it is aimed to determine the environmental satisfaction level of the users of Fındıklı Atatürk Park from the structural landscape elements and plants in the park, the access to the park, the location of the park, the access inner the park, its design, and the activity areas in the park.

MATERIAL and METHOD

Study Area

Atatürk Park chosen as the study area is a shore park in Fındıklı district of Rize Province (Figure 1) (URL-2, 2022).



Figure 1. Study area

Method

The study was conducted in two phases. In the first stage, the structural landscape elements and plants of the study area are determined by on-site studies, and in the second stage, the environmental satisfaction of the users is determined by a questionnaire.

RESULTS

Obtained data related to the first stage

At this stage, structural landscape elements and activity spaces in the park were determined. There is entrance, parking lot (car, bicycle), roads (pedestrian, car, bicycle, walking/running), picnic areas, playground, sports courts (basketball, beach volley), sports viewing steps, skateboarding track, beach, cafe, culture house, local sales units, street delicacies sales area, rock garden, viewing areas, exhibition area, sculptures, seating units, lighting elements in the park (Table 1).

Table 1. Structural landscape elements in the study area

				
Entrance gate	Car park	Bicycle rack	Walking/bicycle path	Street delicacies



Changing room



Shower



Railing



Wall



Beach



Car park



Traditional house



Local sales unit



Local sales unit



Restaurant/cafe



Seating unit type 1



Seating unit type 2



Seating unit type 3



Seating unit type 4



Seating unit type 5



Sculpture 1



Sculpture 2



Playground



Toilet



Skateboard track



Picnic area type 1



Exhibition walls



Basketball court



Picnic area type 2



Dustbin



Lighting unit Fountain pool Flowerpot Rock garden Culture house

Plants in the study area were determined in 3 categories as trees, shrubs, and groundcovers. Results showed that it was determined that there were 22 different tree taxa (Table 2) and 12 different shrubs and groundcovers taxa (Table 3).

Table 2. Trees in the study area



Betula pendula *Tilia platyphllos* *Cupressocyparis leylandii* *Salix babylonica*



Cedrus libani *Acer platanooides* *Laurocerasus officinalis* *Prunus ceracifera*
'Atropurpurea'



Cydonia oblonga *Gingko biloba* *Cercis siliquastrum* *Melia azederach*



Abies sp.



Platycladus orientalis



Pinus pinea



Cedrus libani



Juniperus virginiana



Callistemon citrinus



Robinia Pseudoacacia



Acer platanoides 'Crimson King'



Platanus orientalis



Cotinus coggyria

Table 3. Shrubs and groundcovers in the study area



Juniperus horizontalis



Rosmanirinus officinalis



Berberis thunbergii 'Atropurpurea'



Buxus sempervirens



Rosa sp.



Euonymus japonica
'Aureus'



Camelia japonica



Viburnum lucidum



Corylus sp.



Yucca sp.



Spirea x bumalda



Santolina sp.

Obtained data related to the second stage

At this stage of the research, it was tried to determine the environmental satisfaction levels of the park users from the structural landscape elements and plants in Fındıklı Atatürk Park. For this purpose, a questionnaire was conducted with 130 people consisting of park users. In the questionnaire, while the satisfaction of the users with the structural landscape elements and plants of the park is questioned, the location of the park (being on the coast, being close to the main road, being in a central location, etc.), accessibility (pedestrian and vehicle transportation, park, underpass, overpass), park inner accessibility (pedestrian paths, bicycle paths, access between spaces) and design (all these features) of the park were also questioned. The participants were asked to evaluate the questions of first stage on a Likert scale. The assessment of the questions was as conducted using a 5-point Likert scale ranging from 1= "exactly not satisfied" to 5= "exactly satisfied". The gap width of the scale was calculated with the formula ($a = \text{array width} / \text{number of groups}$), options and limits are given in table 4.

Table 4. Limits in the evaluation of the data of the measurement tool

Weight	Options	Limits
1	Exactly not satisfied	1-1,79
2	Not satisfied	1,80-2,59
3	Partially satisfied	2,60-3,39
4	Satisfied	3,40-4,19
5	Exactly satisfied	4,20-5.00

Firstly, to determine whether the questionnaire data showed a normal distribution, central tendency measures and normality were checked. According to this, it can be said that the data are normal because of taking close values by looking at the values of the mean, median, and mode (Table 5).

Table 5. Analysis of data normality

Statistics		Design	Transportatio	Access	Landscape	Location
		n				
N	Valid	130	130	130	130	130
	Missing	1	1	1	1	1
Mean		4,22	3,38	4,12	3,97	4,35
Median		4,00	4,00	4,00	4,00	4,00
Mode		5	4	4	4	4
Skewness		-,912	-,381	-1,192	-1,049	-,691
Std. Error	of	,212	,212	,212	,212	,212
Skewness						
Kurtosis		,682	-,834	1,833	1,701	,209
Std. Error	of	,422	,422	,422	,422	,422
Kurtosis						

When users asked are they satisfied with the design features of the park, the arithmetic mean of the answers is 4.22. In other words, users stated that they were absolutely satisfied with the design features of the park (5). The answer given by the users to the question about the accessibility of the park is 3.38. In other words, users stated that they are partially satisfied with the transportation of the park (3). The value determined according to the user's evaluation of the accessibility within the park is 4.12. In other words, they stated that they were satisfied with the access feature (4). The level of satisfaction with the structural landscape elements and plants (4) was satisfied. Finally, users evaluated the question about the location of the park, the arithmetic mean of the answers is 4.35. In other words, they stated that they were absolutely satisfied with the location of the park (5). If a ranking is made in terms of all these features, the feature that the users are most satisfied with is the location of the park, followed by its design, the access between the spaces, the landscape features and finally the transportation of the park (Table 6).

Table 6. Characteristics of environmental satisfaction and their values

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Design	130	4,22	,835	,073
Transportation	130	3,38	1,241	,109
Access	130	4,12	,903	,079
Landscape	130	3,97	,880	,077
Location	130	4,35	,657	,058

Simple bivariate correlations were used to determine whether there is a significant relationship between the variables that we determined the level of environmental satisfaction. It was determined that there was only a positive significant relationship ($r=0.17$, $p<0.05$) between landscape and design, among the dependent variables. When we look the correlation coefficients, there is no multicollinearity between the data as the coefficients are below 0.9 (Table 7).

Table 7. Correlation Analysis

Correlations		Design	Transportatio n	Access	Landscape	Location
Design	Pearson	1	-,079	-,136	,178*	-,027
	Correlatio n					
	Sig. (2- tailed)		,372	,123	,043	,761
	N	130	130	130	130	130
Transportatio n	Pearson	-,079	1	,030	-,082	,168
	Correlatio n					
	Sig. (2- tailed)	,372		,734	,356	,056
	N	130	130	130	130	130
Access	Pearson	-,136	,030	1	,063	,022
	Correlatio n					
	Sig. (2- tailed)	,123	,734		,476	,803
	N	130	130	130	130	130
Landscape	Pearson	,178*	-,082	,063	1	,153
	Correlatio n					
	Sig. (2- tailed)	,043	,356	,476		,082
	N	130	130	130	130	130
Location	Pearson	-,027	,168	,022	,153	1
	Correlatio n					
	Sig. (2- tailed)	,761	,056	,803	,082	
	N	130	130	130	130	130

*. Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION and CONCLUSION

Yeşil and Beyli (2018) examined 5 km shore parks of Ordu in their study and evaluated the equipment elements in the parks in terms of landscape design criteria (ergonomics, aesthetics, functionality, suitability for climate, durability, night use). Suitability levels for ergonomic standards were determined in terms of the dimensions and scales of the equipment elements in the study area. In line with the

obtained data, suggestions were proposed about how to eliminate the negativities seen in the parks and what the necessary applications could be done. While emphasizing that the shore parks of the Ordu, chosen as the study area, are important recreation areas of the city, they claimed that they contribute significantly to the aesthetics of the city with their structural and plant materials. In this respect, they stated that the urban furniture in the shore parks, which are the attractor for both city residents and visitors, undertake important functions in terms of aesthetically and functionally. It has been stated that it also offers diversity in addition to the use of compatible equipment in terms of materials (Yeşil and Beyli, 2018). Similar results were found in Rize Fındıklı Atatürk Park. The determined structural and plant elements are quite diverse and meet the needs and expectations of the users. It has been seen that there are seating elements in five different models, pergolas in 3 different models, dustbins in 3 different models, floor coverings consist of different materials and are compatible with the area, varied sports courts (football, basketball, beach volley, swimming, etc.), three different areas for eating needs (restaurant, cafe, and street delicacies) in the park. Plants are well-maintained and sufficient in terms of species diversity. The plants are usually in the form of saplings cause of the park is still very new.

Çorbacı (2020) examined the Adana Yüreğir Coastal Park Project, which is in Yüreğir district of Adana province designed on side of Seyhan river and evaluated the function of this project in Adana's urban green space system. In the evaluations, he paid attention to criteria such as activity, functions, used materials, aesthetic design principles, comfort, image, safety, and maintenance. According to evaluations, he stated that Adana Coastal Park Project has a coastal walking path and a colourful activity path that connects them all, and that it creates a design integrity. In the project, it was determined that different focal points were created on an active walking path and a functional and colourful activity axis by the Seyhan river. It has been stated that this coastal park has a unifying and socializing character, contains various units that will serve all ages and cultures, and allows people to stand out on the water and benefit from platforms for viewing or fishing. Other activity areas are picnic areas, easy access, open-air cafes, and restaurants for the disabled and the elderly, playgrounds, activity parks, ziplines, and water parks (Çorbacı, 2020). As in all coastal projects, the water element that exists in all open green areas designed on the riverbank, seashore or lake shore must be incorporated in the design and appropriate solutions must be done. Water has been seen as a source of life from past to present. Therefore, it is necessary to benefit from these resources for all purposes, whether functional or aesthetical. It has been tried to benefit from the sea as much as possible in Rize Fındıklı Atatürk Park. Sea and shore are also used for activities such as fishing, viewing, swimming, sunbathing, walking, sitting, eating, and drinking etc. in this area.

Bekçi et al. (2019) discussed the user demands and satisfaction levels in the existing recreational areas on the coastline of Rize centre and questioned the user satisfaction and demands of users by questionnaire in their study titled Determination of User Satisfaction of Rize Urban Coast Line. According to the results of the study, when the characteristics of the recreational areas are taken into consideration, it was determined that they preferred to do sports with 38% in the activity and usage criteria, to walk with 78% in the accessibility criteria, to take fresh air with 42% in the comfort and image criteria, and to realise activities with their family or friend groups with 42% in the sociability criteria. In our study, it was concluded that the users were satisfied with their environment in the context of the variables questioned. In particular, the location of the park (being the shore park) has been evaluated as a factor that increases the environmental satisfaction of users of this park. The satisfaction from the park design and the structural landscape elements and plants in it was also higher than the other variables. Environmental

satisfaction is at a partial level in the evaluation of users only in terms of transportation variable. The reason for this is two underpasses and one overpass used for transportation to the area are insufficient and unsuitable. Disabled and elderly ramps slopes are not suitable. Its lighting and security are not sufficient for night use.

REFERENCES

- Yeşil, M. & Beyli, K. N. (2018). Ordu Kenti Kıyı Parkları Donatı Elemanlarının Ergonomi Açısından İncelenmesi. *Ordu Üniversitesi Bilim ve Teknoloji Dergisi*, 8 (2), 215-229. Retrieved from <https://dergipark.org.tr/en/pub/ordubtd/issue/42031/506005>
- Çorbacı, Ö. L. (2020). Adana Yüreğir Kıyı Park Tasarımı ve Kentsel Rekreasyon Planlamasındaki Rolü. *Bartın Orman Fakültesi Dergisi*, 22(3), 717-725.
- Seçmen, S. (2019). Kentsel kıyı alanlarının mekânsal özelliklerine yönelik bir model önerisi: İstanbul örneği.
- Carr, S., Stephen, C., Francis, M., Rivlin, L. G., & Stone, A. M. (1992). *Public space*. Cambridge University Press.
- Eren, E. T. (2018). *Huzurevi Bahçelerindeki Çevresel Memnuniyet Düzeylerinin ve Çevresel Tercihlerinin Belirlenmesi Üzerine Bir Araştırma. KTÜ Fen Bilimleri Enstitüsü Peyzaj Mimarlığı Anabilim Dalı* (Doctoral dissertation, Doktora Tezi).
- Güder, S. E. (2019). *Kıyı alanlarında kentsel mekân kalitesinin iyileştirilmesine yönelik bir araç olarak kentsel tasarım rehberleri: Silifke-Taşucu örneği* (Master's thesis, Lisansüstü Eğitim Enstitüsü).
- Coşkun, T. D. (2008). *Kent estetiği oluşumunda yer oluşturma ilkelerinin Koblenz/İzmir kentleri bağlamında karşılaştırmalı olarak irdelenmesi* (Doctoral dissertation, DEÜ Fen Bilimleri Enstitüsü).
- Polat, S. (2011). *Kamusal dış mekanlarda mimari kimliği değerlendirmek için bir yöntem önerisi: Bursa-Cumhuriyet alanı örneği*. Bursa Uludağ University (Turkey).
- Kelleççi, Ö. L., & Berköz, L. (2010). Konut ve çevresel kalite memnuniyetini yükselten faktörler. *İTÜDERGİSİ/a*, 5(2).
- GÜNDOĞDU, M., Kuru, A., Özkök, M. K., YELER, G., & Erşan, Ş. (2019). Yapılı Çevre Özellikleri ve Konut-Konut Çevresi Kullanıcı Memnuniyeti Etkileşimi: Kırklareli Merkez Örneği. *MEGARON*, 14(4).
- URL-1 (2022). <http://mimdap.org/2008/07/project-for-public-spaces-pps/8487/>
- URL-2 (2022). <https://earth.google.com/web/search/>

FABRICATION OF ECO-FRIENDLY BLENDED YARNS FOR CLOTHING

Munevver Ertek Avcı

Department of Textile, Clothing, Footwear, and Leather, Yeşilyurt Vocational School, Malatya Turgut Ozal University, Malatya, Turkey.
ORCID: 0000-0002-7360-7407

Gamze Okyay

Department of Fashion Design, Yeşilyurt Vocational School, Malatya Turgut Ozal University, Malatya, Turkey.
ORCID: 0000-0003-1312-3897

Hilal Bilgiç

Department of Textile, Clothing, Footwear, and Leather, Yeşilyurt Vocational School, Malatya Turgut Ozal University, Malatya, Turkey.
ORCID: 0000-0002-5195-9890

ABSTRACT

The clothing industry, where technological and financial issues have been the main driving force until recently, has now had to shift its focus to ecological and sustainable products due to increasing environmental problems and health awareness. Therefore, the clothing industry should develop initiatives to motivate its stakeholders to use eco-friendly business methods in the fashion industry. Blending is one of the approaches for creating innovative combinations in a variety of ways. Blends minimize the drawbacks of each component and combine their favorable characteristics. In this study, it was tried to create more ecologically friendly yarns using blending technology in place of yarns made from conventional cotton fibers, which are well known as the "Queen of the fiber plants" and almost cover 40% of the garment market worldwide but are also known to have a negative impact on the environment owing to the excessive use of fertilizers, pesticides, and natural resources during cultivation and processing. To achieve this, an open-end rotor spinning machine was used to create organic cotton-bamboo-flax and organic cotton-bamboo-hemp blended yarns as well as reference yarn. The properties of these yarns such as unevenness, tenacity, and breaking elongation were comparatively examined using statistical analysis methods. The statistical analysis results show that the type of sheath fiber significantly affected all yarn properties. Additionally, compared to the reference yarn, the blended yarns' unevenness and strength properties got worse slightly, while their elongation characteristics were enhanced. As a result, the characteristics of the generated blended yarns are almost identical to those of conventional cotton yarns, and they can be used in place of these yarns in the fabrication of garments.

Keywords: Eco-friendly, organic cotton, bamboo, flax, hemp, blended yarn.

1. Introduction

Up until recently, technological, and financial concerns have been the main drivers of progress in the textile and apparel industries (Niinimäki & Hassi, 2011). However, the apparel industry has now had to turn its focus to the concept of sustainability, due to growing knowledge of human health and

environmental pollution in the clothing sector, as well as of regulatory obligations, demands on natural resources, and ecological effects (Hansen & Schaltegger, 2016). Clothing companies should therefore create programs to encourage their stakeholders to engage in eco-friendly fashion business practices (Abreu, 2015).

Cotton, which is well known as the “Queen of the fiber plants”, is a natural fiber that is mostly used in the textile and clothing industry and almost covers 50% of the textile market worldwide. Cotton production is a global industry in more than 80 countries, accounting for 2.5% of all cultivated land (Rashid et al., 2016). On the other hand, the usage of chemical fertilizers and pesticides, as well as the impact on land use and water footprint, make conventional cotton production one of the most difficult problems in the garment sector (Novaković et al., 2020; Garcia et al., 2019; Bevilacqua et al., 2014). Additionally, Dai et al. (2017) showed through their research that global warming will have a negative impact on the length of cotton fiber, which would result in less cotton being produced. For all these reasons, there is a need for an alternative natural cellulosic fiber to be used as an alternative to conventional cotton in the clothing industry, which not only provides consumers with high comfort properties but also improves sustainability (Novaković et al., 2020). Flax and hemp are two cellulosic-based fibers underlined in this study. When compared to conventional cotton, these fibers have substantially lower environmental impacts because they require nearly no pesticides and only a little amount of fertilizer (Van der Werf, 2004) and have much greater productivity levels per unit of land (Cherrett et al. 2005). Indeed, a life-cycle assessment revealed that organically grown flax and hemp are more environmentally safe than cotton. However, flax and hemp fiber are very much constrained regarding their diffusion in the clothing industry because these fibers have problems in spinning due to their low flexibility properties (Hansen & Schaltegger, 2016; Liu et al., 2012). Therefore, the blend ratio of these fibers in the yarns fabricated was determined as 20%, and organic cotton-bamboo-flax/hemp fiber blends were selected in this study. Considering the above-mentioned problems, eco-friendly blended yarns based on cellulose were developed in this study, and their properties were examined by statistical analysis methods.

2. Materials and Methods

In this study, conventional cotton (CCT, length: 29.28mm, fineness: 0.18tex, strength: 31.00 cN/tex, elongation: 5.30%, Şanlıurfa province, Turkey), organic cotton (OCT, length: 30.00 mm, fineness: 0.18tex, strength: 32.00cN/tex, elongation: 5.10%, Akkucak Tekstil San. Tic. Ltd. Şti., Turkey), bamboo (BM, length: 38.00mm, fineness: 0.12tex, strength: 25.90cN/tex and elongation: 11.60%, TENBRO, China), flax (FX, length: 33.00mm, fineness: 0.33tex, strength: 89.01cN/tex and elongation: 2.80%, Leon VanDeCastele, Belgium), and hemp fibers (HP, cottonized hemp, length: 33.00mm, fineness: 0.39tex, strength: 45.00cN/tex, elongation: 2.60%, La Chanvrière, France) as sheath fibers were used in the generation of blended yarns. Besides conventional cotton yarn, blended yarns were generated with Ne 18/1 yarn linear density, on the open-end rotor spinning machine (Table 1). The experimental study data were then entered into the IBM® SPSS 26 statistical package software by using a one-way analysis of variance (ANOVA). The significance of the sheath fiber type was analyzed at a 95% confidence interval (CI).

Table 1. Notation and composition of the blended yarns

(CCT: Conventional cotton, OCT: Organic cotton, BM: Bamboo, FX: Flax, and HP: Hemp)

Notation	Sheath fiber type
CCT	100% Conventional cotton
OCTBMFX	47% Organic cotton, 33% Bamboo, and 20% Flax
OCTBMHP	47% Organic cotton, 33% Bamboo, and 20% Hemp

3. Results and Discussion

In this section, the unevenness, tenacity, and breaking elongation properties of blended yarns were examined.

Yarn Unevenness (CV_m%)

The results of the unevenness of the yarns produced are given in Figure 1. According to the ANOVA results, sheath fiber type was statistically significant ($p=0.00$) on the unevenness values of the yarns. When looking at the yarn unevenness values, it was found that CCT sheath fiber yarn had the lowest unevenness value. The fact that slightly higher unevenness values were observed in yarns containing flax and hemp fiber might be due to the low fiber-to-fiber cohesion of these fibers.

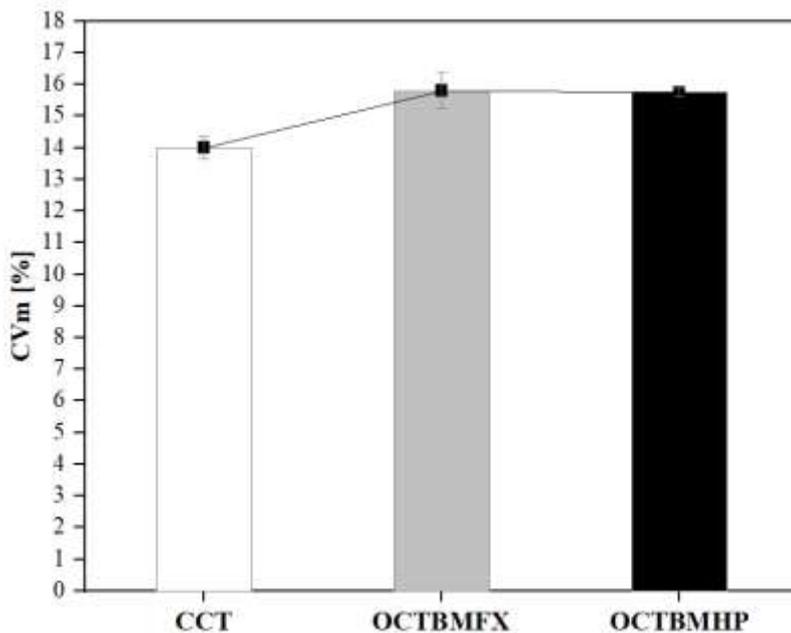


Figure 1. Unevenness findings of reference yarn and blended yarns.

Yarn Tenacity

The tenacity findings of the yarns produced are shown in Figure 2. When the tenacity values of the blended yarns were evaluated statistically, the ANOVA findings revealed that sheath fiber type ($p=0.002$) had a statistically significant effect on the yarn tenacity values. The blended yarns' tenacity values were quite close to each other (OCBMFX: 9.902 ± 0.38 and OCBMHP: 9.602 ± 0.64) and slightly lower than the reference yarn, which had the maximum tenacity value (CCT: 10.998 ± 0.46). This might be a result of the 33% presence of bamboo fiber in the yarn structure, which has a lower tenacity value than

conventional cotton fiber.

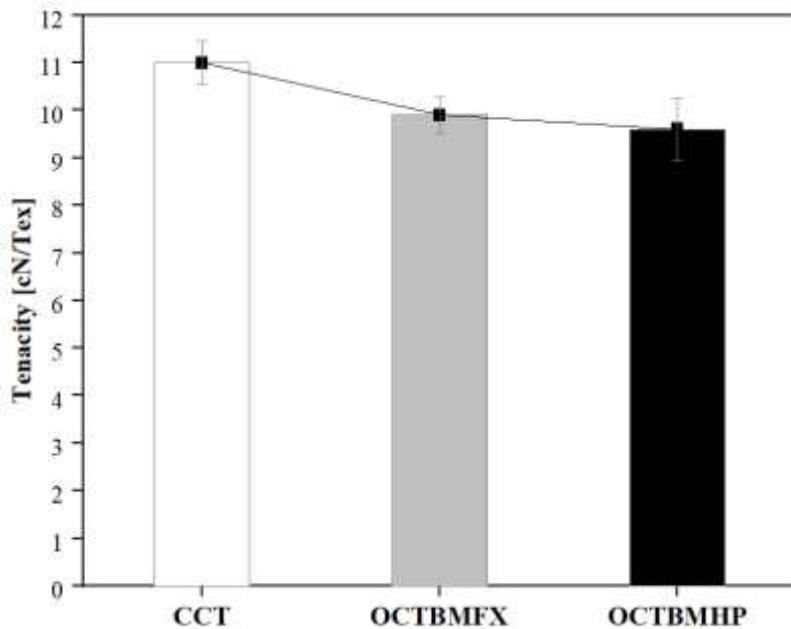


Figure 2. Tenacity findings of reference yarn and blended yarns.

Yarn Breaking Elongation

In figure 3, the breaking elongation values of the yarns produced are displayed. Sheath fiber type ($p=0.000$) exhibited statistically significant effects on yarn-breaking elongation values, according to the ANOVA results. The highest breaking elongation values were observed in the blended yarns. Due to having good elongation properties of the bamboo fibers (11.6%) compared to other sheath fibers, hybrid yarns containing bamboo fibers had the highest elongation values, as expected, while hybrid yarns including CCT sheath fiber had the lowest elongation values.

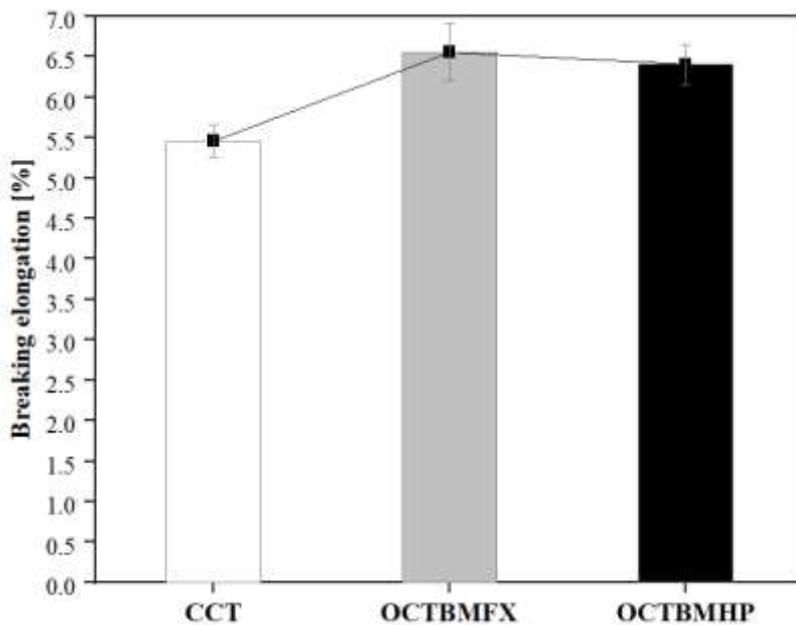


Figure 3. Breaking elongation findings of reference yarn and blended yarns.

4. Conclusion

To rectify the environmental and economic issues created by conventional cotton fiber, which is extensively used in garment manufacture, blended yarns were generated utilizing eco-friendly cellulose-based fibers. Sheath fiber type had a significant effect on yarn properties. Because flax and hemp fibers have low fiber-to-fiber friction, the unevenness values of yarns made from these fibers were higher than those of conventional cotton fiber. While using 33% bamboo fiber in the yarn structure increased the yarn break elongation values, it decreased the yarn strength value slightly. As a result, the features of the developed blended yarns are nearly identical to those of conventional cotton yarns, and they can be employed in the manufacturing of garments in place of these yarns.

Acknowledgments

The authors appreciate the contributions of Çalık Denim, Malatya, Turkey, who carried out yarn production and analysis.

References

- Abreu, M. C. S. D. (2015). Perspectives, drivers, and a roadmap for corporate social responsibility in the textile and clothing industry. In *Roadmap to sustainable textiles and clothing* (pp. 1-21). Springer, Singapore.
- Barrett, J., Chadwick, M., & Chadwick, M. (2010). Ecological footprint and water analysis of cotton, hemp, and polyester.
- Bevilacqua, M., Ciarapica, F. E., Mazzuto, G., & Paciarotti, C. (2014). Environmental analysis of a cotton yarn supply chain. *Journal of Cleaner Production*, 82, 154-165.
- Dai, Y., Yang, J., Hu, W., Zahoor, R., Chen, B., Zhao, W., ... & Zhou, Z. (2017). Simulative global warming negatively affects cotton fiber length by shortening fiber rapid elongation duration. *Scientific reports*, 7(1), 1-13.
- Garcia, S., Cordeiro, A., de Alencar Nääs, I., & Neto, P. L. D. O. C. (2019). The sustainability awareness of Brazilian consumers of cotton clothing. *Journal of cleaner production*, 215, 1490-1502.
- Hansen, E. G., & Schaltegger, S. (2016). Mainstreaming of sustainable cotton in the German clothing industry. In *Sustainable Fibres for the fashion industry* (pp. 39-58). Springer, Singapore.
- Liu, S., Dai, J., Jia, H., Liu, X., & Xu, B. (2012). Effect of sirospun spinning with a press bar top pin on qualities of flax/cotton blended yarn. *Textile Research Journal*, 82(10), 985-993.
- Niinimäki, K., & Hassi, L. (2011). Emerging design strategies in sustainable production and consumption of textiles and clothing. *Journal of cleaner production*, 19(16), 1876-1883.
- Novaković, M., Popović, D. M., Mladenović, N., Poparić, G. B., & Stanković, S. B. (2020). Development of comfortable and eco-friendly cellulose-based textiles with improved sustainability. *Journal of Cleaner Production*, 267, 122154.
- Rashid, B., Yousaf, I., Rasheed, Z., Ali, Q., Javed, F., & Husnain, T. (2016). Roadmap to sustainable cotton production. *Life Sci. J*, 13(11), 41-48.
- Van der Werf, H. M. (2004). Life cycle analysis of field production of flax hemp, the effect of production practices on environmental impacts. *Euphytica*, 140(1), 13-23.

CONTAMINATION OF PUBLIC PLACES AT CENTRAL BELGRADE MUNICIPALITIES WITH DOGS PARASITES DURING 2021

Ivan Pavlović

Scientific Institute of Veterinary Medicine of Serbia, Belgrade, Serbia

ABSTRACT

Green areas and parks are the main place where children play and are resting places for city people and places where dog owners walk pets, which pollute these areas with their excrement. Dog excrement present an epidemiological danger, considering that dogs are true hosts of a large number of zoonotic parasites species. From these reason, since 1993, we monitor the parasitic contamination of green areas and parks of Belgrade where dogs most often walk. Here we present the results of the parasitological examination of soil at those places during 2021. A total of 74 samples were examined by a conventional flotation method and parasite eggs or oocysts were differentiated according to their morphologic characteristics. Parasites contamination were found in 39.06% samples and polyparasitism in 54.61%. *Toxocara canis* eggs were found in 29.68%, *Ancylostomidae* spp. in 27.18%, *Dipylidium caninum* 26.56%, *Strongyloides stercoralis* 7.81%, *Toxascaris leonina* in 6.97%, *Taenia* -type eggs in 6.25% and *Trichuris vulpis* in 4.68% samples. *Giardia duodenalis* were established in 15.62% , *Amoeba* sp. in 11,06%, *Isospora* spp. in 9.36% and *Cryptosporidium* spp. in 3.37% samples. If we make comparisons with earlier research in the Belgrade area (from 2016 to 2020), it can be seen that the percentage of contamination in a slight decline as in the past five years, when it amounted to 41.37%.. These comparisons are possible because every year (since 1993) the same number of soil samples are examined from the same locations and in the same time period, using the same test methods. Research results are published periodically, so that they are available for wider analysis. The conclusion is that the obtained results are within the global scope of the prevalence of parasitic species found at public places and that they are a global epidemiological problem. These researches will be continue in the future.

Keywords: dogs, helminths, protozoa, epidemiology, urban environment

A META-ANALYSIS ON ANTIDOTAL EFFECTS OF DIPHENHYDRAMINE AGAINST ORGANOPHOSPHATE AND CARBAMATE INSECTICIDES POISONING IN LABORATORY ANIMALS

Fouad K. Mohammad

Department of Physiology, Biochemistry and Pharmacology,
College of Veterinary Medicine, University of Mosul, Iraq

Ammar A. Mohammed

Department of Pharmacology, College of Pharmacy, University of Duhok,
Duhok, Kurdistan Region, Iraq

Hussein M. Rashid

Department of Pharmacology, College of Pharmacy,
University of Duhok, Duhok, Kurdistan Region, Iraq

Hishyar M. S. Garmavy

Department of Pharmacology, College of Pharmacy,
University of Duhok, Duhok, Kurdistan Region, Iraq

ABSTRACT

The antimuscarinic action of the H₁-antihistamine diphenhydramine is useful for the treatment of poisoning induced by organophosphate and carbamate insecticides in man and experimental animals. The purpose of the present meta-analysis was to identify studies that demonstrate antidotal effects of diphenhydramine against the acute toxicity of organophosphate and carbamate insecticides in mice, rats and chicks. We used PRISMA and meta-analysis on the indices of acute poisoning (death, signs of poisoning and toxicity score) of organophosphate or carbamate insecticides in laboratory animals. The studies were identified after data search, and then they were included in the meta-analysis. Two-group random effects meta-analysis was conducted using software tools available online. Open-Meta Analyst was used to obtain the forest plot and effect size of the relative risk with the heterogeneity test and leave-one-group assessment. Meta-Essentials Version 1.5 was used to assess the publication bias by the funnel plot that included effect size and standard error, with a statistical analysis by the Egger's test, followed by the trim-and-fill analysis for missing points. Studies selected for meta-analysis were 13, which comprised 16 reports on the effects of diphenhydramine on toxicity indices of the insecticides. Diphenhydramine significantly reduced the relative risks of organophosphate and carbamate insecticides, which were (including their 95% confidence intervals): 0.375 (0.261, 0.54) for the animal death, 0.399 (0.283, 0.563) for signs of poisoning and 0.466 (0.363, 0.597) for the toxicity score. The % weight of the reports varied between 1.713% to 20.245% for the death analysis, 1.612% to 23.062% for signs of poisoning and 4.566% to 13% for the toxicity score in the laboratory animals. The leave-one-group assessment of the reports indicated that the effect size was not affected, as the values were close to the original one. A significant heterogeneity was found on data of the toxicity score, but not on the death and signs of poisoning. Publication bias was identified by the funnel plot, and the trim-and-fill assessment identified the missing points. In conclusion, the present review and meta-analysis showed that

diphenhydramine characteristically possesses effects against poisoning induced by the cholinesterase inhibiting insecticides with a reduction of their relative risks within the toxicity indices. Diphenhydramine could be an additional antidote against these insecticides, next to the standard one atropine.

Keywords: Antihistamine, Acetylcholinesterase, Insecticide, Antidote, Organophosphate, Carbamate, Toxicity

POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SMOKED FISH AND HUMAN HEALTH RISK ASSESSMENT

Kujtim Uka

Kosovo Food and Veterinary Agency, Kosovo Food and Veterinary Laboratory, “Lidhja e Pejës” 241,
Prishtina, Kosovo

Dijana Blazhekovikj - Dimovska

University “St. Kliment Ohridski”, Faculty of Biotechnical Sciences, “Partizanska” b.b., Bitola, N.
Macedonia, <https://orcid.org/0000-0001-5912-9093>

Mentor Ismaili

University “Hasan Prishtina”, Faculty of Medicine, Prishtina, Kosovo

Vlora Zogejani

Kosovo Food and Veterinary Agency, Kosovo Food and Veterinary Laboratory, “Lidhja e Pejës” 241,
Prishtina, Kosovo

Ariana Kadriu

Kosovo Food and Veterinary Agency, Kosovo Food and Veterinary Laboratory, “Lidhja e Pejës” 241,
Prishtina, Kosovo

ABSTRACT

Polycyclic aromatic hydrocarbons (PAHs) are associated with risks to human health, especially carcinogenesis. One form of exposure to these compounds is through ingestion of smoked fish, which can occur during fish processing, involving high temperatures. Smoking is one of the oldest methods of fish preservation since smoke contains bactericidal and antioxidant properties. Depending on the smoking method, the amount of carcinogenic compounds in smoke varies. Several PAHs compounds represent carcinogenic, especially for smoked fish. The EU Scientific Committee on Food (SCF) has identified 15 PAHs compounds as carcinogenic genotoxic i.e. Benzo[a]anthracene, Benzo[b]fluoranthene, Benzo(j)fluoranthene, Benzo[k]fl fluoranthene, Benzo(a)pyrene, Benzo(ghi) perylene, Chrysene, Cyclopenta[cd]pyrene, Dibenz[a,h]anthracene, Dibenzo[a,e]pyrene Dibenzo[a,l]pyrene, Dibenzo[a,i]pyrene, Indeno[1,2,3-cd]pyrene, and 5-Methylchrysene. This research aimed to determine the content of polycyclic aromatic hydrocarbons (PAHs) in five species of smoked fish, namely brown trout (*Salmo trutta*), tuna (*Thunnus albacares*), mackerel (*Scomber scombrus*), Atlantic salmon (*Salmo salar*) and mullet (*Mugil cephalus*), obtained from markets of different countries. The levels of these compounds in smoked fish have been determined by a GC/MS technique. The content of all identified compounds, in each fish species, was below the permissible limits following European regulations for the maximum permitted amount of polycyclic aromatic hydrocarbons in smoked products.

Keywords: smoked fish, polycyclic aromatic hydrocarbons, risk assessment

Introduction

According to [1], more than 100 polycyclic aromatic hydrocarbons (PAHs) have been characterized, sixteen of which were classified as priority pollutants because of their toxicity. [2] considered that PAHs have been reported to be highly mutagenic and carcinogenic in humans. One form of exposure to these compounds is through ingestion of smoked fish, which can occur during fish processing, involving high temperatures. Several PAHs compounds represent carcinogenic, especially for smoked fish. Smoking is one of the oldest methods of fish preservation since smoke contains bactericidal and antioxidant properties. Depending on the smoking method, the amount of carcinogenic compounds in smoke varies. [3] concluded that serious public health concerns could occur if PAHs residues present in smoked fish are above-recommended levels.

MATERIALS AND METHODS

This research aimed to develop an analytical method for the determination of PAHs in samples of smoked fish. The method was proved using PAH standard Calibration MIX 1x1 ml, 10ug / ml - Acetonitrile.

Materials

Samples of five species of smoked fish obtained from markets of different countries, namely brown trout (*Salmo trutta*) from Kosovo, tuna (*Thunnus albacares*) from Italy, mackerel (*Scomber scombrus*) from Great Britain, Atlantic salmon (*Salmo salar*) from Italy and mullet (*Mugil cephalus*) from Greece, were used for this research.



Fig.1. Smoked fish samples

Extraction of PAHs was carried out based on the method described by [4]. For this purpose, the following reagent and standards were used: Acetonitrile, water deionized, magnesium sulfate, sodium chloride 400 mg, C18 400 mg, Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Anthracene, Phenanthrene, Dimethyl, Fluoranthene, Pyrenees, Benzo (a) anthracene, Chrysene, Benzo (b) fluoranthene, Benzo (k) fluoranthene, Benzo (e) pyrene, Indeno (1,2,3-cd) pyrene and Benzo (g, h, i) perylene.



Fig.2. Sample during quenchers (5982-6555) (Extraction containing 6 g magnesium sulfate and 1.5 g sodium chloride)



Fig.3. Sample during purification with quenchers (5982-5158) (contains 400 mg PSA, 400 mg C18EC, and 1200 mg $MgSO_4$)

Methods

Below are the equipment and methods used for this research:

General laboratory equipment

- cups sized glass _ to MISCELLANEOUS
- tubes 50 ml
- tubes of 15 m
- Volumetric flasks with different sizes
- Balloons – different size

Measuring and testing equipment

- Electronic Scales s with weight and precision up to 0.01mg
- Centrifuge
- Mixer
- Vortex

Main devices measurement

- GCMS with MS detector
- Column per GCMS: DB-5

- GCMS - vials

Centrifuge tube 50 ml with cap.

Column chromatographic DB-23 (30 Detector spectrometer mass capable of recording and transitions of at least GC / MS and equipped with ESI interface.

- Centrifuge tube 15 ml with cap
- Glass tubes of 10 ml

Computerized system for GCMS, and chromatographic data calculation.

Chromatographic Method - Gas chromatography

The cleaned up extracts were analysed naphthalene, acenaphthylene, benzo[b]fluoranthene, phenanthrene, dibenzo[a,h]anthracene, chrysene, benzo[a]pyrene, acenaphthene, benzo[k]fluoranthene, fluorene, pyrene, benzo[a]anthracene, anthracene, fluoranthene, indeno[1,2,3-cd]pyrene, and benzo[g,h,i] anthracene, using Gas chromatography, programmed as follows:

Table.1. MS - Operating conditions for testing PAHs in smoked fish meat

Column	HP-5	30mX
Injector temperature	temperature 280°C	
Carrier gas	Helium	
Carrier gas flow	1.2 mL / min	
Split ratio	50:02:00	
Oven Program	60°C. 2.8 min 1°C	
	20 0°C / min 150°C 0 min	
	12 0°C / min 300°C 11.6 min	
Total run time:	29.6 min	
Injection Volume	2.0 ul	
Diluent	Acetonitrile	
MS Parameters:		
Ionization source	EI	
Electron energy	70 Ev	
MS Source	230°C	
MS Quad	150C	
SIM or SIR (Selective Ion Monitoring) Parameters:		
Solvent delay	5.0 min	

Samples Preparation: meat sample of smoked fish

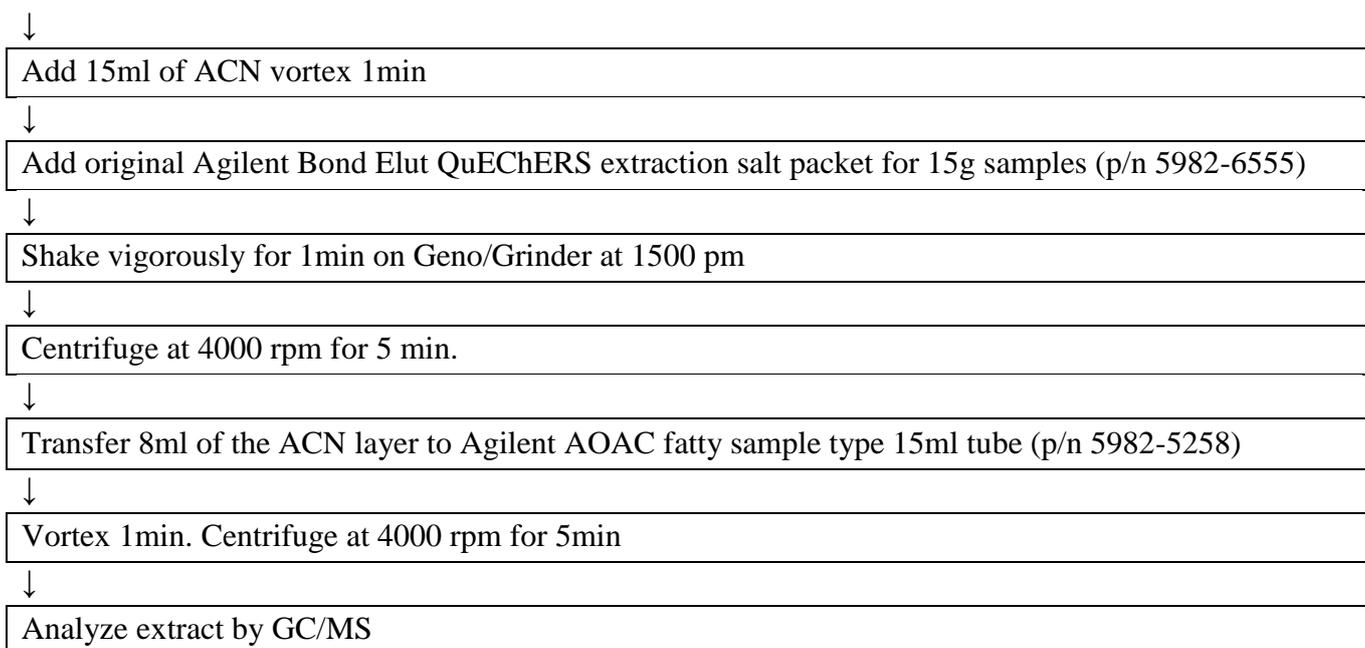
These are the steps for sample preparation:

Agilent Bond Elut QuEChERS Extraction Procedure for PAHs in Fish

Weigh a 3g sample ($\pm 0.05g$) in a 50 ml centrifuge tube
--

↓

Add 12ml of DI water and 2 ceramic bars to the sample



The samples have been tested within 24 hours from the moment of preparation.

5. RESULTS AND Discussion

Polycyclic Aromatic Hydrocarbons (PAHs) levels in five commonly consumed smoked fish species, namely, brown trout (*Salmo trutta*) from Kosovo, tuna (*Thunnus albacares*) from Italy, mackerel (*Scomber scombrus*) from Great Britain, Atlantic salmon (*Salmo salar*) from Italy and mullet (*Mugil cephalus*) from Greece were assessed to evaluate possible human health risks associated with consumption.

Testing is performed using the analytical method of Gas chromatograph with a detector with a spectrometer of mass (GC-MS). Methods are accurate in detecting PAH - in smoked fish meat. The calibration curve ranged from 10-1000 ng/ml.

Table 2. PAH compounds Calibration MIX 1x1 ml, 10 ug / ml – Acetonitrile

Compounds	MM g / mol	Tar get ion	Q1	Q 2	R T (m in)	Correla tion coefficie nt (R2)	Calibra tion Curve - range (ng / ml)	LO D (ng / ml)	LO Q (ng /ml)
NAPHTHAL ENE (C₁₀H₈)	128. 17	128	12 9	12 7	4.4 5	1	10-1000	8.0 9	24.5
ACENAPHT HYLENE (C₁₂H₈)	152. 2	152	15 1	15 3	6.3 5	0.99	10-1000	61. 54	186. 5
ACENAPHT HENE (C₁₂H₁₀)	154. 2	154	15 3	15 2	6.6	1	10-1000	24. 49	74.2 2

FLUORES (C ₁₃ H ₁₀)	166. 22	166	16 5	16 7	7.3 4	1	10-1000	31. 22	94.6 1
PHENANTH RENE (C ₁₄ H ₁₀)	178. 23	178	17 9	17 6	8.8 7	0.99	10-1000	46. 56	141. 08
ANTHRACE NE (C ₁₄ H ₁₀)	178. 23	178	17 9	17 6	8.9 5	0.99	10-1000	50. 14	151. 94
FLORANTH ENE (C ₁₆ H ₁₀)	202. 26	101	20 2	20 3	11. 02	0.99	10-1000	53. 47	162. 03
PYRENE (C ₁₆ H ₁₀)	202. 26	202	20 0	20 3	11. 4	0.99	10-1000	53. 1	160. 9
BENZO (A) ANTHRACE NE (C ₁₈ H ₁₂)	228. 29	228	22 9	22 6	13. 75	0.95	10-1000	107 .5	325. 9
CHRYSENE (C ₁₈ H ₁₂)	228. 29	228	22 6	22 9	13. 82	0.99	10-1000	44. 64	135. 28
BENZO (B) FLUORANT HENE (C ₂₀ H ₁₂)	252. 31	252	12 6	25 3	15. 71	0.97	10-1000	81. 59	247. 25
BENZO (K) FLUORANT HENE (C ₂₀ H ₁₂)	252. 32	123	25 2	25 3	15. 76	0.97	10-1000	80. 78	244. 78

Table 3. PAH compounds in smoked fish samples

Compound	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
1 NAPHTHALENE (C10H8)	n/d*	n/d	n/d	n/d	n/d	n/d
2 ACENAPHTHYLENE (C12H8)	n/d	n/d	n/d	n/d	n/d	n/d
3 ACENAPHTHENE (C12H10)	n/d	n/d	n/d	n/d	n/d	n/d
4 FLUORENE (C13H10)	n/d	n/d	n/d	n/d	n/d	n/d
5 PHENANTHRENE (C14H10)	n/d	n/d	n/d	n/d	n/d	n/d
6 ANTHRACENE (C14H10)	n/d	n/d	n/d	n/d	n/d	n/d
7 FLORANTHENE (C16H10)	8.36	n/d	n/d	0.38	1.07	n/d
8 PYRENE (C16H10)	7.94	n/d	0.59	0.36	1.21	n/d
9 BENZO (A) ANTHRACENE (C18H12)	1.61	0.16	0.38	0.3	0.18	n/d
10 CHRYSENE (C18H12)	n/d	n/d	n/d	n/d	n/d	n/d
11 BENZO (B) FLUORANTHENE (C20H12)	n/d	n/d	n/d	n/d	n/d	n/d
12 BENZO (K) FLUORANTHENE (C20H12)	n/d	n/d	n/d	n/d	n/d	n/d
13 BENZO (A) PYRENE (C20H12)	n/d	n/d	n/d	n/d	n/d	n/d
14 BENZO (G, H, I) ANTHRACENE (C22H12)	n/d	n/d	n/d	n/d	n/d	n/d
15 DIBENZO (A, H) ANTHRACENE (C22H14)	n/d	n/d	n/d	n/d	n/d	n/d
16 INDENO (1, 2, 3-CD) PYRENE (C22H12)	n/d	n/d	n/d	n/d	n/d	n/d

*Sample 6 is the control

Table 4. Levels of contamination with PAH compounds in smoked fish samples

Compounds	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
	8.36	n/d	n/d	0.38	1.07	n/d
Floranthene (C16H10)						
	7.94	n/d	u	0.36	1.21	n/d
Pyrene (C16H10)						
Benzo (A) Anthracene (C18H12)	1.61	0.16	0.38	0.3	0.18	n/d
According to the order of contamination	1	5	4	3	2	6

*Sample 6 is the control

*1 – the highest level; 5 – the lowest level

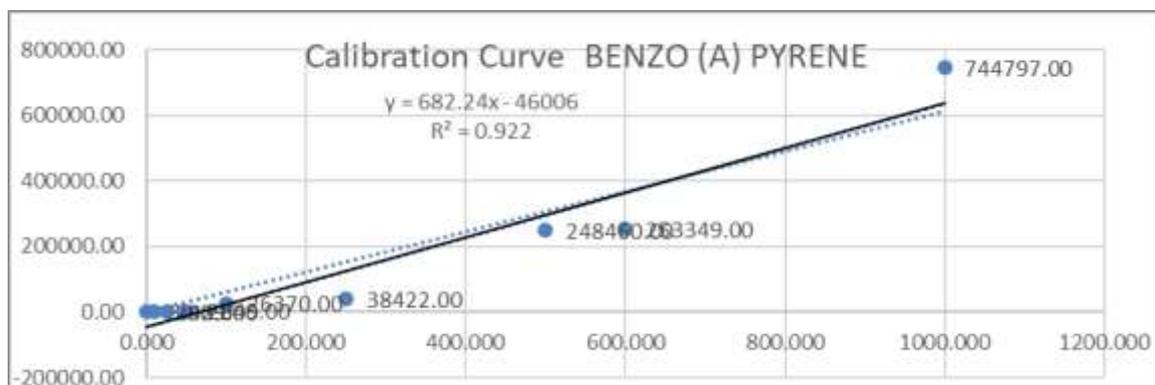


Fig. 4. Calibration curve – BENZO (A) PYRENE -10-1000ng/ml

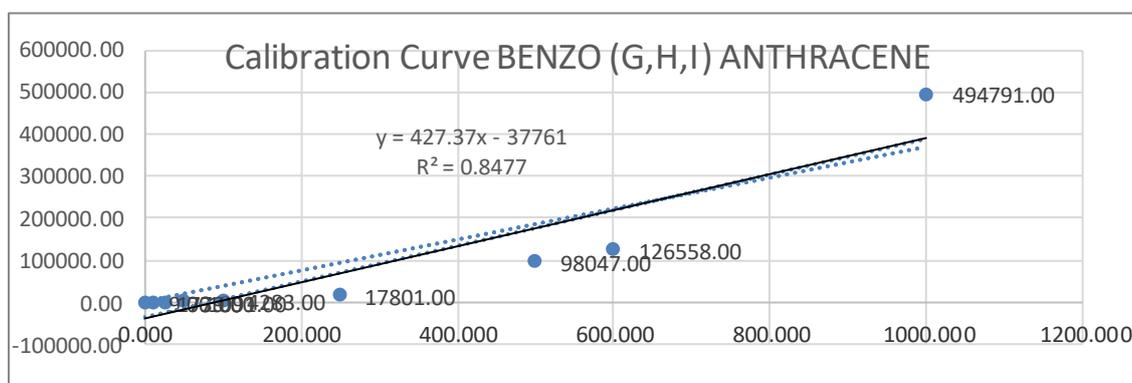


Fig. 5. Calibration curve – BENZO (G, H, I) ANTHRACENE -10-1000 ng/ml

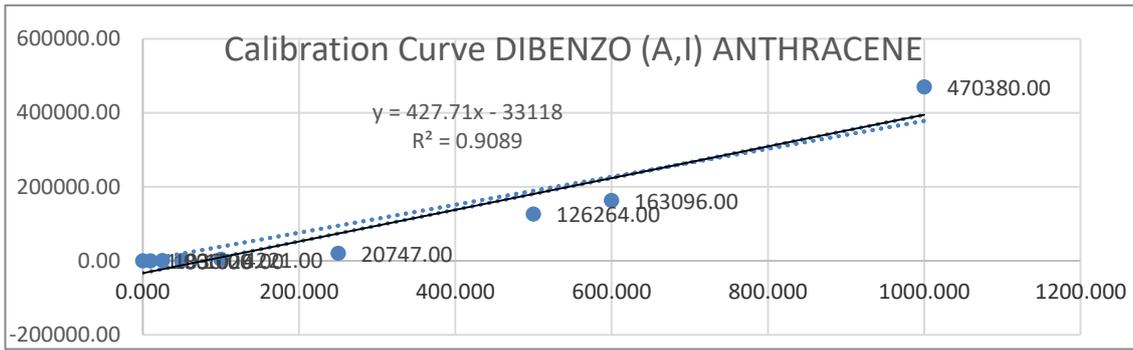


Fig. 6. Calibration curve – DIBENZO (A, I) ANTHRACENE -10-1000 ng/ml

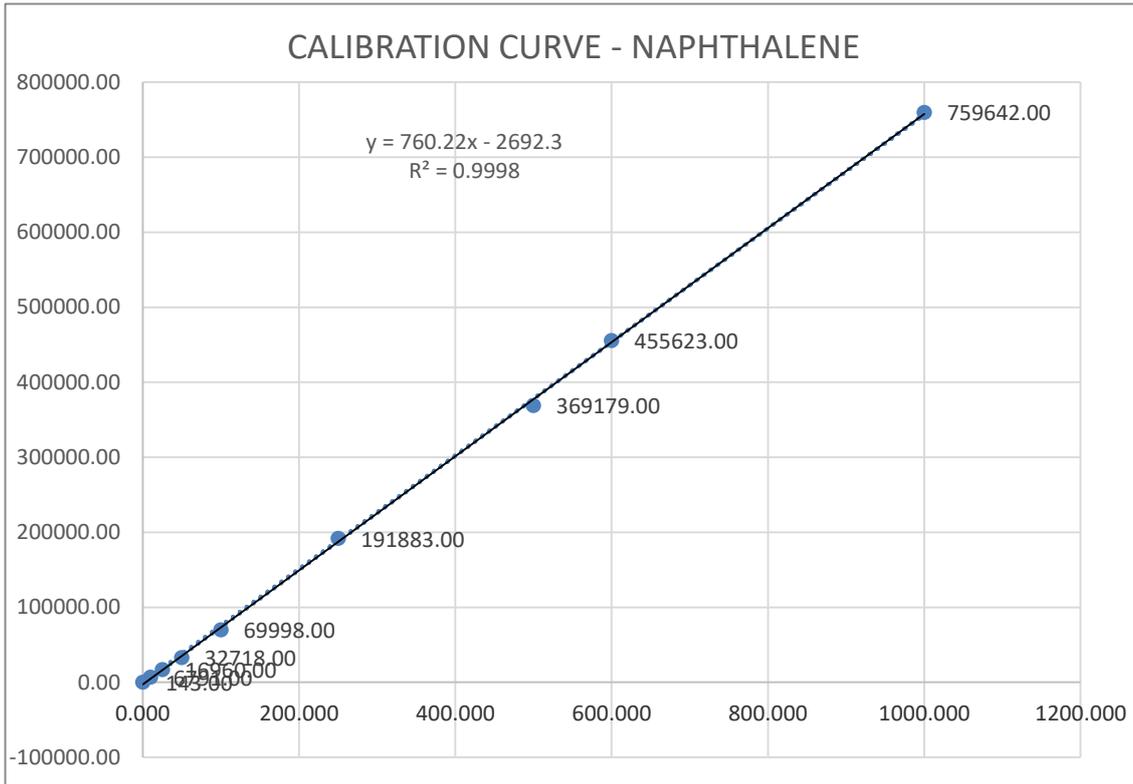
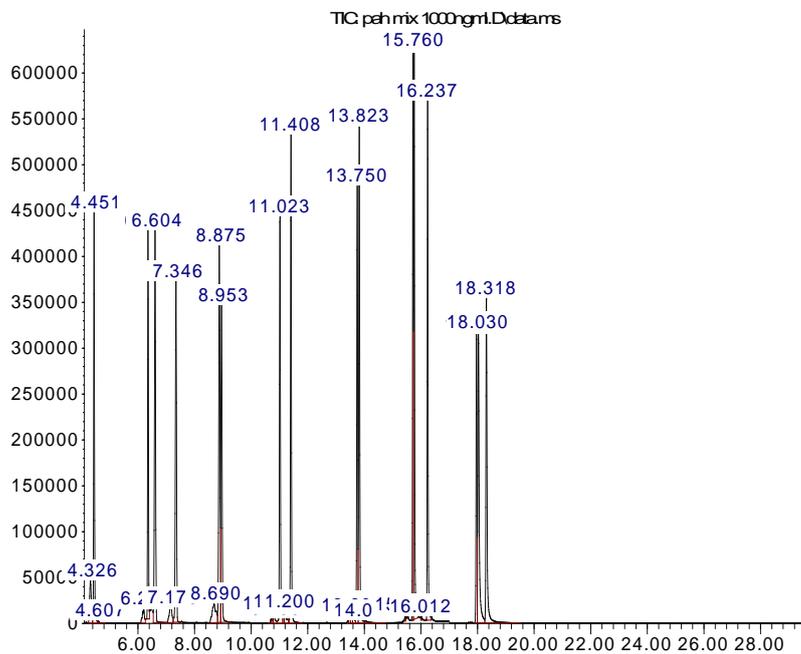


Fig.7. Calibration Curve - Naphthalene -10-1000 ng /ml

Abundance

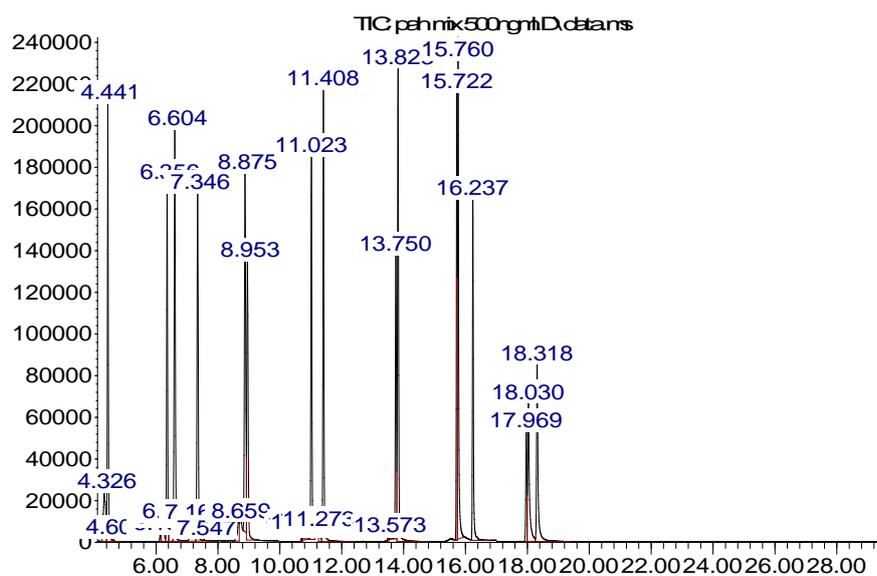


Time-->

Fig. 8. Separation of PAH compounds STAND. MIX 1000ng / ml with column (SCAN) HP-5 30 m x 0.320 mm x 0.25m

Sample Name: PAH MIX 1000 ng / ml	
Compound Name	RT (min)
Naphthalene	4.451
Acenaphthylene	6.356
Acenaphthene	6.604
Fluorene	7.346
Phenanthrene	8.875
Anthracene	8.953
Floranthene	11.023
Pyrenees	11.408
Benzo (a) Anthracene	13.75
Chrysene	13.823
Benzo (b) Fluoranthene	15.717
Benzo (k) Fluoranthene	15.76
Benzo (a) Pyrenees	16.237
Benzo (g, h, i) Anthracene	17.96
Dibenzo (a, i) Anthracene	18.03
Indeno (1,2,3-cd) Pyrenees	18.318

Abundance



Time-->

Fig. 9. Separation of PAH compounds STAND. MIX 1000ng / ml with column HP-5 30 m X – (SIM)

CONCLUSIONS

The major source of contamination by PAHs are processing procedures, such as smoking, drying, and cooking of food. PAHs compounds are formed in the smoked food, depending on a variety of parameters, such as time of exposure, type of wood, distance from the heat source and fat drainage, way of cooking (smoking, grilling, frying, roasting), etc. The impact of PAHs on human health depends mainly on the length and route of exposure, the amount or concentration of PAHs one is exposed to, as well as the relative toxicity of the PAHs. Pre-existing health status and age, as subjective factors can also affect human health. In our research, the content of all identified compounds, in each fish species, was below the permissible limits following European regulations for the maximum permitted amount of polycyclic aromatic hydrocarbons in smoked products.

REFERENCES

- [1]. US Environmental Protection Agency (USEPA), Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/600/R-93/089, U.S. Environmental Protection Agency. Washington, DC: Office of Research and Development, 1993.
- [2]. P. Simko, "Determination of polycyclic aromatic hydrocarbons in smoked meat products and smoke flavoring food additives, J. Chromatogr. B, 2002, vol. 770 (1–2), pp. 3–18.
- [3]. B. Muyela, A. Shhitandi and R. Ngure R., "Determination of benzo[a]pyrene in smoked and oil fried *Lates niloticus*, Int. Food Res. J. 2012, vol. 19 (4), pp. 1595–1600.
- [4]. T. Pena, L. Pensado, C. Casais, C. Mejuto, R. Phan-Tan-Luu, and R. Cela, "Optimization of a microwave-assisted extraction method for the analysis of polycyclic aromatic hydrocarbons from fish samples". J. Chromatogr. 2006, vol. 1121, pp. 163–169.

***IN VITRO* CHEMOSENSITIVITY OF A CANINE TUMOR VENEREAL TRANSMISSIBLE CANCER CELL LINE**

Edson Antonio Santamaría-Martínez, Moisés Armides Franco Molina

Paola Leonor García Coronado, Silvia Elena Santana Krimskaya,

Diana Ginette Zarate-Triviño, Natanael Palacios Estrada, Cristina Rodríguez Padilla

Laboratorio de Inmunología y Virología, Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León, San Nicolás de los Garza, NL, Mexico

Yarellys Ramos Zayas, Jorge R. Kawas

Posgrado Conjunto Agronomía-Veterinaria,

Universidad Autónoma de Nuevo León, Escobedo, NL, Mexico

Heriberto Prado García

Laboratorio de Onco-Inmunobiología, Departamento de Enfermedades Crónico-Degenerativas,
Instituto Nacional de Enfermedades Respiratorias, Ciudad de Mexico, Mexico

ABSTRACT

The canine transmissible venereal tumor (CTVT) is the most common malignity in dogs. Because there are reports that this tumor is resistant to vincristine sulfate, the chemotherapeutic options are scarce, and the development of new therapeutic approaches is necessary. In this study, we evaluated the cytotoxic activity of vincristine, doxorubicin, temozolomide, panobinostat, toceranib, gemcitabine, cisplatin, fluorouracil, cyclophosphamide, and methotrexate on a CTVT cell line, determining that all drugs decreased the viability in a dose-dependent manner. Furthermore, they inhibit cellular migration in a time- and drug-dependent manner, as evaluated by the wound healing assay. On the other hand, vincristine, panobinostat, gemcitabine, toceranib, cyclophosphamide, and methotrexate increased the percentage of cells in the subG1 phase, and doxorubicin, temozolomide, gemcitabine, toceranib, and methotrexate decreased the percentage of cells in the synthesis phase. To efficientize the use of vincristine, only toceranib increased the cytotoxic effect of vincristine in a synergistic manner. Our results confirm the use of vincristine as the gold standard for CTVT treatment as monotherapy and suggest the use of a combinatorial and sequential treatment with toceranib.

UNSUPERVISED MACHINE LEARNING: METHODS AND IMPLICATIONS FOR NETWORKING

Seemant Tiwari

Southern Taiwan University of Science and Technology, Tainan City 71005,

Taiwan ORCID: 0000-0002-6886-5508

ABSTRACT

An technology known as "unsupervised learning" discovers patterns in unlabelled data. Although supervised learning was the emphasis of the majority of these studies, machine learning, as well as artificial intelligence, have already been employed in engineering analysis. To enhance network efficiency and provide applications like transportation planning, fault diagnosis, power prediction, web traffic segmentation, and quality of service optimization, there is a rapid uptick in the use of unsupervised machine learning using unorganized raw network data. Unsupervised learning approaches are becoming more popular in connectivity because of their effectiveness in other industries including machine vision, naturally occurring language processing, voice recognition, and optimization techniques. Unsupervised learning can free us from the restrictions of data sets and manually generated feature architecture, enabling versatile, all-encompassing, and autonomous machine learning techniques. The term "class finding" is also used to describe unsupervised machine learning. Unsupervised machine learning and supervised machine learning vary significantly given that the latter lacks a training dataset and, consequently, a defined role for cross-validation. Even if most clustering techniques are characterized in terms of an optimality criterion, there is another significant difference between them. There is frequently no assurance that the worldwide best option was found. Top motivations for employing unsupervised learning in machine learning include the following: Unsupervised machine learning classifies an extensive variety of formerly unidentified patterns in data. We can regulate traits that can be cooperative for classification by expending unsupervised methodologies. Since it is being done in real-time, learners must watch as all of the input data is processed and tagged. Unlabeled data can be retrieved from a system more quickly than data points, which requires human interaction. We hope to increase understanding throughout this study by meticulously integrating findings from earlier research and by giving an up-to-date analysis of fresh innovations and discoveries.

Keywords: Machine learning, unsupervised learning, supervised learning, raw data networks, unsupervised learning techniques

AN ANALYTICAL APPROACH TO ACOUSTOELECTRIC EFFECT IN SOLID STATE DEVICES AND MATERIALS

Awadhesh Prasad

Head, Post Graduate Department of Physics, Veer Kunwar Singh University, Ara (802301), Dist – Bhojpur, (Bihar), India

ABSTRACT

Acoustoelectric effect has been discussed quantitatively. A one-electron wave function known as Bloch function has been discussed. The Acoustoelectric effect has been explained by wave mechanics.

Keywords: Wave mechanics, Bloch-function, One-electron approximation, Schroedinger's equation.

INTRODUCTION

The basic term "acoustoelectric effect" mainly describes the appearance of a dc electric field along a path of travelling acoustic wave of propagation in a channel containing mobile charges. It is a friction of wave particles. The creation of a dc electric field by a travelling acoustic wave on a medium with free carriers is known as the acoustoelectric effect. Both the momentum and the energy of a sound wave are diminished by conduction electrons when it travels through an object. The electrons float under the influence of the momentum attenuation, which acts as a dc force. A direct current will form if this control has a closed circuit. Since momentum attenuation is related to sound intensity, this is the acoustoelectric current, which is proportional to sound intensity. If the circuit is closed, on the other hand, the nomadic electrons create a space charge whose electric field cancels the dc force brought on by the attenuation of the sound wave momentum. The acoustoelectric field exists in this back electric field.

The lattice vibration due to thermal motion is linked to the acoustic wave propagation. The velocity of wave will be a function of the path of propagation. The lattice vibration is deliberated by considering the periodic life of the crystal. It is justifiable for low and high frequency ranges. Assuming that the displacement of the particles from their equilibrium position is small in contrast with the lattice spacings.

Quantum Mechanical Effects in Semiconductor:

Quantum elements can be well understood from the fundamental quantum physics based on the quantum mechanical wave function, used to explain an energy state in which an electron can take place. The Schrodinger equation describes the permissible energy state and the wave functions. The Schrodinger Equation solutions for an electron bound by the attractive potential of a proton, which illustrate the bound states (ground states + excited states) of the hydrogen atom, are a well-known example. This classical quantum physics concept is frequently distinguished from the element in a box explanation of the characteristics of electrons trapped in a square well potential.

DISCUSSION

In order to solve Schroedinger's equation, wave mechanics is used to describe the acoustoelectric effect [1–6]. An valuable potential resulting from the nuclei and all of the other electrons in the crystal is what is expected for a conduction electron to operate in. That this possible $V(r, t)$ could be written as:

$$V(\mathbf{r}, t) = V_0(\mathbf{r}) + V_1(\mathbf{r}, t)$$

$V_0(\mathbf{r})$ is mainly represent the precise potential in the absence of a moving sound wave.

$V_1(\mathbf{r}, t)$ generally shows the use of the estimation that the V_1 is a gradually changing position of function, the perturbation potential, an additional term that results from the occurrence of the acoustic wave

In two parts, the perturbation potential can be seen to be collapsed.

$$V_1 = V_{1a} + V_{1b}$$

V_{1a} is the outcomes mainly rise from the charge deranges setup by the acoustic waves while V_{1b} is the outcomes arise from the charge in interatomic spacing setup by the acoustic wave [1].

Bloch function

Solutions of the Schroedinger Equation for a periodic potential [15]

$$\psi_{\mathbf{k}}(\mathbf{r}) = U_{\mathbf{k}}(\mathbf{r}) \exp(i\mathbf{k}\cdot\mathbf{r}) \quad \dots\dots\dots (1)$$

$U_{\mathbf{k}}(\mathbf{r})$ has the phase of the crystal lattice with $U_{\mathbf{k}}(\mathbf{r}) = U_{\mathbf{k}}(\mathbf{r} + \mathbf{T})$

The eigen functions of the wave equation for a cyclic potential are the product of a plane wave $\exp(i\mathbf{k}\cdot\mathbf{r})$ times a function $U_{\mathbf{k}}(\mathbf{r})$ with the periodicity of the crystal lattice.

Bloch functions, which are one electron wave functions of the type (1), can be broken down into a collection of travelling waves. Bloch functions can be combined into localised wave packets to represent electrons that freely move across the ion cores' potential field.

Assuming that $\psi_{\mathbf{k}}$ does not disintegrate if no other wave function has the same energy and wave vector as $\psi_{\mathbf{k}}$. Considering Na rings with N identical lattice points. $U(x) = U(x + Sa)$, where S is an integer, indicates that the potential energy is cyclic in a .

Bloch Function refers to one electron wave function of the form (1). It can also be disintegrated into travelling waves.

Expressing the symmetry of a ring

$$\psi(x+a) = C\psi(x) \quad \dots\dots\dots (2)$$

C is a constant-
On going once around the ring

$$\psi(x+Na) = \psi(x) = C^N \psi(x)$$

$\psi(x)$ must be single valued
 C is one of the N roots of unity or

$$C = \exp\left(\frac{i2\pi S}{N}\right); \quad S = 0, 1, 2, 3, \dots\dots\dots, N-1$$

$$\psi(x) = U_{\mathbf{k}}(x) \exp\left(\frac{i2\pi Sx}{Na}\right)$$

satisfies (2), given that $U_{\mathbf{k}}(x)$ has the periodicity a , so that $U_{\mathbf{k}}(x) = U_{\mathbf{k}}(x+a)$

with $K = 2\pi S/Na$, we have the Bloch conclusion (1).

Kronig-Penney Model

In terms of elementary functions, the wave equation can be easily explained with periodic potential with well square array as shown in Fig. -1. The equation of wave is shown as:

$$-\frac{\hbar^2}{2m} \frac{d^2}{dx^2} + U(x) = \epsilon \quad \dots\dots\dots (3)$$

U(x) mainly represent the potential energy while eigen value of energy is shown by ϵ .

Under the range $0 < x < a$, in which value of $U = 0$, the linear arrangement of eigen function is:

$$Ae^{ikx} + Be^{-ikx} \quad \dots\dots\dots (4)$$

of plane waves traveling to the right and to the left with energy

$$\psi = \frac{\hbar^2 k^2}{2m}$$

Under the limitation in this region i.e. $-b < x < 0$, the solution of this form:

$$Ce^{Qx} + De^{-Qx} \quad \dots\dots\dots (3a)$$

with $UO - \epsilon = \frac{\hbar^2 Q^2}{2m} \quad \dots\dots\dots(4a)$

The solution in the region $a < x < a + b$ must be linked to the solution (3a) in the section $-b < x < 0$ by the Bloch theorem.

$$(a < x < a + b) = (-b < x < 0) e^{ik(a+b)} \quad \dots\dots\dots(5)$$

A,B,C and D are the Constants that are selected therefore $\frac{d}{dx}$ are continuous at value of $x = 0$ and $x = a$. These are basically a standard quantum mechanical conditions at boundary in issues.

At $x = 0$

$$A + B = C + D \quad \dots\dots\dots (6)$$

$$ik(A - B) = Q(C - D) \dots\dots\dots (7)$$

At $x = a$,

$$Ae^{ika} + Be^{-ika} = (Ce^{-Qb} + De^{Qb})e^{ik(a+b)} \dots\dots\dots(8)$$

$$ik (Ae^{ik.a} - Be^{-ika}) = Q (Ce^{-Qb} - De^{Qb}) e^{ik(a+b)} \dots\dots\dots(9)$$

If in case the determinant of the coeff of A, B, C and D not visible then Eq. 4 to 9 must have an outcomes.

$$\left(\frac{Q^2 - K^2}{2QK}\right) \sin \sin hQb \sin \sin Ka + \cos \cos hQb \cos \cos Ka = \cos \cos K (a + b) \dots\dots\dots (10a)$$

It is often repetitive to get this equation when we cross the boundary i.e. $b=0$ and $U_0 = \infty$ just like that $Q^2ba/2 = P$, which is similar to a finite quantity. In this limit $Q \gg K$ and $Qb \ll 1$. Then 10 (a) moderates to

$$\left(\frac{P}{Ka}\right) \sin ka + \cos ka = \cos ka \dots\dots\dots 10(b)$$

The spans of K for which this equation has solutions are plotted in figure - 2, for the case $P = 3\pi/2$. The corresponding values of the energy are outlined in figure - 3.

Wave equation of electron in a periodic potential

In view of figure - 4, the approximate form for the solution of the Schroedinger equation if the wave vector is at a zone margin, as at $K = \frac{\pi}{a}$

Let us consider the equation of wave for a common potential at broad ranging vales of K . Let $U(x)$ basically refers to total potential energy of an electron with a, where a is known as lattice constant. Potential energy is conventional under a crystal lattice conversion:

$$U(x) = U(x + a).$$

Under a crystal lattice translation, a function conventional symbol may be long lasting as a Fourier series in the G , where G represents common lattice vectors. Here is the equation of the Fourier series for the potential energy:

$$U(x) = \sum_G U_G e^{iGx}$$

The values of the coefficients U_G for actual crystal potential have a tendency to decline quickly with escalating magnitude of G . For a simple Coulomb potential U_G decreases as $1/G^2$.

The potential energy $U(x)$ to be an actual function

$$U(x) = \sum_{G>0} U_G (e^{iGx} + e^{-iGx}) = 2 \sum_{G>0} U_G \cos Gx \quad \dots\dots\dots (11)$$

The solutions are termed eigen functions or orbitals or Bloch functions. Clearly, the wave equation is

$$\left(\frac{1}{2m} p^2 + U(x) \right) \psi(x) = \left(\frac{1}{2m} p^2 + \sum_G U_G e^{iGx} \right) \psi(x) = \epsilon \psi(x) \quad \dots\dots\dots(12)$$

With the help of one-electron, Eq. 12 is mainly formed. Here x shows the motion of single electron. The wave function $\psi(x)$ can be expressed as the sum of a Fourier series over all wave vector values permitted by the boundary constraints., so that

$$\psi(x) = \sum_K C(K) e^{iKx} \quad \dots\dots\dots (13)$$

Here, K is real. The combination and set of values of k has the form $2\pi n/L$ while all these values satisfy the condition of periodic boundary over L length and n is an integer (both positive and negative)

The Kinetic energy term is

$$\begin{aligned} \frac{1}{2m} p^2 \psi(x) &= \frac{1}{2m} \left(-i\hbar \frac{d}{dx} \right)^2 \psi(x) \\ \frac{-\hbar^2}{2m} \frac{d^2}{dx^2} \psi(x) &= \frac{\hbar^2}{2m} \sum_K K^2 C(K) e^{iKx} \end{aligned}$$

and the potential energy term is

$$\left(\sum_G U_G e^{iGx} \right) \psi(x) = \sum_G \sum_K U_G e^{iGx} C(K) e^{iKx}$$

The equation is derived as the sum:

$$\begin{aligned} \sum_K \frac{\hbar^2}{2m} K^2 C(K) e^{iKx} + \sum_G \sum_K U_G C(K) e^{i(K+G)x} \\ = \epsilon \sum_K C(K) e^{iKx} \end{aligned}$$

Having same coefficient of Fourier constituent. Thus

$$(\lambda_K - \varepsilon)C(K) + \sum_G U_G C(K - G) = 0$$

With the data

$$\lambda_K = \frac{\hbar^2 K^2}{2m}$$

Using a deformation potential's drawing, determine V_{1b} . The top side of one or more of a crystal's energy bands will change energy in response to uniform crystal dilatation or density.

Beginning with the solid potential acting on electron in the undiluted crystal, one may predict the effects of dilation on a particular band segment by supplementing the real potential with a constant and invariable perturbative potential corresponding to the change in energy of that band segment.

Deformation potential is the name given to this disturbance potential.

When analysing the shift of electrons and holes in a crystal under the influence of acoustic deformations of the crystal, the theory of a deformation potential has proven to be highly helpful. According to the postulation, low energy electrons and holes with little structured bands have a potential energy V i proportional to the crystal's dilation [2].

$$V_l = -e_l \Delta$$

e_l is a constant and Δ the dilatation

Concluding Remarks:

An hard attempt has been made to decode the effects of acoustoelectric with the help of wave mechanics and soem top experiments [1-17].

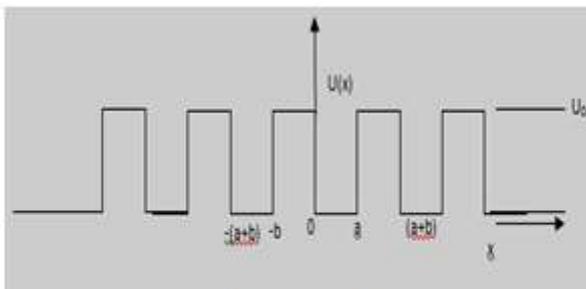


Figure – 1

Square well periodic potential as presented by Kronig and Penny

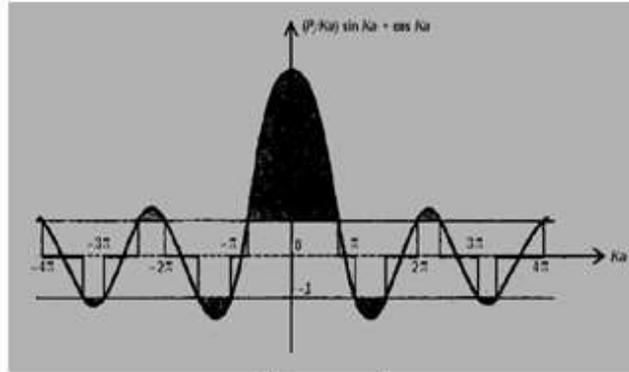


Figure - 2

Plot of the function $(P/Ka) \sin Ka + \cos Ka$, $P = 3\pi/2$. The legitimate values of the energy ϵ are specified by those ranges of $Ka = (2m\epsilon/\hbar^2)^{1/2}a$ for which the function remains between ± 1 .

For more values of the energy, there are no any other travelling wave observed for more values of energy so that it banned the gaps in the spectrum of energy are shaped.

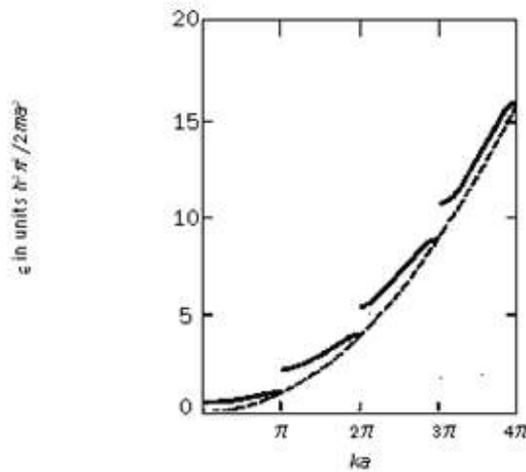


Figure - 3

Plot of energy versus wavenumber for the Kronig-Penney potential, with $P = 3\pi/2$. Notice the energy gaps at $Ka = \pi, 2\pi, 3\pi, \dots$

Λ ←+i

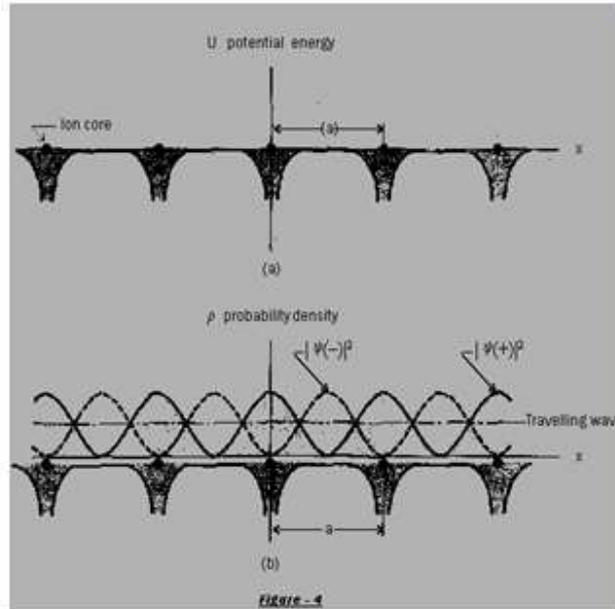


Fig - 4(a) - Alteration of potential energy of a conduction electron in the field of the ion core of a linear lattice.

Fig - 4(b) – Distribution of probability density ρ for $|(-)|^2 \propto \pi x/a$; $|(+)|^2 \propto \pi x/a$, and a travelling wave in the lattice. The potential energy is reduced compared to the average potential energy detected by a travelling wave due to the wave function $|(+)|$ accumulation of electronic charge on the positive ions' nuclei. In contrary to what a travelling wave would see, the wave function $|(-)|$ increases the potential energy by piling up charge in the region between the ions. Understanding the cause of the energy gap requires knowledge of this figure as an input.

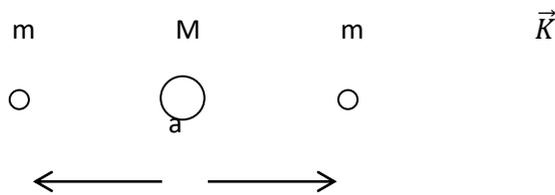


Figure 5:

a diatomic crystal structure where M and m are the masses and C is the force between the neighbouring planes. The wavevector K 's wavevector has a repeat distance of a . The atoms are displayed in their original locations.

Two distinct atoms of masses M and m alternately placed to create a one-dimensional crystal.

$$m < M$$

a is interatomic spacing.

Information on the lattice vibration can be obtained from the mode of ultrasonic wave propagation through a semiconductor and solid state material. The dispersion relation serves as an example of the acoustical output of the lattice spectrum.

$$\omega^2 = c \left(\frac{1}{M} + \frac{1}{m} \right) - c \left[\left(\frac{1}{M} + \frac{1}{m} \right)^2 - \frac{4ka}{Mm} \right]^{1/2} \dots(14)$$

Wave vector is represent by k

Elastic force constant is shown by c

Anular frequency is represent by ω

Linear array of dissimilar atoms is shown by m with a spacing

The maximum possible angular frequency for the acoustic mode is $W_1 = (2c/M)^{1/2}$

The range of frequency for which K must be complex reaches from $W_1 = (2c/M)^{1/2}$
to $W_2 = (2c/m)^{1/2}$

References

1. R. H. Parmenter, The Acoustoelectric effect, Physical Review, Vol. 89. No. 5, pp 990 – 998, (1953)
2. G. Weinreich, Acoustodynamic Effect in Semiconductors, Physical Review, Vol. J04, No.2, pp 321 – 324, (1956)
3. B. Tell and G. Weinreich, Acoustoelectric Effect and Intervalley Scattering rates in Antimony Doped Germanium, Physical Review, Vol. 143, No.2, pp 584 – 587, (1966)
4. G. Weinreich, T. M. Sanders, Jr., and H.G. White, Acoustoelectric Effect in n -type Germanium, Physical Review, Vol. 114, No.1, pp 33 – 44, (1959)
5. F. E. Borgnis, Acoustic Radiation Pressure of Plane Compressional Waves, Rev. of Mod. Phys Vol. 25, No.3, pp 653 – 664, (1953)
6. Wen - Chung Wang, Strong Acoustoelectric Effect in CdS, Phys. Rev. Lett Vol 9, No. 11, pp 443 – 445, (1962)
7. V. R. Singh, Awadhesh Prasad, Effect of Ultrasonic Stress on the Sensitivity of Silicon Strain Devices and Application to Acoustic Power Measurement, Sensors and Actuators A, Elsevier Sequoia, Lausanne, Netherlands, Vol. 28, pp 7 – 11, (1991)
8. V. R. Singh, Awadhesh Prasad, Effect of Ultrasonic Stress on amplification of an operational amplifier device, Applied Acoustics, UK, Vol. 27, pp 69 – 73, (1989)
9. V. R. Singh, Awadhesh Prasad, Acoustoelectric Effect in Semiconductor Materials and Devices, Chinese Journal of Acoustics, Vol 9 No.3, pp 275 – 279, (1990)
10. V. R. Singh, Awadhesh Prasad, Sanjay Yadav, Ultrasonic Stress Effect on a Germanium based Junction Transistor, Acustica, Great Britain, Vol. 71, pp 79 – 80, (1990)
11. Awadhesh Prasad, V. R. Singh, Characteristic of Silicon Laser Monitor $p - i - n$ Photodiodes in Ultrasonic Field, IETE Technical Review, New Delhi, Vol. 7, No.1, pp 64 – 65, (1990)
12. V. R. Singh, Awadhesh Prasad, Effect of Ultrasonic Stress on the $N -$ type Silicon Photodiodes, ITBM, France, Vol. 10. No.5, pp 568 – 571, (1989)
13. V. R. Singh, Awadhesh Prasad, Effect of Ultrasonic Stress on Offset Voltage of operational Amplifier Devices, Noise Control Engineering Journal, USA, VoL 35, No 2, pp 65 – 67, (1990)
14. S. G. Eckstein, Acoustoelectric Effect, Journal of Applied Physics, Vol. 35, No 9, pp. 2702 – 2707, (1964)
15. C. Kittel, Introduction to Solid State Physics, John Wiley and Sons, Inc , New York, (1996).
16. Rohn Truell, Charles Elbaum, Bruce B. Chick, Ultrasonic Methods in Solid State Physics, Academic Press, Inc., New York and London, (1969).

17. Awadhesh Prasad, Head, Post Graduate Department of Physics, Veer Kunwar Singh University, Ara, Pin – 802301, Bhojpur, Bihar, India, Acoustoelectric Current in a Quantum Well, International Capital Conference on Multidisciplinary Scientific Research, Oral Presentation, Universidade Fernando Pessoa, Portugal, 13 – 14 July, 2022.

A PHENOMENOLOGICAL STUDY OF DRELL-YAN Φ^*_H DISTRIBUTION OVER A WIDE MASS REGION THROUGH NNLO+N³LL ACCURACY

Kadir Ocalan

Faculty of Aviation and Space Sciences, Necmettin Erbakan University, Konya, Turkey, ORCID:
<https://orcid.org/0000-0002-8419-1400>

ABSTRACT

High-accuracy theoretical predictions for the key observable ϕ^*_η of neutral-current Drell-Yan dilepton production $Z/\gamma^* \rightarrow l^+l^-$ in proton-proton (pp) collisions are presented in the context of high energy physics phenomenology. The differential distributions of the ϕ^*_η are acquired based on the state-of-the-art predictions of the combined calculations, where fixed-order perturbative quantum chromodynamics (QCD) corrections at next-to-next-to-leading order (NNLO) accuracy matched to resummation of large logarithmic terms at next-to-next-to-leading logarithmic (NNLL) and next-to-NNLL (N³LL) accuracies, i.e., NNLO+NNLL and NNLO+N³LL, respectively. The predicted distributions are obtained for a set of dilepton invariant mass m_{ll} ranges over a wide kinematic region of $50 < m_{ll} < 1000$ GeV in different ranges of the dilepton rapidity y_{ll} acceptance region of $|y_{ll}| < 2.4$. The matched predictions through NNLO+N³LL provide reasonable description for the ϕ^*_η distributions including the dilepton transverse momentum p_{T}^{ll} as well) in almost all the m_{ll} and y_{ll} ranges in comparisons with the pp collisions data at 13 TeV center-of-mass-energy. Exceptionally the intermediate- to high- ϕ^*_η region in the lowest m_{ll} range 50–76 GeV is tested to constitute a challenge for the presented predictions. The predictions are also provided at 14 TeV using the latest parton distribution function (PDF) sets MSHT20 and CT18, complementarily with the NNPDF3.1. Finally, the differential distributions are provided based on the combined calculations of NNLO QCD corrections and NLO electroweak (EW) corrections (i.e., NNLO QCD+NLO EW) to enable assessment of the impact of the EW corrections for the ϕ^*_η observable. The presented higher-accuracy predictions represent an important contribution to Drell-Yan phenomenology in terms of inclusion of the resummed calculations at N³LL and EW corrections at NLO, matched to NNLO QCD predictions.

Keywords: high-energy particle physics, Drell-Yan dilepton production, NNLO+N³LL perturbative QCD, high-accuracy phenomenology of ϕ^*_η observable

INTRODUCTION

Neutral-current Drell-Yan lepton pair (dilepton) production processes, mediated by $Z(\gamma^*)$ boson as $q\bar{q} \rightarrow Z/\gamma^* \rightarrow l^+l^-$ with l is either electron (e) or muon (μ), play a crucial role at hadron colliders such as at the CERN Large Hadron Collider (LHC) facility. These processes enable several highly-motivated physics studies owing to their large production cross sections and clean experimental signatures in proton-proton (pp) collisions. Primarily, high-precision tests of standard model (SM) physics with substantial inputs for parton distribution functions (PDFs) in the proton can be carried out in the course of Drell-Yan dilepton studies. Monte Carlo based simulations have been tuned and various fixed-order theoretical calculations have been tested stringently using this decay channel. Drell-Yan dilepton production aids in improvements of modeling backgrounds of rare SM processes, such as Higgs boson and top pair productions and of beyond the SM signatures such as supersymmetry, dark matter, and in particular high-mass dilepton searches. In addition, this decay process is considered to be a standard

candle for calibration detector response for higher energy and momentum resolution in the context of experiments.

In this report, a study is presented for theoretical predictions of the key observable ϕ^*_{η} of Drell-Yan dilepton production in pp collisions, based on the state-of-the-art calculations in the domain of the high-energy physics phenomenology. In the predictions, fixed-order perturbative quantum chromodynamics (QCD) calculations, expanded in terms of the strong coupling constant α_s , are included beyond next-to-leading order (NLO) which is at next-to-NLO (NNLO) accuracy. Resummation of large logarithmic effects at next-to-next-to-leading logarithmic (NNLL) and at next-to-NNLL (N^3LL) accuracies is also included to account for soft and collinear QCD radiation which impacts primarily low dilepton transverse momentum p^{\perp}_T region. Inclusion of corrections corresponding to N^3LL corrections is intended to improve reliability of the ϕ^*_{η} predictions both in terms of accuracy and precision. Moreover, corrections for electroweak (EW) effects are calculated and included in the predictions so as to improve description for the ϕ^*_{η} distribution from intermediate- to high- p^{\perp}_T region. These different calculations are combined in order to match N^3LL resummation to NNLO QCD as NNLO+ N^3LL and include both QCD and EW corrections in the form of NNLO QCD+NLO EW for a thorough assessment of the ϕ^*_{η} variable.

The motivation of extensive studies of the ϕ^*_{η} variable stems from limited precision of lepton momentum resolutions in experiments that leads to higher uncertainties for the p^{\perp}_T variable of dilepton system in the final state. By this token, the ϕ^*_{η} turns out to be a good alternate for the p^{\perp}_T as they are closely correlated to each other with the relation the $\phi^*_{\eta} \sim p^{\perp}_T/m_{\text{II}}$ (m_{II} stands for the invariant mass of the dilepton system), where with ϕ^*_{η} has relatively lower uncertainties due to the fact that it is defined to rely only on angular quantities. The ϕ^*_{η} , which can probe the similar physics as p^{\perp}_T does with higher achievable precision, is defined compactly as in the following

$$\phi^*_{\eta} = \tan\left(\frac{\pi - \Delta\phi}{2}\right) \sin(\theta^*_{\eta}), \quad \cos(\theta^*_{\eta}) = \tanh\left(\frac{\Delta\eta}{2}\right), \quad (1)$$

where $\Delta\phi$ and $\Delta\eta$ signify azimuthal angle and pseudorapidity differences between leptons, respectively, in the rest frame of colliding protons. The θ^*_{η} is the angle between dilepton system and colliding protons in the rest frame of the dilepton system itself. This report is aimed to present a brief consideration of the much detailed work which was documented in details in the original published paper [1].

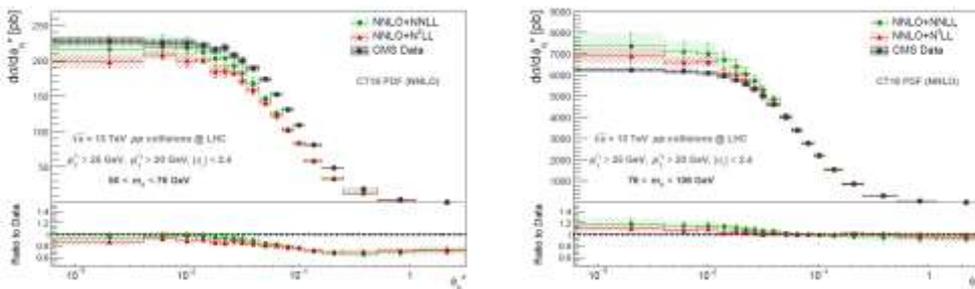
METHODOLOGY

In the computations of higher-order predictions for the differential cross sections of the Drell-Yan dilepton process as a function of the ϕ^*_{η} (p^{\perp}_T) observable, the fixed-order calculations are carried out using the MATRIX computational framework [2]-[3]. Calculations including resummation of logarithmically enhanced terms are achieved by the MATRIX+RadISH (v1.0.1) framework [4]. NNLO QCD+NLO EW combined calculations are obtained by a dedicated version of the MATRIX (v2.0.0) framework [5]. The so-called transverse momentum q_T -subtraction method [6]-[7] is used within the computational frameworks for the cancellation of infrared divergences that arise in the intermediate stages of the calculations. These divergences are regulated using a fixed cut-off value $r_{\text{cut}}=0.0015$ (0.15%) for the quantity $r=p_T/m$ for a system of colorless system, where it acts as a slicing parameter. Scattering amplitudes are taken from the OpenLoops program, in addition to the LHAPDF 6.2.0 framework which is used for the evaluation of PDFs from data files. Various PDF models are benefited in convolution of

the calculations as NNPDF3.1, CT18, and MSHT20, all based on $\alpha_s=0.118$. The Fermi constant G_F EW input scheme is used with all parameters relevant for inclusive Z boson process are chosen as $m_Z=91.1876$ GeV and $G_F=1.16639 \times 10^{-5}$ GeV⁻². Central values of scales are dynamically set in the computations as $\mu_R=\mu_F=m_{ll}$. In the resummed calculations, central value of the resummation scale is set to $x_Q=m_{ll}/2$. In the calculations, uncertainties due to variations of scales using nine-point variation customary scheme, PDF model, and α_s variation are considered and presented as total theoretical uncertainty by summing all these sources of uncertainties in quadrature.

PHENOMENOLOGICAL RESULTS

The predicted ϕ^*_{η} distributions are first compared with the CMS data at the LHC [8] in the fiducial phase space encompassing $p^{\perp}_T > 25$ GeV, $p^{\perp}_T > 20$ GeV, and $|\eta| < 2.4$ selection requirements. Comparisons are made at 13 TeV center-of-mass pp collisions energy using the combined predictions NNLO+NNLL and NNLO+N³LL in 5 different ranges of the dilepton invariant mass m_{ll} between 50-1000 GeV as 50 GeV < m_{ll} < 76 GeV, 76 GeV < m_{ll} < 106 GeV, 106 GeV < m_{ll} < 170 GeV, 170 GeV < m_{ll} < 350 GeV, 350 GeV < m_{ll} < 1000 GeV. As shown in the Figure 1, data description for the ϕ^*_{η} distribution improves remarkably well with the NNLO+N³LL predictions in almost all of the m_{ll} ranges. Intermediate- to high- ϕ^*_{η} region is observed to constitute a challenge for the predictions in the lowest m_{ll} range, where both nonperturbative and EW effects need to be accounted for. Precision achieved in the NNLO+N³LL calculations amounts generally to 2-3% in most of phase space region of the ϕ^*_{η} distributions. The predicted p^{\perp}_T distributions of NNLO+NNLL and NNLO+N³LL accuracies at 13 TeV are also compared with the available data [9] in 5 different dilepton rapidity y_{ll} ranges in the the complete central acceptance of 0.0-2.4, by using the fiducial requirements of $p^{\perp}_T > 25$ GeV, $p^{\perp}_T > 25$ GeV, $|\eta| < 2.4$, and 76 GeV < m_{ll} < 106 GeV in accordance with the related CMS measurement. The NNLO+N³LL predictions are observed to be very reliable in all the y_{ll} ranges in reproducing the data distributions. In low- p^{\perp}_T regions, uncertainties are observed to be larger which are assessed to be due to missing nonperturbative effects. In all the comparisons in both the m_{ll} and y_{ll} ranges, the combined prediction NNLO+N³LL is justified to be in very good agreement with the data to extend calculations beyond 13 TeV to 14-TeV energy.



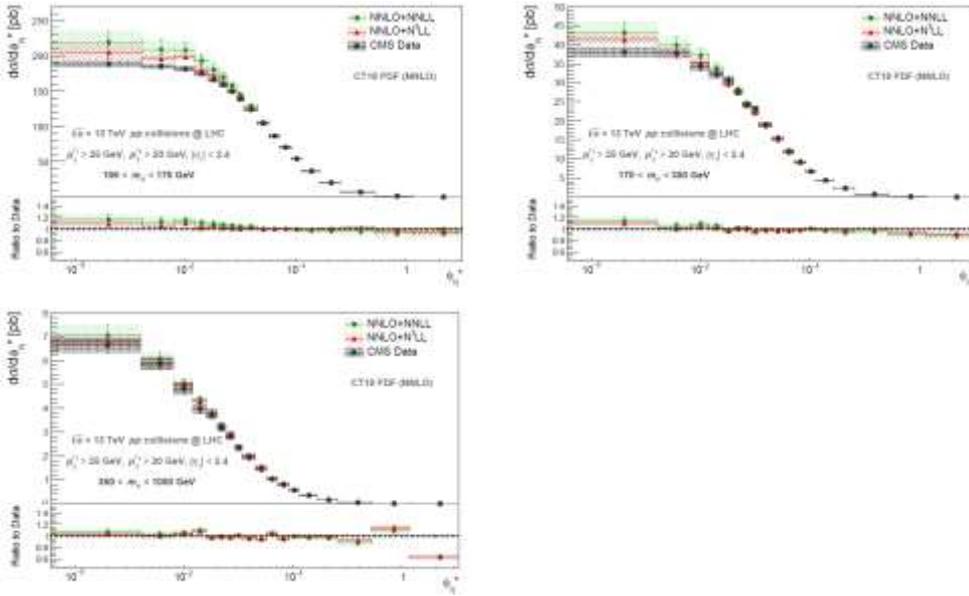
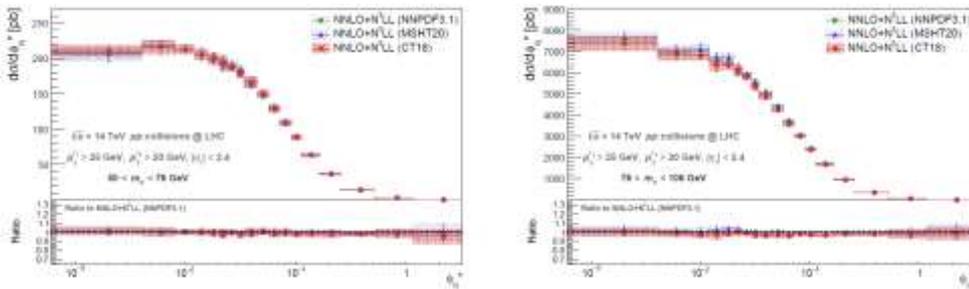


Figure 1. The predicted ϕ^*_η distributions at NNLO+NNLL and NNLO+N³LL accuracies in 5 different dilepton invariant mass m_{II} ranges, compared with the available CMS data at 13 TeV.

The matched NNLO+N³LL predictions at 14 TeV are studied by exploiting different the most up-to-date PDF models from different collaborations as NNPDF3.1, CT18, and MSHT20 PDF in both the m_{II} and y_{II} ranges. Difference among the high-accuracy NNLO+N³LL predictions using different PDF sets is at most a few % depending on ϕ^*_η region as shown in Figure 2. Therefore, the matched predictions using all the PDF sets are able to reproduce ϕ^*_η distributions in a consistent manner. Moreover, relative fractions of the included NNLO+N³LL corrections are studied with respect to the fixed-order alone NNLO and NNLO+NNLL predictions at 14 TeV, $\delta\sigma^{(1)}$ and $\delta\sigma^{(2)}$ respectively. The relative corrections are assessed to be mostly negative and quite large depending greatly on different m_{II} bins as tabulated in Table 1. Therefore the resummation matched NNLO predictions cannot be neglected and should be considered in high-accuracy predictions of the dilepton production in pp collisions. Furthermore, achievable theoretical uncertainties for the predicted differential cross sections as functions of ϕ^*_η and p^{\perp}_T observables are examined extensively. In the low and high ϕ^*_η (p^{\perp}_T) regions, the uncertainties are up to 3-4% in the ϕ^*_η distributions in contrast to the ones in the ϕ^*_η distributions, where they increase more than 10% as shown in Figure 3. Therefore, the key observable ϕ^*_η is clearly shown to provide considerably higher precision in comparison to the p^{\perp}_T of the dilepton system.



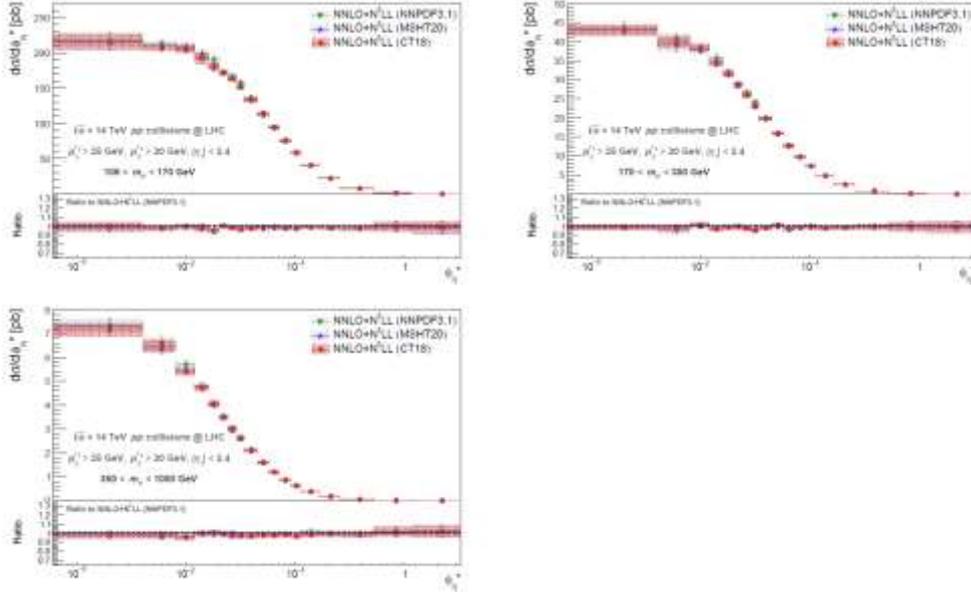


Figure 2. The predicted ϕ^*_η distributions at NNLO+N³LL using different PDF models in 5 different dilepton invariant mass m_{ll} ranges at 14 TeV

Table 1. Fractions of the NNLO+N³LL corrections relative to the NNLO and the NNLO+NNLL predictions, $\delta\sigma(1)$ and $\delta\sigma(2)$, respectively, for the $d\sigma/d\phi^*_\eta$ at 14 TeV. The $\delta\sigma(1)$ and $\delta\sigma(2)$ results are given in percent (%) for different m_{ll} ranges

m_{ll} ranges: Q^2_η bin	50–76 GeV		76–106 GeV		106–170 GeV		170–350 GeV		350–1000 GeV	
	$\delta\sigma^{(1)}$	$\delta\sigma^{(2)}$	$\delta\sigma^{(1)}$	$\delta\sigma^{(2)}$	$\delta\sigma^{(1)}$	$\delta\sigma^{(2)}$	$\delta\sigma^{(1)}$	$\delta\sigma^{(2)}$	$\delta\sigma^{(1)}$	$\delta\sigma^{(2)}$
0.000–0.004	-83.8	-7.9	-4.4	-5.2	-182.67	-6.55	-143.77	-4.17	-179.30	-3.17
0.004–0.008	-109.5	-6.1	-117.7	-7.2	-141.16	-4.78	28.23	-5.79	-46.69	-4.50
0.008–0.012	-213.3	-6.6	114.1	-4.8	-23.70	-5.57	-46.38	-3.56	-41.30	-1.02
0.012–0.016	-5.3	-6.6	-40.6	-8.8	-47.89	-6.36	-44.79	-4.62	-36.08	-0.58
0.016–0.020	-42.4	-8.0	-46.5	-6.7	-45.85	-5.20	-40.57	-2.39	-29.50	-0.98
0.020–0.024	-46.9	-7.9	-46.7	-4.8	-44.09	-3.77	-36.87	-2.49	-24.75	-1.75
0.024–0.029	-45.2	-5.5	-45.7	-4.4	-42.03	-3.29	-32.87	-1.75	-20.32	-0.06
0.029–0.034	-44.6	-6.8	-43.5	-4.4	-38.47	-2.91	-28.78	-0.94	-16.15	-1.18
0.034–0.045	-42.3	-5.7	-38.3	-4.0	-32.48	-2.58	-22.85	-1.14	-10.96	0.83
0.045–0.057	-35.9	-3.5	-30.8	-2.3	-25.99	-0.72	-16.96	-0.31	-5.76	-0.02
0.057–0.072	-30.0	-2.6	-25.0	-0.1	-19.84	0.54	-11.11	0.83	-1.36	0.46
0.072–0.091	-23.5	-0.7	-18.9	0.8	-13.04	1.36	-6.04	0.97	2.79	1.85
0.091–0.114	-17.7	0.6	-12.6	0.9	-7.87	1.89	-1.43	1.64	5.51	0.95
0.114–0.165	-10.3	2.4	-5.7	3.3	-1.79	2.94	3.05	2.55	9.12	2.23
0.165–0.258	-1.9	4.8	1.9	4.8	5.23	4.84	7.89	3.74	11.13	2.02
0.258–0.524	5.9	7.7	8.1	7.5	9.61	6.40	10.07	5.32	10.52	4.14
0.524–1.153	5.4	4.9	5.8	4.7	5.99	4.20	5.23	3.04	4.07	2.07
1.153–3.277	0.9	-0.8	0.9	0.8	0.94	1.32	0.76	0.50	0.38	2.28

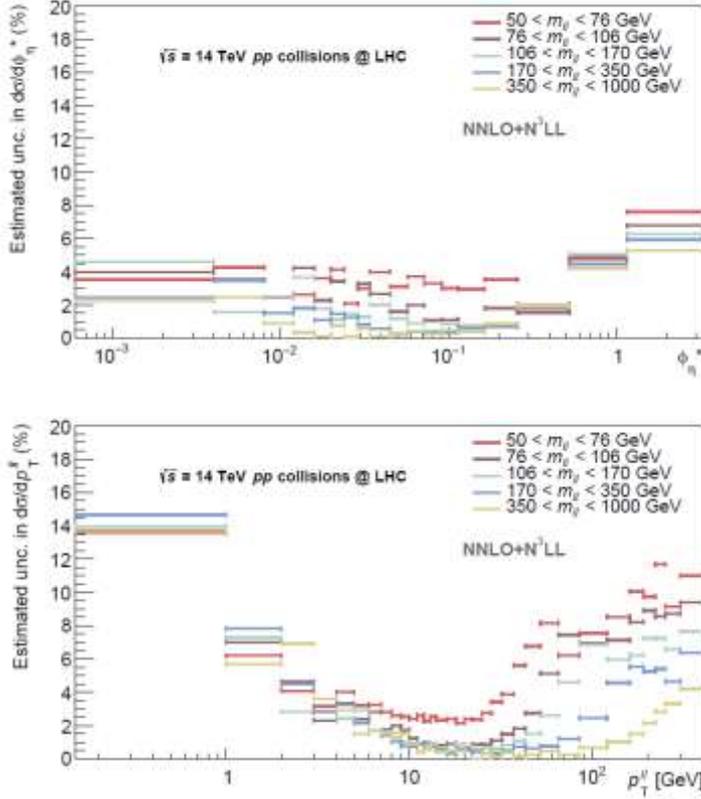


Figure 3. Achievable theoretical uncertainties in the predicted differential cross sections at NNLO+N³LL as functions of the ϕ^*_{η} (top) and p^{ll}_T (bottom) variables at 14 TeV

Next the combined NNLO QCD and NLO EW predictions are considered to assess the impact of EW radiation effects for the ϕ^*_{η} distributions in addition to the matched NNLO+N³LL predictions as presented before. EW corrections are expected to be significant towards higher regions of the differential cross sections as a function of the ϕ^*_{η} (p^{ll}_T) distribution. Consequently, EW corrections are of importance to accomplish a thorough description in the predicted distributions for different m_{ll} and y_{ll} ranges. In the course of NNLO QCD+NLO EW calculations, the dedicated NNPDF3.1 PDF sets with the LUXqed photon PDFs at the respective perturbative order are used apart from the ordinary PDF sets that are exploited before. The EW effects at NLO accuracy are found to have sizable impact on fiducial cross sections, notably in the lowest m_{ll} bin which amount up to $\sim 30\%$ as given in Table 2. The EW corrections amount to at most $\sim 5\%$ in the 76-1000 GeV range and all of them are predicted to be negative for the fiducial cross section. Conversely, the EW corrections are observed to be fully positive in the lowest m_{ll} bin.

In addition, the combined (N)NLO QCD+NLO EW predictions are compared with the 13 TeV CMS data [8] in bins of the m_{ll} for the ϕ^*_{η} observable as shown in Figure 4. The data-to-predictions agreement is found to be reasonably well with the inclusion of EW correction from moderate- to high- ϕ^*_{η} region. In the low- ϕ^*_{η} region, nonperturbative effects and enhanced logarithmic corrections are non-negligible. Discrepancies between data and (N)NLO QCD+NLO EW predictions in the low- ϕ^*_{η} region are more sizable in the lower m_{ll} bins such as 50-106 GeV, whereas discrepancies gradually decrease towards higher m_{ll} region. Therefore, matched predictions of NNLO+N³LL is still crucial for a reasonable

description of the low- $\phi^*\eta$ region. In future theoretical studies additional efforts can be put in place to have proper combinations of NNLO+N³LL and NLO EW corrections to achieve adequate predictions for the entire $\phi^*\eta$ region.

Table 2. Drell-Yan dilepton production cross sections at 13 TeV (top) and 14 TeV (bottom) in the fiducial phase space for different m_{ll} ranges based on the predictions at (N)NLO QCD and (N)NLO QCD+NLO EW. The amount of included corrections $\delta\sigma$ are given in percent (%) for different invariant mass m_{ll} ranges.

m_{ll} range: Predictions	50-75 GeV		75-100 GeV		100-170 GeV		170-350 GeV		350-1000 GeV	
	σ [pb]	$\delta\sigma$ (%)	σ [pb]	$\delta\sigma$ (%)	σ [pb]	$\delta\sigma$ (%)	σ [pb]	$\delta\sigma$ (%)	σ [pb]	$\delta\sigma$ (%)
NLO QCD	51.68 ± 6.2%	—	799.1 ± 4.8%	—	20.36 ± 3.7%	—	2.785 ± 2.2%	—	0.285 ± 1.3%	—
NLO QCD+NLO EW	39.81 ± 9.2%	25.7	779.5 ± 4.6%	-2.5	19.26 ± 3.2%	-4.5	2.708 ± 1.6%	-2.8	0.275 ± 1.4%	-3.7
NNLO QCD(r_{stat})	28.85 ± 2.8%	-9.0	769.2 ± 1.0%	-3.7	19.89 ± 0.8%	-1.3	2.735 ± 1.0%	-1.9	0.280 ± 0.5%	1.0
NNLO QCD(int)	26.63 ± 5.8%	-35.9	743.3 ± 1.8%	-7.0	18.65 ± 2.0%	-7.5	2.564 ± 1.8%	-7.9	0.290 ± 0.5%	1.9
NNLO QCD+NLO EW(r_{stat})	36.96 ± 6.7%	28.2	749.7 ± 1.0%	-2.5	18.99 ± 0.5%	-4.5	2.656 ± 0.5%	-2.8	0.278 ± 0.3%	-5.7
NNLO QCD+NLO EW(int)	34.45 ± 5.6%	29.4	733.7 ± 1.9%	-2.6	17.75 ± 2.1%	-4.8	2.487 ± 1.9%	-3.0	0.280 ± 0.4%	-3.6

m_{ll} range: Predictions	50-75 GeV		75-100 GeV		100-170 GeV		170-350 GeV		350-1000 GeV	
	σ [pb]	$\delta\sigma$ (%)	σ [pb]	$\delta\sigma$ (%)	σ [pb]	$\delta\sigma$ (%)	σ [pb]	$\delta\sigma$ (%)	σ [pb]	$\delta\sigma$ (%)
NLO QCD	33.70 ± 8.4%	—	853.2 ± 5.0%	—	21.63 ± 3.9%	—	2.995 ± 2.3%	—	0.312 ± 1.3%	—
NLO QCD+NLO EW	42.36 ± 9.5%	25.7	832.7 ± 4.8%	-2.4	20.65 ± 3.7%	-4.4	2.933 ± 1.7%	-2.7	0.300 ± 1.3%	-3.7
NNLO QCD(r_{stat})	30.76 ± 2.7%	-8.7	823.8 ± 0.9%	-3.5	21.33 ± 0.8%	-1.3	2.959 ± 0.9%	-1.2	0.314 ± 0.5%	0.7
NNLO QCD(int)	30.37 ± 3.2%	-9.9	802.1 ± 1.5%	-6.8	20.74 ± 1.8%	-4.0	2.811 ± 1.5%	-6.1	0.318 ± 0.6%	2.1
NNLO QCD+NLO EW(r_{stat})	39.42 ± 4.8%	28.2	803.3 ± 0.9%	-2.5	20.36 ± 0.5%	-4.5	2.856 ± 0.4%	-2.8	0.301 ± 0.2%	-3.7
NNLO QCD+NLO EW(int)	38.85 ± 4.9%	28.5	781.6 ± 1.5%	-2.8	19.77 ± 1.8%	-4.7	2.729 ± 1.3%	-2.9	0.306 ± 0.4%	-3.6

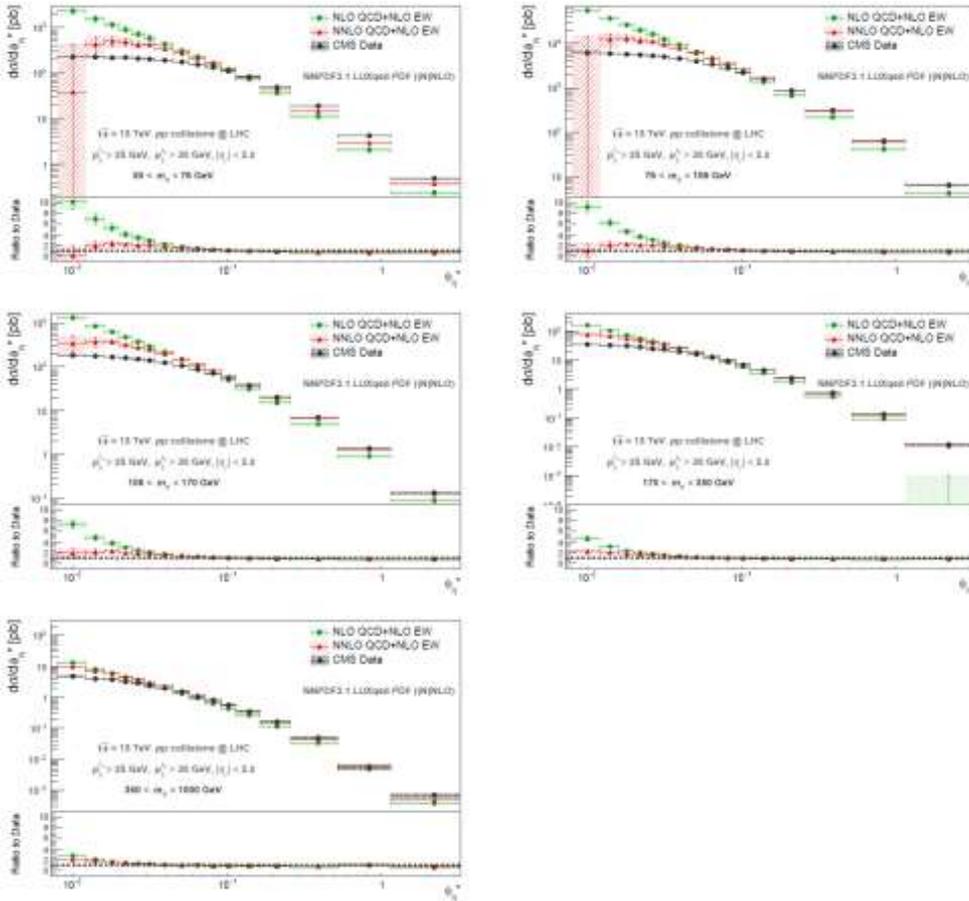


Figure 4. The predicted $\phi^*\eta$ distributions from the combined (N)NLO QCD+NLO EW predictions, compared with the CMS data in 5 different invariant mass m_{ll} ranges at 13 TeV

CONCLUSIONS

In this proceeding, we have presented an overview concerning the genuine predictions for the key observable $\phi_{\eta}^*(p_{\perp}^{\text{ll}})$ of the Drell-Yan dilepton production process $pp \rightarrow Z/\gamma^*+X \rightarrow l^+l^-+X$ with the inclusion of resummed and EW corrections combined with the fixed-order perturbative QCD calculations, NNLO QCD+N³LL and NNLO QCD+NLO EW, respectively. The predicted results are presented thoroughly in 5 different m_{ll} ranges between 50-1000 GeV and 5 different y_{ll} ranges in the central detector acceptance region 0-2.4 and stringently validated with experimental data at 13 TeV from the LHC. The NNLO+N³LL predictions are observed to provide the most accurate and precise (less than 5-6% level) description of the $\phi_{\eta}^*(p_{\perp}^{\text{ll}})$ distributions. Exceptionally tension is encountered between data and NNLO+N³LL towards higher ϕ_{η}^* values in the lowest m_{ll} range 50-76 GeV, which points to the need of accounting for EW effects and nonperturbative effects. The study revealed that NLO EW effects are positive and very sizable which are more pronounced in the lowest m_{ll} range 50-76 GeV. Conversely, EW effects are negative and less sizeable in going from the lowest m_{ll} range to higher m_{ll} ranges at both 13 TeV and 14 TeV. The impact of NLO EW corrections are reported to be significant, and thereby the predictions at NLO EW are vital for adequate description of the $\phi_{\eta}^*(p_{\perp}^{\text{ll}})$ distributions in addition to the matched NNLO QCD+N³LL predictions.

REFERENCES

- [5]. K. Ocalan, “Accurate prediction of the Drell-Yan ϕ_{η}^* distribution in wide dilepton mass and rapidity ranges in pp collisions through NNLO+N³LL”, Phys.Scripta, vol. 96, no.12, 125323, 2021.
- [6]. S. Catani, L. Cieri, G. Ferrera, D. deFlorian, and M. Grazzini, K. Ocalan, “Vector boson production at hadron colliders: a fully exclusive QCD calculation at NNLO”, Phys. Rev. Lett., vol. 103, 082001, 2009.
- [7]. M. Grazzini, S. Kallweit, and M. Wiesemann, “Fully differential NNLO computations with MATRIX”, Eur. Phys. J. C, vol. 78, 537, 2018.
- [8]. S. Kallweit, E. Re, L. Rottoli, and M. Wiesemann, “Accurate single- and double-differential resummation of colour-singlet processes with MATRIX+RadISH: W^+W^- production at the LHC”, J. High Energy Phys., vol. 12, 147, 2020.
- [9]. M. Grazzini, S. Kallweit, J. M. Lindert, S. Pozzorini, and M. Wiesemann, “NNLO QCD+NLO EW with Matrix+OpenLoops: precise predictions for vector-boson pair production”, J. High Energy Phys., vol. 02, 087, 2020.
- [10]. S. Catani and M. Grazzini, “An NNLO subtraction formalism in hadron collisions and its application to Higgs boson production at the LHC”, Phys. Rev. Lett., vol. 98, 222002, 2007.
- [11]. S. Catani, L. Cieri, D. de Florian, G. Ferrera, and M. Grazzini, “Vector boson production at hadron colliders: hard-collinear coefficients at the NNLO”, Eur. Phys. J. C, vol. 72, 2195, 2012.
- [12]. The CMS Collaboration, “Measurement of mass dependence of the transverse momentum of Drell-Yan lepton pairs in proton-proton collisions at 13 TeV”, CMS-PAS-SMP-20-003, Available: <https://cds.cern.ch/record/2764470>
- [13]. A. M. Sirunyan et al., “Measurements of differential Z boson production cross sections in proton-proton collisions at 13 TeV”, J. High Energy Phys., vol. 22, 061, 2019.

COMPUTATIONAL STUDY ON WIND FIELD DOMAIN AT DISTINCT WIND VELOCITY MAGNITUDES ACROSS HORIZONTAL AXIS WIND TURBINE FOR ESTIMATION OF POWER OUTPUT

Aniekan Essienubong Ikpe, Victor Etok Udoh

Department of Mechanical Engineering, Akwa Ibom State Polytechnic, Ikot Osurua

Emem Okon Ikpe

Department of Science Technology, Akwa Ibom State Polytechnic, Ikot Osurua

ABSTRACT

In this study, wind field domain at distinct wind velocity magnitudes across horizontal axis wind turbine was studied for estimation of power output. The high cost of wind turbine experiments necessitated this investigation. Details of the rotor (NACA 4610 airfoil), simulation parameters, Windfield parameters and Windfield velocity magnitudes were employed in FAST simulation module which formed the basis for unsteady Aeroelastic FAST simulation, analysis and post processing from internal database of QBlades software. Wind velocity magnitudes of 1.33-2.67, 2.67-5.33, 4.00-8.00 and 5.33-10.67 m/s as well as simulation time steps of 5, 10 and 15 seconds were fed into Q-Blade software and were also considered as conditions for simulation and estimation of power output (O_p) and power coefficient (C_p) in Artificial Neural Networking (ANN) tool. Simulated profile of wake vortex trajectories, wake distribution patterns behind the rotors and cut plots of wind velocity magnitudes were modelled based on the principles of cylindrical coordinate system or helical vortices. The O_p and C_p were examined from the wake vortex simulation models which produced maximum O_p of 2.71754 KW and C_p of 1.73265 at wind velocity magnitude of 10.67 m/s and simulation time step of 15s from ANN simulation. On the other hand, maximum O_p of 2.81354 KW and C_p of 1.83278 were obtained at the same wind velocity magnitude of 10.67 m/s and simulation time step of 15s from QBlade simulation. Cut plots of the wind velocity magnitude revealed that the incompressible flow field had stabilized and became higher at a simulation time step of 15s while wake velocity in the Windfield domain increased turbulently at wind velocity magnitude between 5.33 and 10.67 m/s, thereby, intensifying the wake effects for improved Windfield and power output.

Keywords: Wind turbine, Velocity magnitudes, Wake vortex, Windfield, Power output.

1. Introduction

In the year 2018, over 51 Gw of installed capacity of wind power was recorded in the world, with a growth rate of 9% and a total capacity of about 591 Gw (Jiang et al., 2020). This makes wind power one of the most viable solutions to the long term energy problem bedeviling power supply around the globe. Wind turbine is a rotating equipment that converts the kinetic energy in the wind flowing across its blade into mechanical energy. On the conversion of mechanical energy into electricity, the equipment becomes a wind generator, wind power unit (WPU), wind energy converter (WEC) or aero generator (Patel and Patel, 2012). In recent times, computational fluid dynamics which is one of the branches of fluid mechanics has been applied widely in computing the aerodynamic behaviour and performance of wind

turbine rotor blades. Wind turbine can be classified into two categories namely: Horizontal-Axis Wind Turbine (HAWT) and Vertical-Axis Wind Turbine (VAWT). HAWT is widely used and is more common in the wind energy market as a result of the advanced benefits and high efficiency it offers (Möllerström et al., 2019). Studies on aerodynamic related simulations have been centred on Computational Fluid Dynamics (CFD) due to its robust computational methods as well as the turbulent models and diverse degrees of complexity it incorporates. For example, compressible Euler Equations are employed in computations with very high Reynolds number that causes viscous effects to be negligible (Huysse et al., 2002; Whitney et al., 2002; Vatandas and Özkol, 2008), otherwise, compressible or incompressible Reynolds Averaged Navier-Stokes Equations are used (Ribeiro et al., 2012). A number of studies has been conducted on horizontal axis wind turbine. For example, Bakırc and Yılmaz (2018) theoretically and computationally investigated the optimal tip-speed ratio of horizontal-axis wind turbines. Two standard airfoils with aerodynamic properties were selected and six different HAWT geometries were generated using the Schmitz formula. The six HAWTs had an average maximum power coefficient of 0.54 and an OTSR of 8.2 when the airfoil properties given in the airfoil catalogue were used; these values were 0.43 and 6.7, respectively, when the airfoil properties were calculated using CFD and 0.41 and 7.3 when the HAWTs were simulated using three-dimensional CFD. Three dimensional (3D) modelling of the wind flow trajectories and its characteristic effects on horizontal axis wind turbine at different wind regimes were carried out by Etuk and Ikpe (2020). The power and the coefficient of power were examined from the wake vortex simulation while the flow velocity cut plots at different wind speeds (2, 4, 6 and 8 m/s) and time steps (2, 4 and 6 s) were obtained using Q-Blade software. The results revealed that, while the power coefficient was observed to decrease and increase with increasing wind speed, the power output increased variably from 0.0416903 to 2.51354 kW as the wind speed also increased from 2 to 8 m/s at peak time step of 6s. Arun and Surya (2010) designed a horizontal axis wind turbine with two different airfoil sections including the straight and swept back pattern using QBlade. The straight blade design produced 250KW of power at peak wind speed of 36m/s while the swept back bade produced 310 KW of power at peak wind speed of 40m/s, indicating that the swept back blade design outperformed the straight blade pattern. Mikkelsen (2013) investigated the effect of free stream turbulence on a model wind turbine's performance characteristics and the wake development downstream using a reference wind speed of 10 m/s. The wind turbine was found to operate most efficiently at $TSR \approx 6$, the peak power coefficient (C_p) without free stream turbulence was 0.461, while C_p of 0.45 was obtained with free stream turbulence. Hence, the power coefficient seemed to be slightly reduced with increased levels of turbulence, except at low tip speed ratios where the effect of stall dominated. In this study, wind field domain was computed at distinct wind velocity magnitudes across horizontal axis wind turbine for estimation of power output.

2. Research Methods

2.1. Wind field simulation

Flow around the wind turbine rotor blades was modelled using Blade Element Momentum (BEM) theory, by employing the airfoil sectional data. The BEM theory is a model that evaluates the performance of propelling or extracting turbine on the basis of its mechanical and geometric parameters as well as the characteristics of flow and Windfield domain around the turbine rotor blades. In recent times, the air foil have been found to depend heavily on the principles of unsteady flow which which forms the computational wind domain in this study. (Sørensen, 2011; Devinant et al., 2002). The airfoil data was

practically obtained from a wind tunnel experiments and computed through conventional methods such as computational fluid dynamics or aerodynamic design methods. The experiments were conducted using analogue PLINT & Partners Subsonic wind tunnel machine; carried out at the exit area of the wind tunnel, with a measurements section of 0.487 m by 0.487 m (width) \times 0.95 m (height); center-line (reference point) from ground level, with a maximum wind velocity of 30 m/s. In this study, the flow around a rotor blade was modelled using blade element/momentum theory embedded in QBlade software. A generator for turbulent windfields and module to generate a simplified structural model is integrated in QBlade v0.8 which was used to setup a FAST unsteady aeroelastic simulation reported in this study. The wind turbine wakes were modelled as is the case in cylindrical coordinate system or helical vortices which represents the region where the flow is spinning about an axis. Hence, the wind velocity flow field in a cylindrical coordinate system, is described (Zheng et al., 2018) as follows:

$$u_\rho = \frac{\Gamma}{2\pi l} \sqrt[4]{(l^2 + \rho^2)(l^2 + a^2)} \text{Im} \left\{ \frac{e^{ix}}{e^{\pm\xi} - e^{-ix}} \pm \frac{l}{24} \left[\frac{2l^2 + 9a^2}{(l^2 + a^2)^{3/2}} - \frac{2l^2 + 9\rho^2}{(l^2 + \rho^2)^{3/2}} \right] \log(1 - e^{\pm\xi + ix}) \right\}, \quad (1a)$$

$$u_z = \frac{\Gamma}{2\pi l} \begin{Bmatrix} 1 \\ 0 \end{Bmatrix} + \frac{\Gamma}{2\pi l} \frac{\sqrt[4]{(l^2 + a^2)}}{\sqrt[4]{(l^2 + \rho^2)}} \text{Re} \left\{ \frac{\pm e^{ix}}{e^{\pm\xi} - e^{-ix}} + \frac{l}{24} \left[\frac{3\rho^2 + 2l^2}{(l^2 + \rho^2)^{3/2}} + \frac{2l^2 + 9a^2}{(l^2 + a^2)^{3/2}} \right] \log(1 - e^{\xi + ix}) \right\} \quad (1b)$$

$$u_\phi = \frac{\Gamma}{2\pi l} - \frac{lu_z}{\rho} \quad (1c)$$

where u_ρ , u_z and u_ϕ are the velocities in ρ , z and ϕ coordinates, Γ is the circulation of the vortex filament and a is the radius of the helical vortex. To avoid singularity at the mid-section of the helical vortex filament which may result in overestimated velocity values in the airflow close to the vortex centre, flow velocity around the helix is modelled as the rotation core axis (Fukumoto and Okulov, 2005; Mulinazzi and Zheng, 2014). Turbulent Windfield Generator which is a submodule of QBlade uses the Sandia Method to create turbulent windfield. The QBlade simulation interface is presented in Figure 1.



Figure 1: QBlade simulation interface

The windfield profiles generated were further used in a FAST simulation. From inside the FAST module, aeroelastic FAST simulation was set up, simulated and post processed from QBlades internal database. To setup a FAST simulation for the windfield, boundary conditions consisting of the rotor blade details, simulation parameters, windfield parameters and the blade structure were specified in the parameter tab as shown in Table 1 while the flow parameters employed in the wind field simulation are presented in Table 2. This enabled the visualization of different time steps using the slider inside the toolbar.

Table 1: Boundary conditions the wind field simulation

Wind field Parameter	Simulation Parameter	Wind velocities	Environment
Time: 60s	Hub Height: 15 m	1.33-2.67,	Gravity: 9.81 m/s ²
Time steps: 100	Measurement Height: 15 m	2.67-5.33,	Air Dens: 1.225 k/m ³
Points per direction: 40	Turbulence Intensity: 5%	4.00-8.00,	Kin Visc: 1.4661e-05 m/s
No of blades: 3	Include Shear Layer: True	5.33-10.67 m/s	Temperature: 300 K
Nacelle Yaw: 0 Deg	Roughness Length: 1e-02 m		Pressure: 102.126 Pa

Table 2: Flow parameters employed in the wind field simulation

Type of simulation	Steady simulation
Type of flow	Incompressible flow
Fluid material	Air
Turbulence model	SST k- ω
Kinematic viscosity	$1.4607 \times 10^{-5} \text{ m}^2/\text{s}$
Solution methods	Pressure-velocity coupling
	Least-squares cell based
	Pressure (standard); density (second-order upwind)
	Momentum (second-order upwind)
	Turbulent kinetic energy (first-order upwind)
	Specific dissipation rate (first-order upwind)
Wind regime	IEC Class 1A
Rotor orientation	Upwind
Rotation	Clockwise
Control	Variable speed, Pitch-regulated, Yaw controlled
Hub height	119.0 m
Hub overhang	7.1 m
Shaft tilt angle	5°
Rotor precone angle	-2.5°
Blade prebend	3.332 m

A structured Cartesian mesh was created which works efficiently in conjunction with the solver utilised in this study. Local refinement was made in the lower region of the domain which includes the turbine rotors and wake regions. The total number of mesh cells in the domain was 70.6×10^6 with a constant mesh size of 3.0m^3 in the refined regions. This corresponded to 42 cells per rotor diameter, or ≈ 1375 cells over the rotor swept area. The degrees of freedom for the structural model (FlapDOF 1&2, EdgeDOF) was enabled in order to effectively observe the simulation iterations through visual process. The simulation was initiated by pressing the start simulation button from the dock. When the simulation was completed, the FAST results were automatically loaded inside QBlades database for observation. The theory and mathematical formulations upon which the simulation in this study is based are already embedded in the software, and can be expressed in the following Equations: The log law origins line in boundary layer fluid mechanic and atmospheric research for determining the horizontal velocity at height

z is commonly expressed as.

$$V(z) = \frac{V_1}{K} \ln \frac{z}{Z_0} \quad (2)$$

Where V is the friction velocity, K is the Von Karman constant and Z₀ is a measure of surface roughness known as roughness length. There are cases where wind velocity V₁ is known at a reference height Z₁, and required at another Z₂, in which case it can be derived from Equation 3 that:

$$V_2 = V_1 \frac{\ln(Z_2) - \ln(Z_1)}{\ln(Z_1) - \ln(Z_0)} \quad (3)$$

The Spalart-Allmaras model is a relatively simple one-equation model that solves a modeled transport equation for the Kinematic eddy (turbulent) viscosity (Deck et al. 2002). In the turbulence model of Spalart-allmaras the transport equation can be written in the form of the operating parameter \tilde{V} , as

$$\frac{d\tilde{V}}{dt} = ca_1(1 - f_{t2})\tilde{S}\tilde{V} + \frac{1}{\sigma} \left[\nabla \cdot \left((V + \tilde{V}) \nabla \tilde{V} + ca_2(\nabla \tilde{V})^2 \right) \right] - \left(C_{b1}f_w - \frac{ca_1}{K^2} f_{t2} \right) \left(\frac{\tilde{V}}{d} \right)^2 + f_{t1}\Delta U^2 \quad (4)$$

Where V is the molecular viscosity, the four terms on the right hand side correspond to production, diffusion, dissipation and transition respectively. The individual components of the production term is expressed in Equation 5-7:

$$\tilde{S} \equiv S + \frac{\tilde{V}}{k^2 d^2} \left[1 - \left(\frac{\tilde{V}}{V} \right) \left[1 + \frac{\left(\frac{\tilde{V}}{V} \right)^4}{\left[\left(\frac{\tilde{V}}{V} \right)^3 + C_{v1}^3 \right]} \right]^{-1} \right] \quad (5)$$

$$f_w = \frac{\tilde{V}}{\tilde{s}k^2 d^2} \left[1 + C_{b2} \left(\left(\frac{\tilde{V}}{\tilde{s}k^2 d^2} \right)^5 - 1 \right) \right] (1 + C_b^6)^{\frac{1}{6}} \left[\left[1 + C_{b2} \left(\left(\frac{\tilde{V}}{\tilde{s}k^2 d^2} \right)^5 - 1 \right) \right] + C_{b3}^6 \right]^{-\frac{1}{6}} \quad (6)$$

$$f_{t1} = C_{t1}g_t \exp \left[-C_{t2} \frac{b_t^2}{\Delta U^2} (d^2 + g_t^2 d_t^2) \right], \quad f_{t2} = C_{t3} \exp \left[-C_{t4} \left(\frac{\tilde{V}}{V} \right)^2 \right] \quad (7)$$

Where S is the magnitude of the vorticity, d is the distance to the closest wall, dt is the distance from the point in the flow field to the trip on the wall, w_t is the wall vorticity at the trip, ΔU is the difference between velocity at the field point and that at the trip.

gt = min(0.1, ΔU/wt ΔXt) where ΔXt is the grid spacing along the wall at the trip. The empirical constants of the spalart-Allmaras model are: C_{a1} = 0.1355, σ = 2/3, C_{a2} = 0.622, k = 0.4187, C_{b1} = 3.239, C_{b2} = 0.3, C_{b3} = 2.0, C_{v1} = 7.1, C_{t1} = 1, C_{t2} = 2, C_{t3} = 1.22, and C_{t4} = 0.5.

2.2. Artificial Neural Network (ANN) Modelling

A neural network is a data mining tool for discovering unidentified patterns in databases. It is a massive parallel distributed processor with a natural proclivity for storing experimental knowledge and making it available for use. It is similar to the brain in two ways. Cognition is acquired by the network through a learning process, and knowledge is stored using interneuron connection strengths known as synaptic weights. A basic neuron with R input is weighted with the appropriate w. The input to the transfer function f is formed by the sum of the weighted inputs and the bias. Neurons can generate their output using any differentiable transfer function. The log-sigmoid transfer function logic is commonly used in multilayer networks.

As the neuron's net input changes from negative to positive infinity, the function logic generates outputs

ranging from 0 to 1. One of the fundamental problems with Artificial Neural Networks is their inability to accurately predict response variables in the absence of a design of experiment. As a result, the performance of ANN is dependent on the beauty of the experimental design. As a result, the ANN predictive model was used to predict the response variables beyond the scope of the experiment. For neural network modelling, sixty (60) experimental data points were generated by replicating the design matrix from the CCD. The experimental data were first normalized to avoid the issue of weight variation, which can lead to overtraining, a major limitation in neural network modelling. The raw training data and normalized form of the data used in neural network modelling had several input variables designated as In1, In2, In3, In4 and so on, representing the boundary conditions for the Windfield simulation in Table 1. Power output and power coefficients (O_p and C_p) are represented by the output variables out1 and out2. The ANN simulation conditions were to optimize the output responses.

2.2.1. Selection of Training Algorithm and Hidden Neurons

In the application of neural networks to data modelling and prediction, input and output data training that results in the design of network architecture is critical. Two factors were considered in order to obtain the optimal network architecture with the most accurate understanding of the input and output data: the selection of the most accurate training algorithm and the number of hidden neurons. Various training algorithms and hidden neurons were chosen and tested based on this consideration to determine the best training algorithm and accurate number of hidden neurons that will produce the most accurate network architecture. The coefficient of determination (r^2) and mean square error were used to determine selectivity (MSE). Table 3 shows the performance of the different training algorithm tested.

Table 3: Selection of optimum training algorithm for ANN

S/No	Training Algorithm (Learning Rule)	Training MSE	Cross Validation MSE	R-Square (r^2)
1	Hopfield	0.003572	0.00338	0.71
2	Generalized Regression	0.007641	0.00229	0.82
3	Gradient and rate of change of gradient (Quick prop)	0.003870	0.00271	0.77
4	Adaptive step sizes for gradient plus momentum (Delta Bar Delta)	0.004411	0.00509	0.83
5	Second order method for gradient (Conjugate gradient)	0.06333	0.00558	0.79
6	Improved second order method for gradient (Levenberg Marquardt)	0.0000221*	0.000023*	0.97*

The results of the training algorithm in Table 3 revealed that the improved second order gradient method, also known as the Levenberg Marquardt Back Propagation training algorithm, was the best learning rule and was thus used to design the network architecture. Different numbers of hidden neurons were chosen to create a trained network using the Levenberg Marquardt Back Propagation training algorithm to

determine the exact number of hidden neurons. The trained network's performance was evaluated using mean square error (MSE) and coefficient of determination (r^2). To design the network architecture, the number of hidden neurons with the lowest MSE and highest r^2 as shown in Table 4 was chosen.

Table 4: Selection of optimum number of hidden neurons for ANN

S/No	Number of Hidden Neurons	Training MSE	Cross Validation MSE	R-Square (r^2)
1	2	0.00336	0.00772	0.88
2	4	0.00488	0.00908	0.74
3	6	0.00567	0.00156	0.86
4	8	0.00399	0.00993	0.86
5	10	0.000201*	0.000027*	0.98

Tables 3 and 4 indicates how a Levenberg Marquardt Back Propagation training algorithm with 10 hidden neurons in the input and output layers was used to train a network of three input processing elements (Pes) and one output processing element. The hyperbolic tangent (tan-sigmoid) transfer function is used by the network's input layer to calculate the layer output from the network input, while the linear (purelin) transfer function is used by the network's output layer. The number of hidden neurons per layer was set to ten, and network performance was measured using the mean square error of regression (MSEREG). The following parameters were used: learning rate of 0.01, momentum coefficient of 0.1, target error of 0.01, analysis update interval of 500, and maximum training cycle of 1000 epochs. The input data is divided into training data sets, validation data sets, and testing data sets during the network generation process. For this study, 60% of the data was used for network training, 25% for network validation, and the remaining 15% was used to test the network's performance. Using these parameters, an optimal neural network architecture, as shown in Figure 2, was generated.

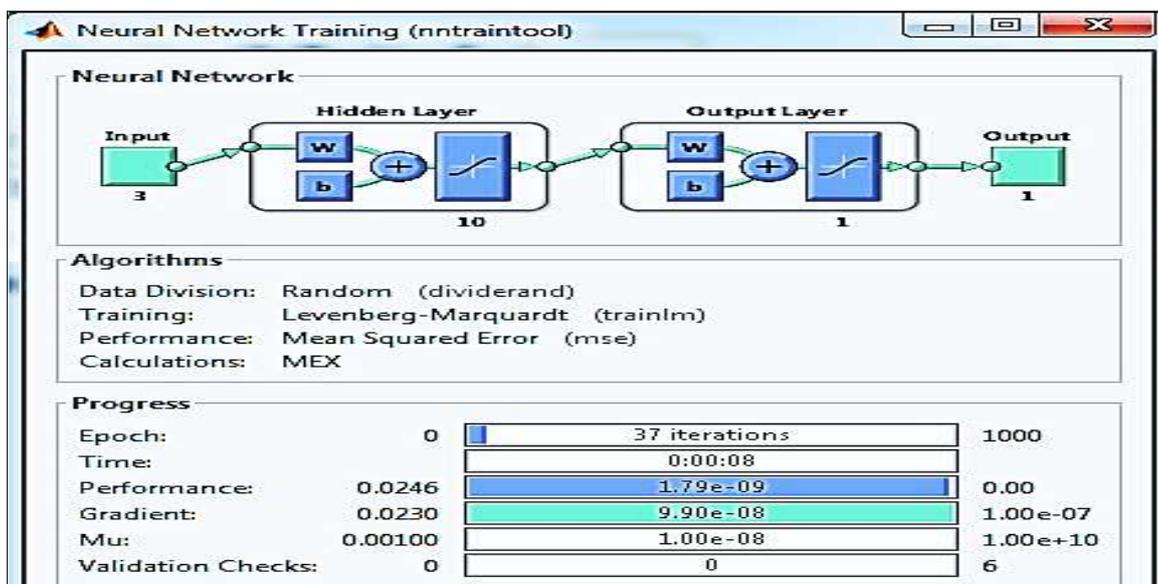


Figure 2: Artificial neural network architecture

From the network training profile, the network performance was approximately 100% which is significantly good, with a performance error of $1.79e^{-09}$ which is far lesser than the set target error of 0.01.

The maximum number of iteration needed for the network to reach this performance was observed to be 37 iterations which is also lesser than the initial 1000 epochs. The gradient function was calculated to be $9.90e^{-08}$ with a training gain (Mu) of $1.00e^{-08}$. Validation check of zero was recorded which is expected since the issue of wieht biased had been addressed via normalization of the raw data. Figure 3 depicts a performance evaluation plot that shows the progress of training, validation, and testing.

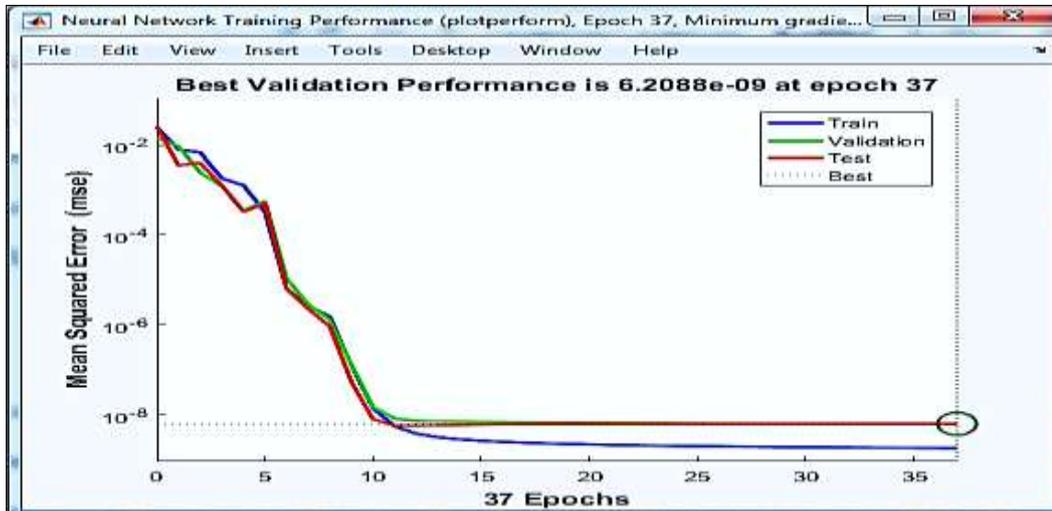


Figure 3: Performance curve of trained network for predicting power generation

From the performance plot in Figure 3, no evidence of over fitting was observed. However, similar trend was observed in the behavior of the training, validation and testing curve which is expected since the raw data were normalized before use. Lower mean square error is a fundamental criteria used to determine the training accuracy of a network. At epoch 37, an error value of $6.2088e^{-09}$ is an indication that the network has a strong capacity to predict the O_p and C_p . The training state is depicted in Figure 4, which includes the gradient function, training gain (Mu), and validation check.

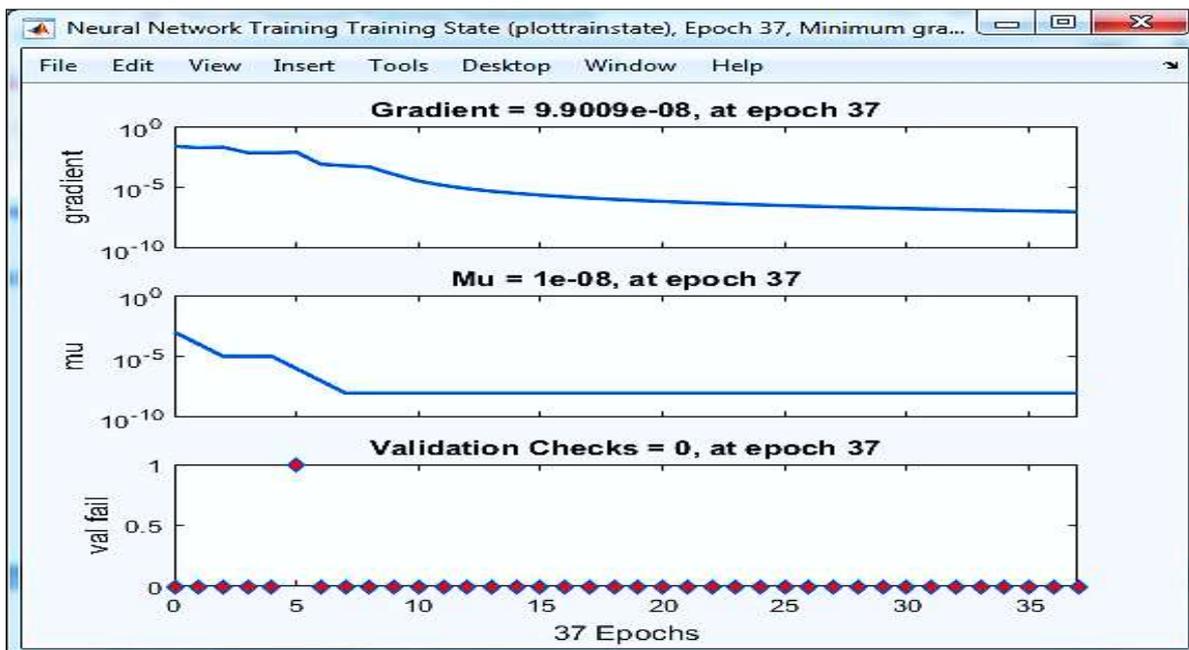


Figure 4: Neural network training state for predicting power generation

Back propagation is a technique used in artificial neural networks to calculate each neuron's error contribution after a batch of data training (Ikpe et al., 2019). To explain the error contributions of each of the selected neurons, the neural network calculates the gradient of the loss function, the lower the error, the better. Figure 4 shows that the computed gradient value of $9.90009e-08$ which indicates that the error contributions of each selected neuron are very small.

Momentum gain (Mu) is a control parameter for the neural network training algorithm. It is the training gains, with a value less than one. A network with a momentum gain of $1.0e-08$ has a high capacity to predict power generation. Figure 5 depicts a regression plot that shows the relationship between the input variables gas pressure (FPG2), ambient temperature (INLET), compressed temperature difference (CTD), and target variable power generation (M/Watts), as well as the progress of training, validation, and testing.

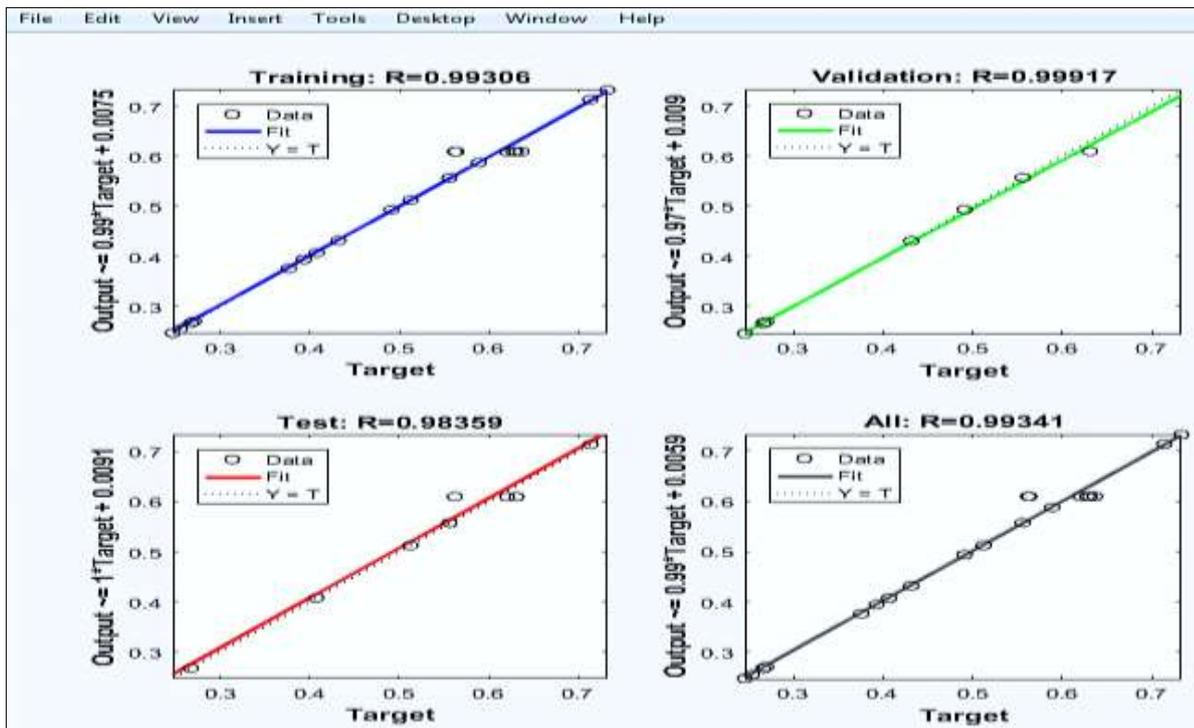


Figure 5: Regression plot showing the progress of training, validation and testing

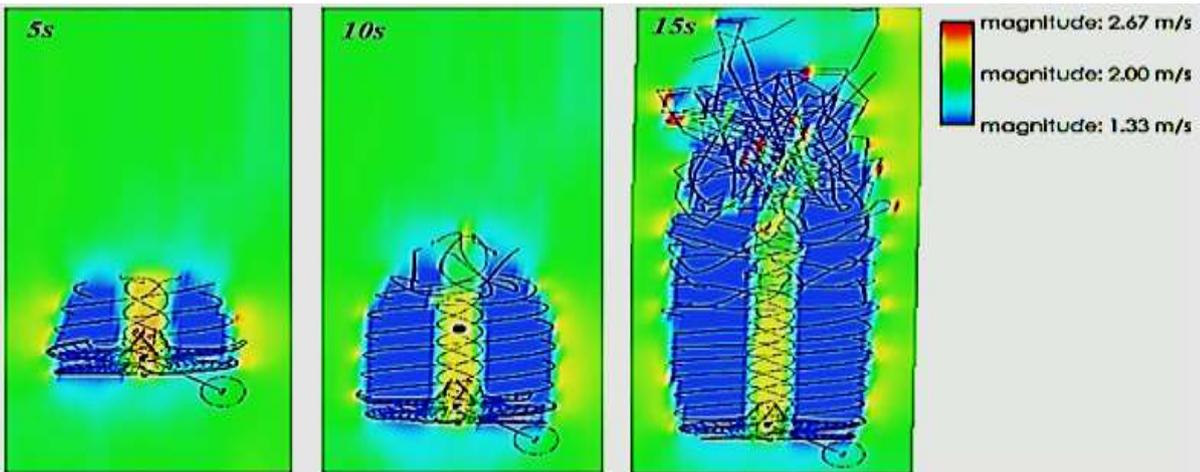
Based on the computed values of the correlation coefficient (R) as observed in Figure 5, it was concluded that the network has been accurately trained and can be employed to predict O_p and C_p beyond the scope of experimentation. To test the reliability of the trained network, the network was employed to predict its own value of O_p and C_p using the same input parameters generated from the central composite design.

3. Results and Discussion

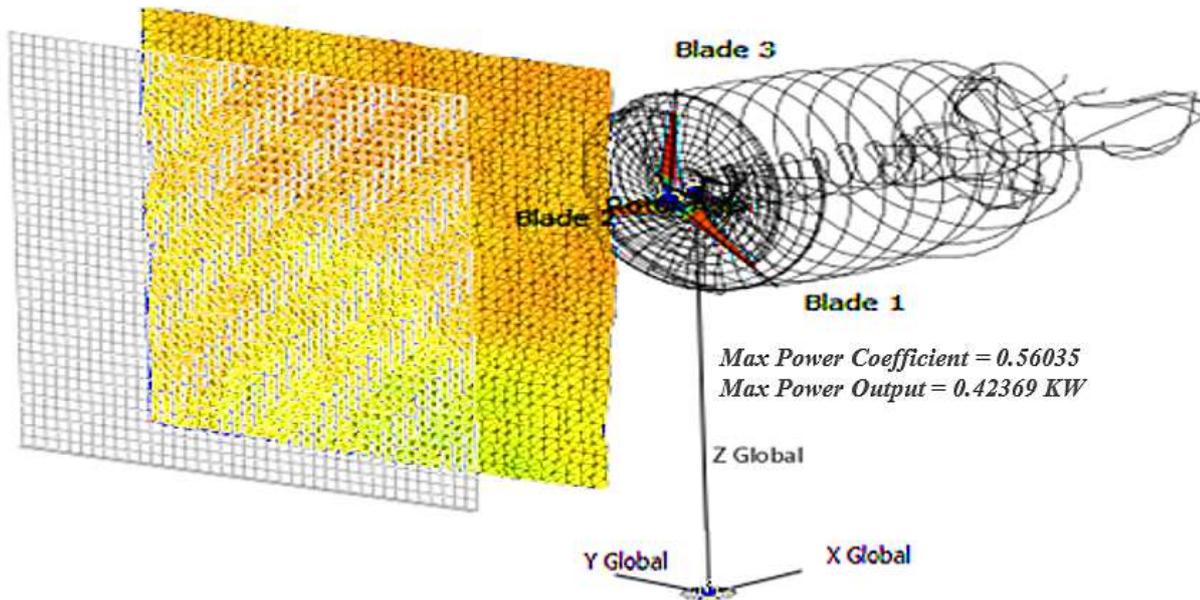
3.1. Wake Effects and Wind Velocities on Power Outputs

The following diagrams (Figure 6-9a-b) show the vortex flow and the velocity cut plots simulated at different wind speeds, while power and wake properties are examined. The simulation data from the turbine LLT simulation coupled with the different wind fields previously simulated are applied. A rotor overhang length of 0.6m and a hub height of 15m was used. The upwind type simulation was selected; the rotor shaft tilt was set at 5 deg in the downward direction. A TSR of 5 was selected for all scenarios

and the simulation was run for 10s time steps. Models developed for wind field domain in the study, represented the distribution of surface plot of the wind perpendicular to the turbine axis. All wind heights were taken at 15m and a constant turbulence of 5%. A wind shear of 0.001m which was assumed for all wind fields. From Figure 6a, it can be observed that as the simulation time progressed, velocity magnitude of wind along the axis of the turbine increased from 1.33-2.67 m/s. Therefore, wake shedding began to occur at about halfway across the cut plane at 10s, and at 15s, the wind velocity magnitude is observed to have developed fully. This resulted in maximum power coefficient of 0.560359 and maximum power output of 0.42369 KW as shown in Figure 6b. The results were recorded after 15s. The summary is presented in Figure 6c which illustrates the plot of power outputs against wind velocity magnitudes (1.33-2.67 m/s) and simulation time steps (5-15 s).



a.



b.

Figure 6: a. Cut plots of wind velocity magnitudes (1.33-2.67 m/s) @ 5, 10 and 15 s, b. simulated profile of wake vortex trajectories @ the same wind velocity

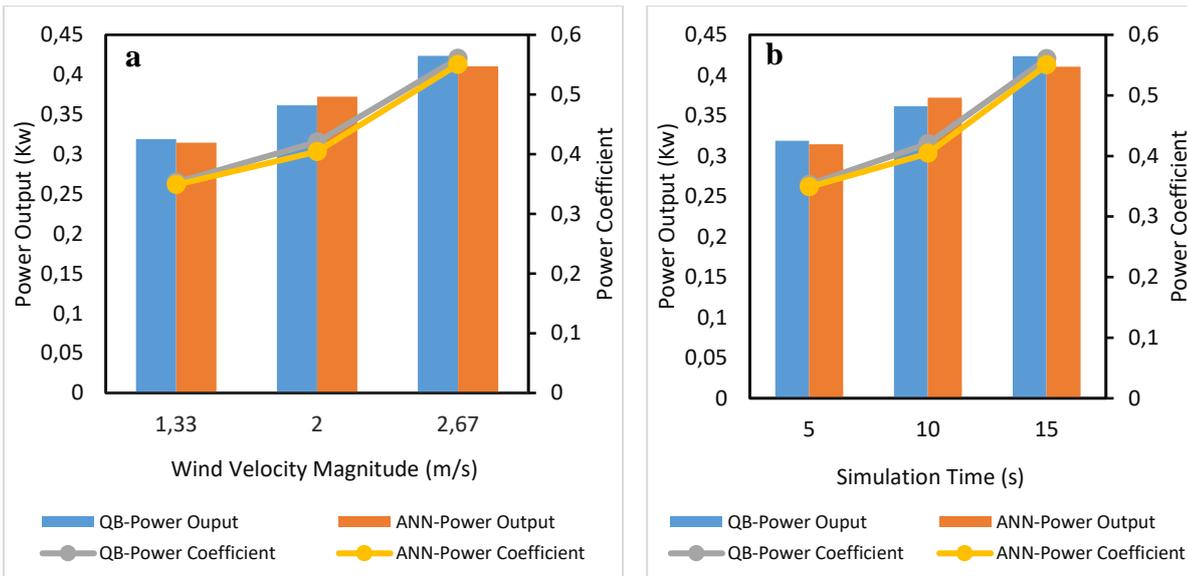
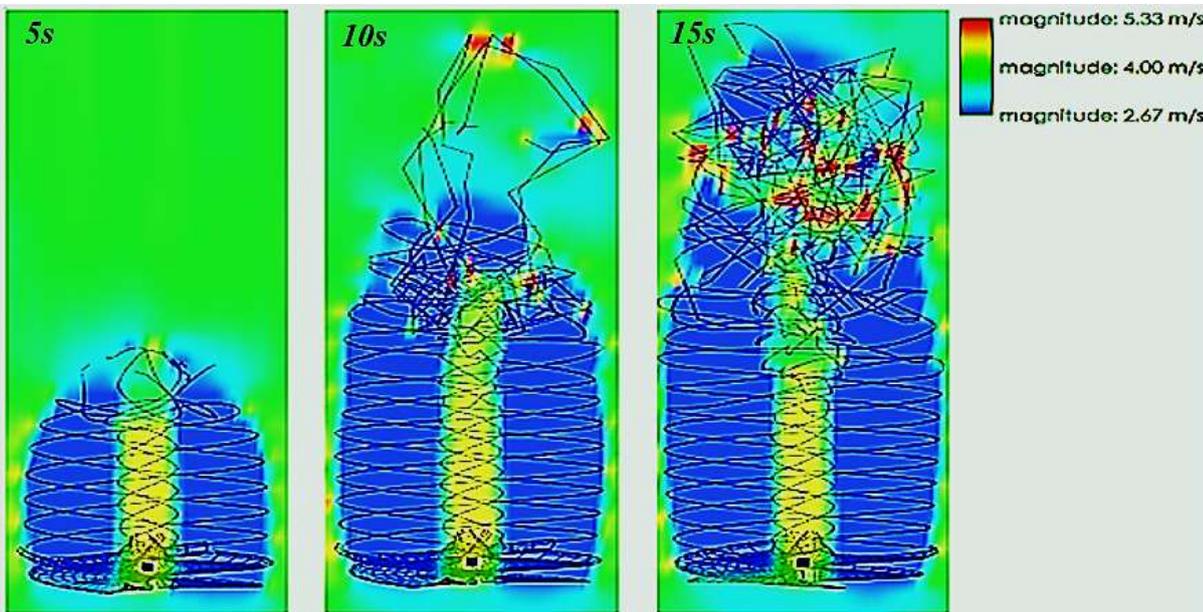
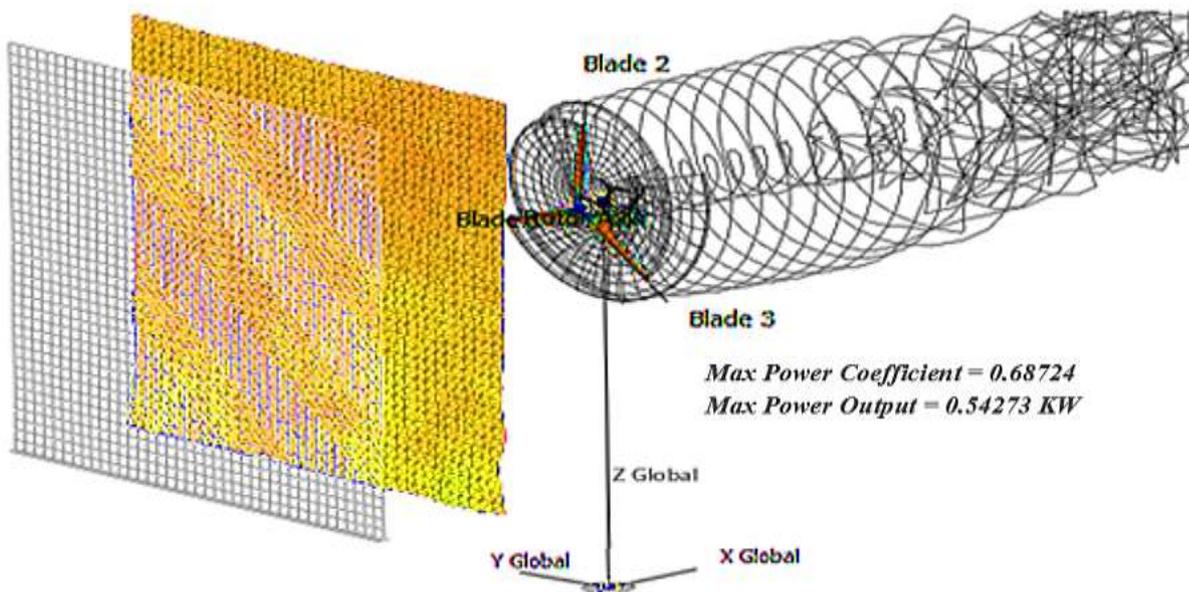


Figure 6c: Plot of power outputs against wind velocity magnitudes (1.33-2.67 m/s) and simulation time steps (5-15 s)

From Figure 7a, it is observed that velocity magnitude of wind along the axis of the turbine increased from 2.67-5.33 m/s as the simulation time step progressed from 5-15s. Therefore, wake shedding also commence at about halfway across the cut plane at 10s, and at 15s, the wind velocity magnitude is observed to have developed fully. This resulted in maximum power coefficient of 0.68724 and maximum power output of 0.54273 KW as shown in Figure 7b. The results were recorded after 15s. The summary is presented in Figure 7c which shows the plot of power outputs against wind velocity magnitudes (2.67-5.33 m/s) and simulation time steps (5-15 s).



a.



b.

Figure 7: a. Cut plots of wind velocity magnitudes (2.67-5.33 m/s) @ 5, 10 and 15 s, b. simulated profile of wake vortex trajectories @ the same wind velocity

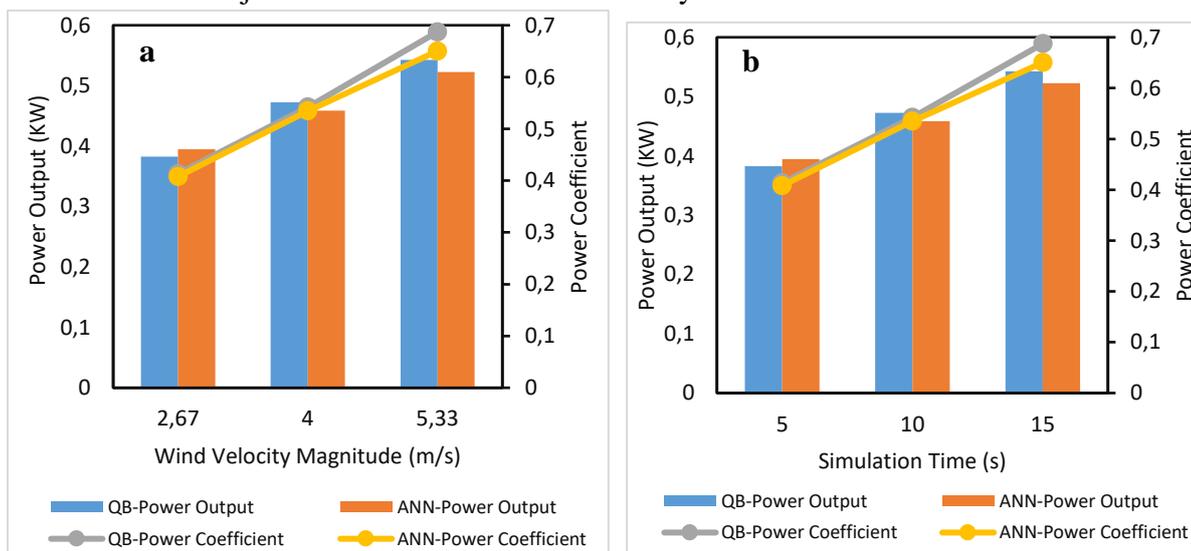
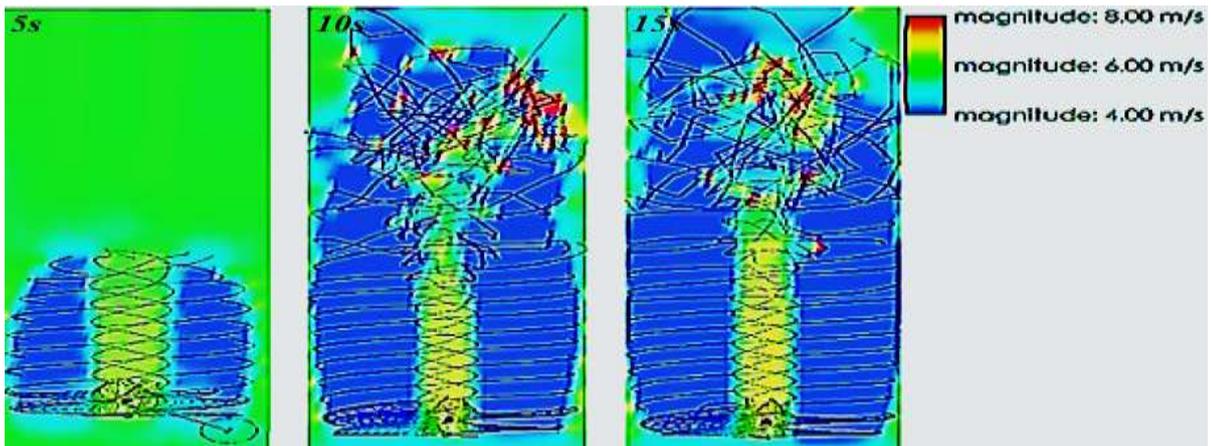
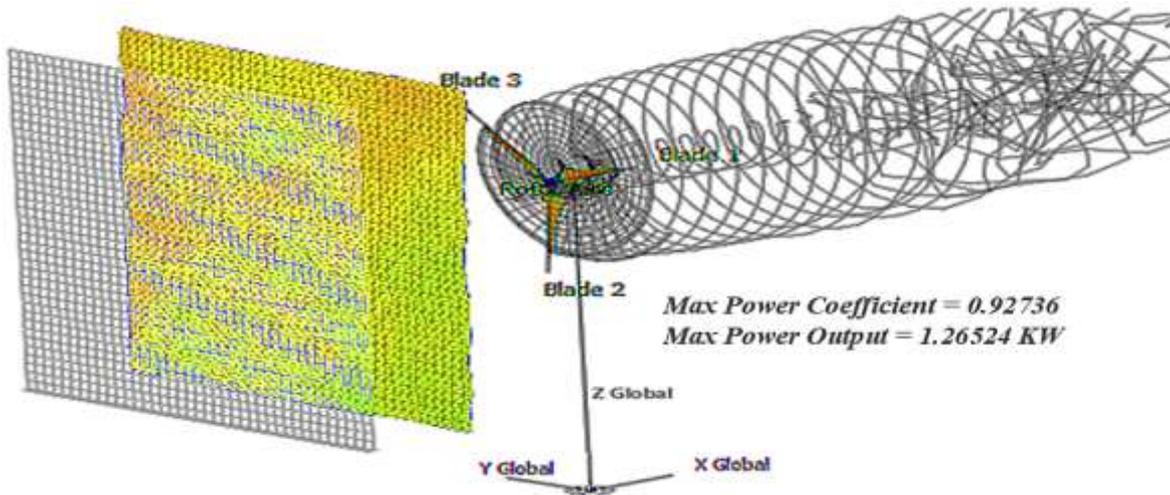


Figure 7c: Plot of power outputs against wind velocity magnitudes (2.67-5.33 m/s) and simulation time steps (5-15 s)

From Figure 8a, it is observed that velocity magnitude of wind along the axis of the turbine increased from 4.00-8.00 m/s as the simulation time step progressed from 5-15s. The cut plots of wind velocity magnitudes at 10 and 15s were uniform, and looked similar, although that of 15s looked more intense. The cut plots showed greater wake shedding and turbulence at 10 and 15s compared to the velocity cut plots at 5 s. This led to maximum power coefficient of 0.92736 and maximum power output of 1.26524 KW as shown in Figure 8b. The results were recorded after 15s. The summary is presented in Figure 8c which shows the plot of power outputs against wind velocity magnitudes (4.00-8.00 m/s) and simulation time steps (5-15 s).



a.



b.

Figure 8: a. Cut plots of wind velocity magnitudes (4.0-8.0 m/s) @ 5, 10 and 15 s, b. simulated profile of wake vortex trajectories @ the same wind velocity

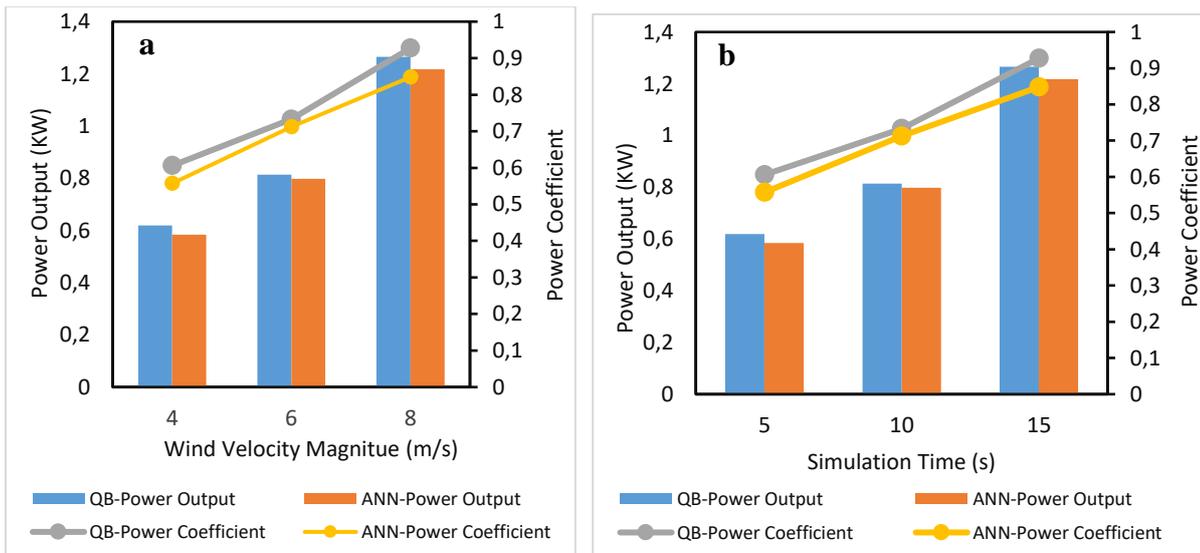
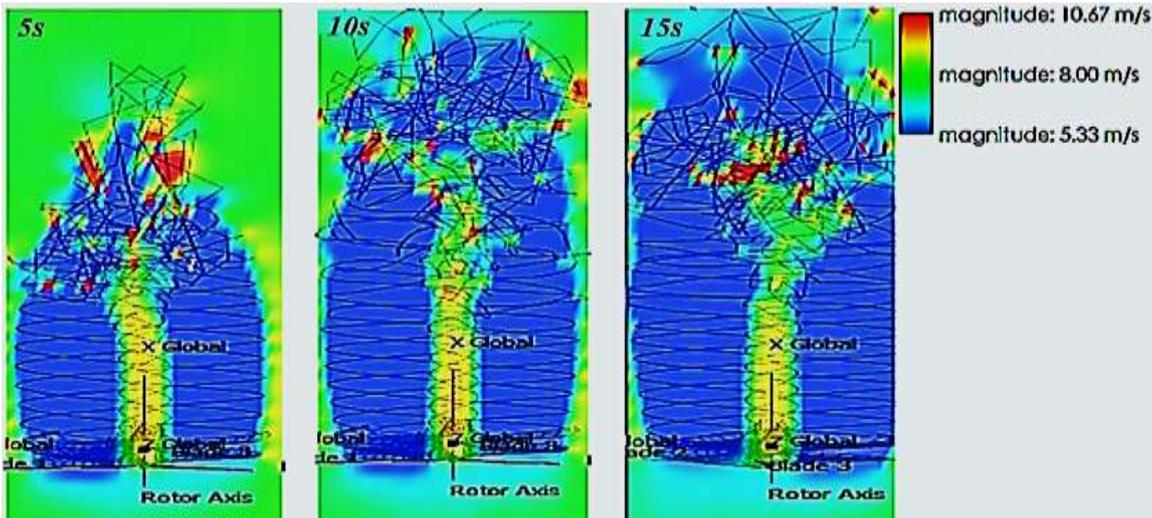
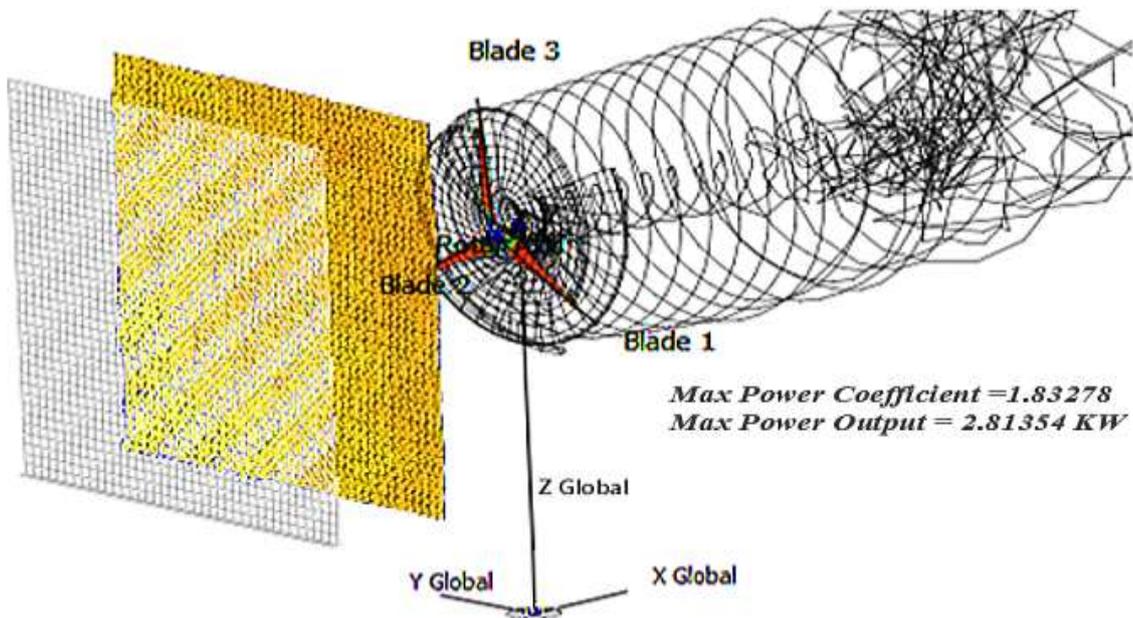


Figure 8c: Plot of power outputs against wind velocity magnitudes (4.0-8.0 m/s) and simulation time steps (5-15 s)

From Figure 9a, it is observed that velocity magnitude of wind along the axis of the turbine increased from 5.33-10.67 m/s as the simulation time step progressed from 5-15s. The cut plots of wind velocity magnitudes at 10 and 15s were uniform, and looked similar, although that of 15s looked more intense. The cut plots showed greater wake shedding and turbulence at 10 and 15s compared to the velocity cut plots at 5 s. The wind turbulence and flow length at velocity magnitude 5.33-10.67 m/s is observed to be higher than the ones obtained from previous plots. This led to maximum power coefficient of 1.83278 and maximum power output of 2.81354 KW as shown in Figure 9b. The results were recorded after 15s. The summary is presented in Figure 9c which shows the plot of power outputs against wind velocity magnitudes (5.33-10.67 m/s) and simulation time steps (5-15 s).



a.



b.

Figure 9: a. Cut plots of wind velocity magnitudes (5.33-10.67 m/s) @ 5, 10 and 15 s, b. simulated profile of wake vortex trajectories @ the same wind velocity

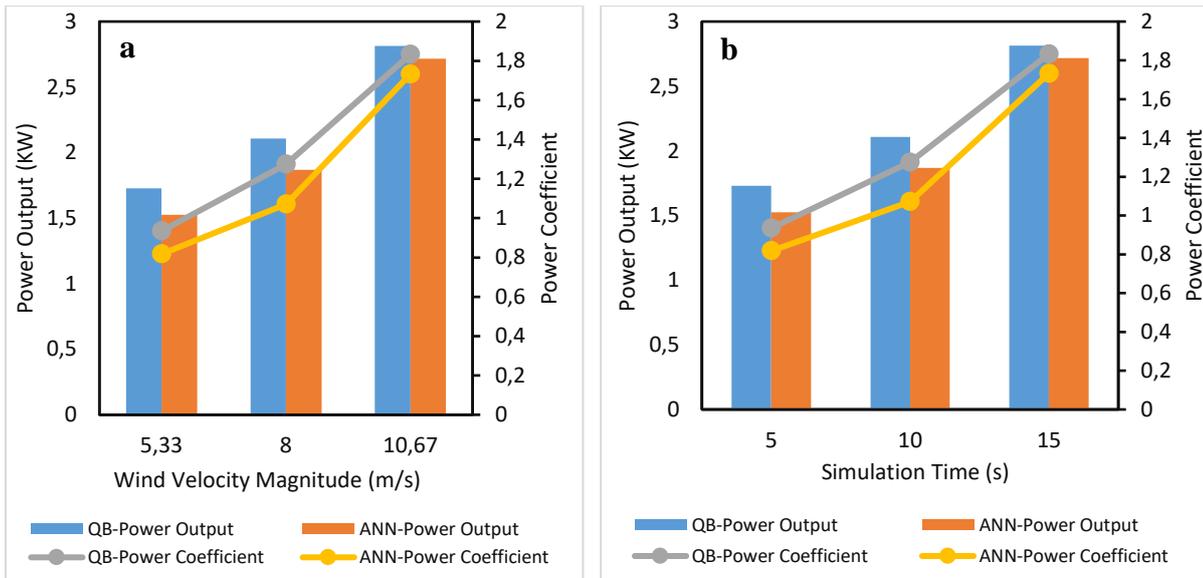


Figure 9c: Plot of power outputs against wind velocity magnitudes (5.33-10.67 m/s) and simulation time steps (5-15 s)

Extracted from the xy-plane of Figure 6-9b, Figure 10a-d shows velocity contours induced by the transient components of turbulence effects taken in the xy-plane for turbulence event moving through the Windfield computational domain. Initially, the turbulence persists as a coherent profile, with some vertical direction of turbulence observed. The sequence showed propagation and decay of the turbulence profile along the Windfield domain. This describes the turbulence perturbation, or deviation from the Windfield domain. A large recirculation region of Windfield is observed, which contributes to the vertical direction of the turbulence. This vertical direction may lead to increased vertical shear across the turbine rotors at downwind locations.

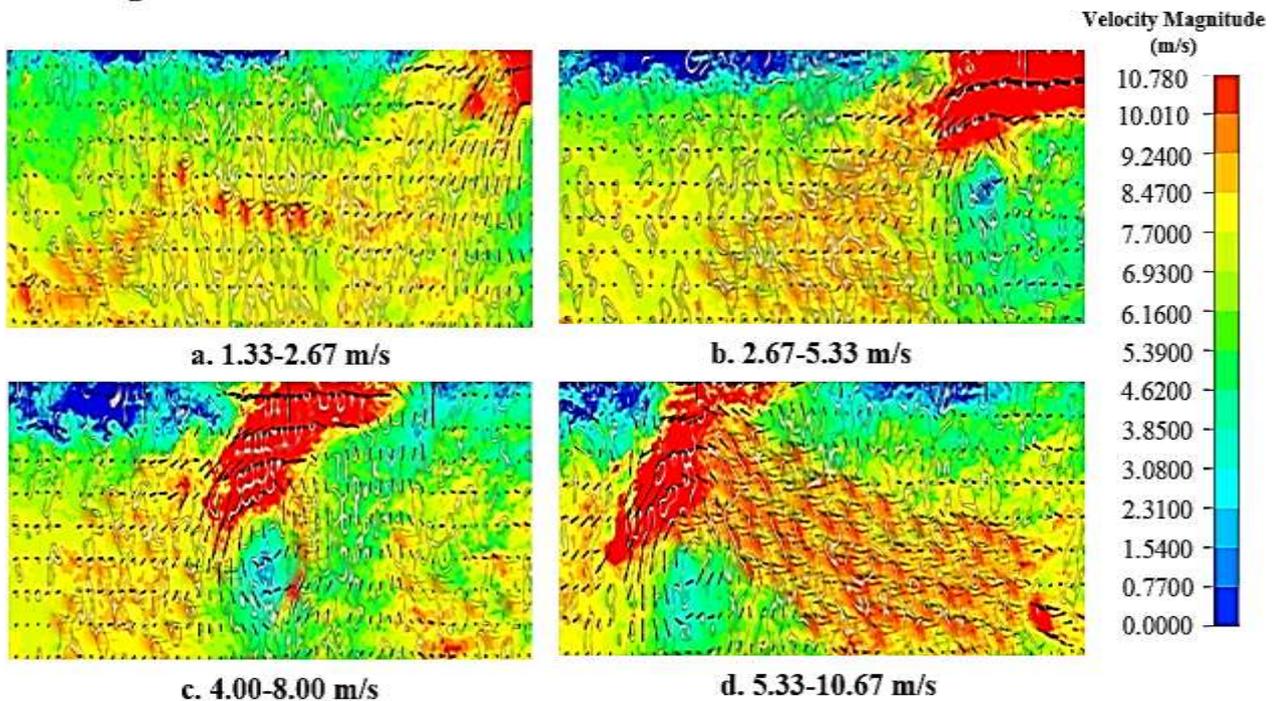


Figure 10: Windfield domain at distinct wind velocity magnitude from 1.33-10.67 m/s

4. Conclusion

This study centred around computational study on wind field domain at distinct wind velocity magnitudes ranging from 1.33-10.67 m/s across horizontal axis wind turbine for estimation of power output at simulation time step ranging from 5-15 s. Based on the outcome observed in the course of the study, it was concluded that:

- i. From Figure 6-9a, wind velocity magnitudes simulated at time steps of 5, 10 and 15 s were observed to intensify as the simulation time increased. However, this increase which depended on the Windfield domain was not constant, but varied from the peak to half way, from half way to low speed regime and so on depending on the wind intensity.
- ii. Maximum power outputs were obtained at maximum wind velocity magnitudes and simulation time steps. In other words, power outputs were observed to increase as velocity magnitudes and simulation time also increased.
- iii. The power coefficient is as a result of turbulence effect amidst the flowing wake vortices in Figure 6-9b which is responsible for power output.
- iv. From the Windfield domain plot at distinct wind velocity magnitude in Figure 10a-d, flow field around the reference air foil (NACA 4610) is characterized by two major mechanisms including convection and turbulent diffusion.

References

- Arun, A. K. and Surya, J. (2019). A Comparison of the Straight Blade and Swept Back Blade Horizontal Axis Wind Turbine. *SSRG International Journal of Mechanical Engineering*, 2348-8360, 30-35.
- Bakırc, M. and Yılmaz, S. (2018). Theoretical and computational investigations of the optimal tip-speed ratio of horizontal-axis wind turbines. *Engineering Science and Technology, an International Journal*, 21, 1128-1142.
- Deck, S., Duveau, P., Espiney, P. and Guillen, P. (2002). Development and Application of Spalart-Allmaras One Equation Turbulence Model to Three Dimensional Supersonic Complex Configurations. *Aerospace Science and Technology*, 6(3), 171-183.
- Etuk, E. M. and Ikpe, A. E. (2020). 3D Modelling of the Wind Flow Trajectories and Its Characteristic Effects on Horizontal Axis Wind Turbine at Different Wind Regimes. *Journal International Environmental Application & Science*, 15(2), 68-80.
- Huyse, L., Padula, S. L., Lewis, R. M., Li, W. (2002). Probabilistic approach to free-form airfoil shape optimization under uncertainty. *American Institute of Aeronautics and Astronautics*, 40(9), 1764–1772.
- Ikpe, A. E., Ndon, A. E. and Adoh, A. U. (2019). Modelling and Simulation of High Density Polyethylene Liner Installation in Engineered Landfill for Optimum Performance. *Journal of Applied Science and Environmental Management*, 23(3), 449-456.
- Jiang, Y., He, C., Zhao, P. and Sun, T. (2020). Investigation of Blade Tip Shape for Improving VAWT Performance. *Journal of Marine Science and Engineering*, 8(225), 1-20.
- Mikkelsen, K. (2013). Effect of free stream turbulence on wind turbine performance. Norwegian University of Science and Technology, EPT-M-2013-84.
- Möllerström, E.; Gipe, P.; Beurskens, J.; Ottermo, F. (2019). A historical review of vertical axis wind turbines rated 100 kW and above. *Renewable and Sustainable Energy Reviews*, 105, 1–13.
- Patel, B. and Patel, D. A. (2012). A Review on Aerodynamic Analysis of Wind Turbine Blade using CFD Techniques. *International Journal of Engineering Research and Technology*, 1(10), 1-5.

- Ribeiro, A. F. P., Awruch, A. M. and Gomes, H. M. (2012). An airfoil optimization technique for wind turbines. *Applied Mathematical Modelling*, 36, 4898-4907.
- Sørensen, J. N. (2011). Aerodynamic aspects of wind energy conversion. *Annual Review of Fluid Mechanics*, 43, 427-448.
- Vatandas, E. and Özkol, I. (2008). Coupling dynamic mesh technique and heuristic algorithms in 3-D-tapered wing design. *International Journal for Numerical Methods in Engineering*, 74(12), 1771–1794.
- Whitney, E. J., Sefrioui, M., Srinivas, K. and Periaux, J. (2002). Advances in hierarchical parallel evolutionary algorithms for aerodynamic shape optimization. *JSME International Journal Series B*, 45(1) 23–28.

INTERPERSONAL DIFFICULTIES IN MIGRAINE PATIENTS: PREDICTING RISK FACTORS

Zahra Batool

Department of Clinical Psychology, School of Professional Psychology
University of Management & Technology, Lahore, Pakistan

Rabia Khadim

Department of Clinical Psychology, School of Professional Psychology
University of Management & Technology, Lahore, Pakistan

ABSTRACT

The aim of a current study was to investigate the predictors of interpersonal difficulties in migraine patients, as the frequent attacks of migraine headaches if not treated and managed timely can lead to major psychosocial issues. So drawing the support of strong literature, this study explores the relationship between Psychosocial Issues as a predictor of Interpersonal Difficulties in a sample of 160 Migraine patients through snowball sampling. The present study comprised of demographic sheet, an indigenous “Psychosocial Issues Scale” (Batool & Khadim, 2022), and Interpersonal Difficulties Scale (Ihsan & Mahmood, 2013). Results showed that interpersonal difficulties are positively correlated with psychosocial issues. Hierarchical Regression shows gender and intensity as significant predictors of Interpersonal Difficulties. In terms of gender, women experience more frequent migraine attacks as compared to men and similarly face more psychosocial problems than men whereas ANOVA pointed out the significant difference in employment status, frequency, and duration. The results of the study underlined Intra and interpersonal variables in the cultural framework of psychosocial issues with its clinical implications.

Keywords: Psychosocial Issues, Interpersonal Difficulties, and Migraine Patients

REMOVAL OF BPA BY ADSORPTION BY USING ORGANOCCLAYS AND BIO-ADSORBENT

BEN JADDI Mountassira, AHARI M'hamed

Applied Chemistry Unit, Department of Chemistry, Faculty of Science and Technology,
Abdelmalek Essaadi University, Al Hoceima, Morocco

ABSTRACT

Water quality, whether for human consumption, irrigation, or simply dumped into nature, such as rivers, oceans, or soil, has become a major problem and source of worry for governments, national and international entities and organizations. As a result, environmental protection has become a major economic and political issue. This has sparked and encouraged the development of new pollution control measures as well as the upgrading of current ones. For the removal of specific soluble contaminants in industrial or domestic effluents, many approaches have been tried. Adsorption, electrolysis, flotation, precipitation, ion exchange, liquid-liquid extraction, membrane filtration, and so on are examples of processes that are distinct from one another. Because of its high potential to filter contaminated water, adsorption is one of the most widely used processes for removing pollutants. The goal of this project is to eliminate Bisphenol A, which is known to be hazardous to individuals and the environment and creates major difficulties even at low concentrations, through adsorption on bio adsorbents such as sawdust, activated carbon, and clay.

Keywords: Bisphenol A, clay, bio-adsorbent, adsorption, pollution.

EFFECT OF POLLUTANT PARTICLES ON PIPE EROSION: A NUMERICAL STUDY

A. Adjeloua, H. Lebbal, N. Boualem

Laboratory of Composites Structures and Innovative Materials (LCSIM), Mechanical Engineering Faculty, USTO MB Oran BP 1505 El-M'naouer, Oran, Algeria

B. Derrar

Aerohydrodynamic Laboratory, Maritime Engineering Department, of Mechanical Engineering Faculty, University of Sciences and Techniques of Oran Mohamed Boudiaf, Bir El Djir, BP 1505, 31000, El M'naouer, Oran, Algeria

ABSTRACT

Pipelines used to transport hydrocarbons often contain contaminants solid particles, such as sand often transported with fluid in motion. These solid particles can agglomerate on pipe walls, deforming or tearing off the surface material in a process called erosion, in addition to physical exhaustion of pipe wall material. Erosion by solid particles can be detrimental to pipeline walls by other indirect means. For example, solid particles can damage coating layers inside pipes or remove chemical inhibitors from interior surfaces, exposing pipe materials to corrosion. These synergistic effects, often referred to as erosion-corrosion, can be extremely costly and can lead to accelerated degradation of oil and gas pipelines. The objective of our study is to determine fluid flow velocity, particle impact velocity and solid body erosion rate by finite elements method. A numerical model is carried out to study erosive wear rate in a pipe elbow at 90° and comparison of the results with those obtained with three different wear models.

Keywords: Erosion, Pipeline, corrosion, particules, degradation.

CERAMIC COBALT-CONTAINING PIGMENTS BASED ON WILLEMITE STRUCTURE

Alimdjanova D.I.

Tashkent Institute of Chemical Technology, Uzbekistan

Babakhanova Z.A.

Tashkent Institute of Chemical Technology, Uzbekistan

The porcelain and faience industry of Uzbekistan is in dire need of high-quality proper raw materials, as well as high-quality dyes for decorating products, since there is no domestic production of ceramic pigments in the country.

Well known that variously colored pigments can be obtained by creating isomorphous mixtures with chromophores and introducing small amounts of modifiers into the crystal lattice. Willemite $2\text{ZnO}\cdot\text{SiO}_2$ [1, 2] is recognized as one of the options for matrices for obtaining light and dark blue pigments of high intensity and color purity. These pigments are temperature resistant up to 1200°C . Cobalt-zinc orthosilicates formed in the $\text{ZnO}\text{-CoO}\text{-SiO}_2$ system are of interest as catalytic and optoactive materials and for creating a wide range of light and dark blue ceramic pigments due to their high thermodynamic stability in various media [3–5]. Zinc orthosilicates doped with Eu^{3+} , Mn^{2+} , Tb^{3+} , Ce^{3+} ions with the willemite structure, due to the combination of physicochemical properties, are also used as phosphors, glass-ceramic and dielectric materials, as well as ceramic pigments with high temperature stability [6]. The effectiveness of the willemite blue pigment determines the prospects for the synthesis of double zinc-cobalt orthosilicate and the study of its physicochemical properties. At present, willemite structure blue pigments were obtained by solid-phase, sol-gel, and hydrothermal methods of synthesis [7].

In purpose to optimize the composition and expand the tonality of ceramic pigments, willemite structure ceramic pigments with coloring component of cobalt oxide were synthesized. The potential source of SiO_2 was the natural quartz sand of the Jeroy deposit of Uzbekistan. Solid-phase synthesis of pigments was carried out at 1250°C using standard ceramic technology, followed by the study of the obtained pigments using chemical (NEX CG spectrometer from Rigaku), X-ray phase (XRD-7000 diffractometer from Shimadzu) and IR spectroscopic (UR-20 spectrophotometer) methods of analysis, determination of color characteristics on UV spectrometry (Shimadzu UV-2600 spectrophotometer).

Table 1 shows the chemical composition of the quartz sand of the Jeroy deposit. The high content of the basic oxide (SiO_2 - 94.8%) makes it possible to use it instead of SiO_2 in the compositions of masses for the synthesis of pigments.

Table 1. Chemical Composition of Jeroy quartz sand

Material	Content of oxides, mass %								
	SiO_2	Al_2O_3	CaO	MgO	Fe_2O_3	Na_2O	K_2O	TiO_2	п.п.п.
Jeroy quartz sand	94.8	3.68	0,267	0,097	0,078	0,001	1,00	0,0377	2,77

To obtain cobalt-containing pigments based on the crystal lattice of willemite, we designed a number of compositions with partial and complete replacement of Zn^{2+} in the composition of willemite by Co^{2+} . Initial willemite was preliminarily synthesized from ZnO and SiO_2 oxides. Taking into account the fact

that the replacement of SiO₂ in the composition of the synthesized pigments with quartz sand did not significantly affect the intensity of the obtained colors, we used quartz sand as a source of SiO₂. The chemical compositions of the prototypes are shown in Table 2.

Table 2. Compositions of samples for obtaining cobalt-containing pigments based on willemite

No. composition	Composition	ZnO	CoO	SiO ₂	Color
1.	Zn _{2.0} Si _{1.0} O ₄	73.10	-	26.90	White
2.	Zn _{1.0} Co _{1.0} Si _{1.0} O ₄	37,51	34,70	27,79	Blue
3.	Zn _{0.5} Co _{1.5} Si _{1.0} O ₄	22,70	49,01	28,30	Violet -blue
4.	Co _{2.0} Si _{1.0} O ₄	-	71.43	28,57	Bright blue

Figure 1 shows obtained pigments based with willemite structure. The synthesized from chemical reagents initial pigment has a milky white color. When Zn²⁺ is replaced by Co²⁺ in an amount of 1.0 mol (Zn_{1.0}Co_{1.0}Si_{1.0}O₄), a pigment with a blue color is formed, when Zn²⁺ is replaced by Co²⁺ in an amount of 1.5 mol (Zn_{0.5}Co_{1.5}Si_{1.0}O₄), the color of the pigment acquires a purple-blue color. A further increase in the degree of substitution of Zn²⁺ for Co²⁺, corresponding to complete substitution (Co_{2.0}Si_{1.0}O₄), leads to a bright blue color.

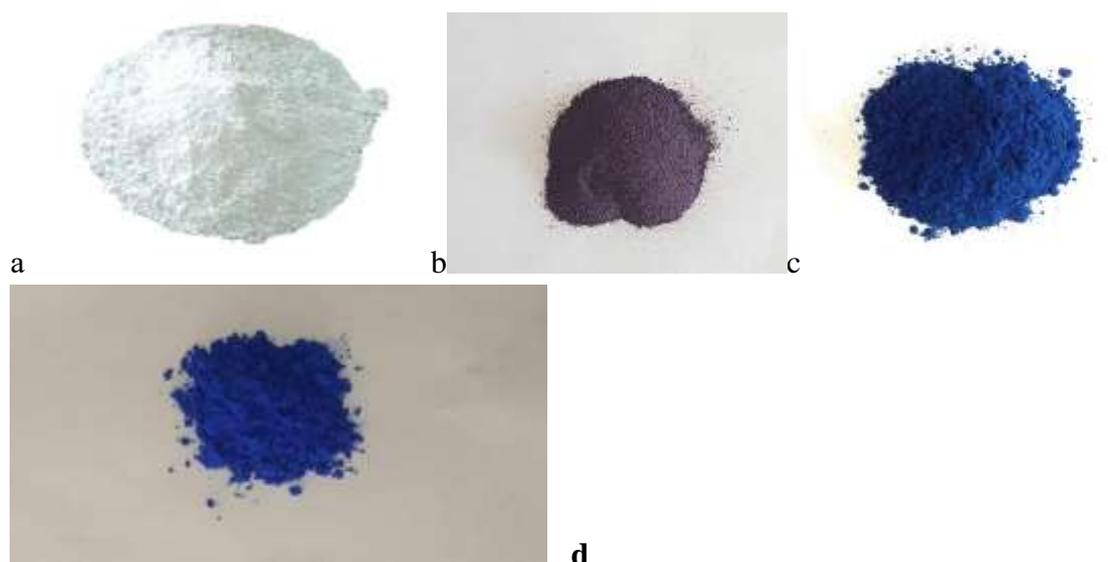


Fig.1. Photographs of synthesized pigments with the willemite structure. **a**-initial Zn_{2.0}Si_{1.0}O₄, **b**-pigment of composition Zn_{0.5}Co_{1.5}Si_{1.0}O₄, **c**- pigment of composition Co_{2.0}Si_{1.0}O₄, **d**- pigment of composition Co_{2.0}Si_{1.0}O₄.

Figure 2 shows the color areas of the original and cobalt-containing pigments depending on their composition.

The spectral curve of the original willemite is characterized by the presence of a wide maximum within λ from 240-380 nm, which corresponds to white color. (Fig. 3). With the complete replacement of zinc by cobalt, the maximum of the curves shifts to the wavelength region corresponding mainly to blue (494.0 nm) and light blue (528.0 nm) colors (Fig. 4).

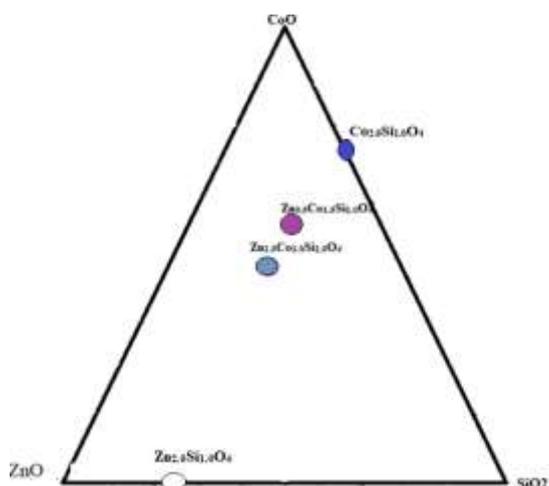
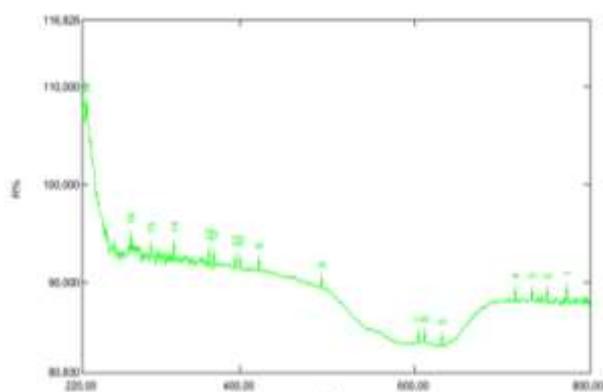
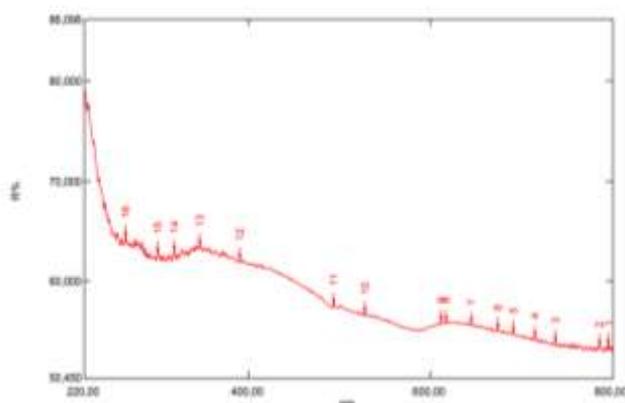


Fig. 2. Points of the compositions of the synthesized pigments in the concentration triangle.



#	Wavelength	R %	Color
1	276.00	93.115	white
2	225.50	107.362	white
3	365.50	92.294	white
4	325.50	93.115	white

Fig. 3. Reflection spectra of the original willemite.



#	Wavelength	R %	Color
1	390.50	62.147	violet
2	494.00	52.59	blue
3	528.00	56.54	light blue
4	347.50	63.15	

Fig. 4. Reflection spectra of the pigment of composition $\text{Co}_{2.0}\text{Si}_{1.0}\text{O}_4$

On the X-ray diffraction pattern of the calcined samples, corresponding to the composition of the original willemite, reflections with low intensity were found, which are characteristic of the mineral willemite $2\text{ZnO}\cdot\text{SiO}_2$. When ZnO is completely replaced by CoO, diffraction maxima appear that belong to Co_2SiO_4 . However, in both cases, the X-ray diffraction patterns still retain the reflections of the starting compounds.

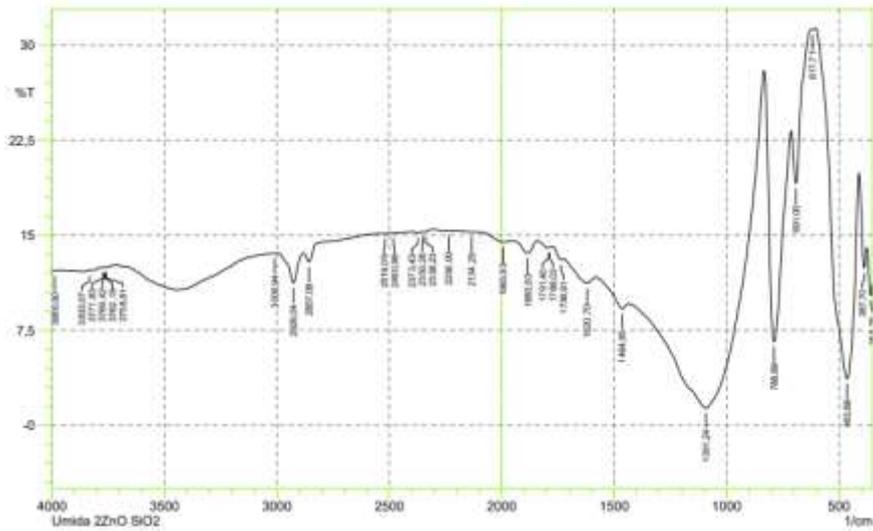


Fig. 5. IR spectrum of the synthesized initial willemite ZnO·SiO₂.

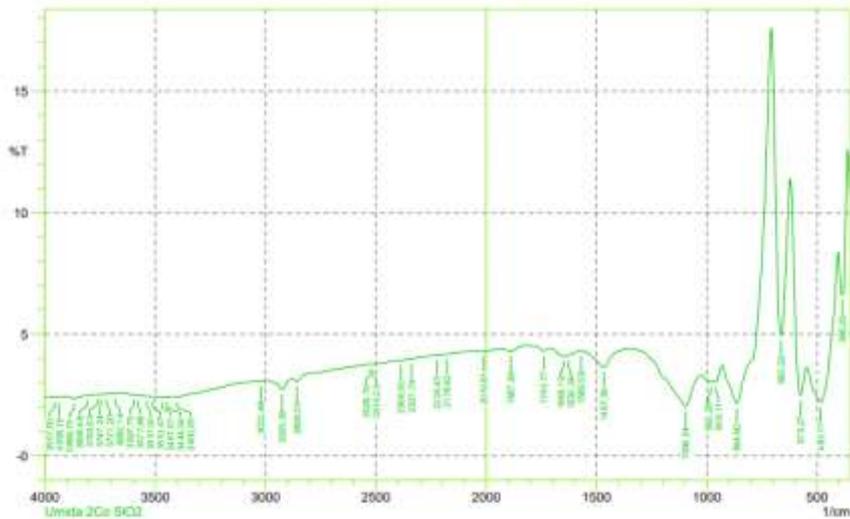


Fig. 6. IR spectrum of the synthesized pigment with composition Co_{2.0}Si_{1.0}O₄.

The IR spectra of the synthesized initial willemite have absorption bands characteristic of willemite 617.7 cm⁻¹, 1091.2 cm⁻¹, 1464 cm⁻¹, 2926 cm⁻¹, reflecting the [ZnO₄]⁴⁻ structural complexes, where Zn²⁺ has a tetrahedral coordination. During the synthesis of a cobalt-containing pigment, starting from Zn_{0.5}Co_{1.5}Si_{1.0}O₄ until the complete replacement of Zn²⁺ by Co²⁺, absorption bands appear in the spectra in the region of 500-665 cm⁻¹ (575.27, 663.52, 2010.81 cm⁻¹) characteristic for olivine and reflecting structural groups [CoO₆]⁴⁻. The data obtained indicate that the complete replacement of Zn²⁺ in the composition of willemite by cobalt results in the formation of cobalt orthosilicate Co₂SiO₄ with a bright blue color palette, which crystallizes in the olivine structure.

Thus, using reactive oxides of zinc and cobalt and natural quartz sand, it is possible to obtain ceramic pigments of high thermal and chemical resistance from violet-blue to bright blue hues, which makes it possible to optimize the compositions and expand the tonality of ceramic pigments obtained in regional conditions.

References

1. Maslennikova G.N., Pishch I.V. Ceramic pigments. M: RIF Strojmaterialy. 2009.-224 s.
2. Llusar, M. Color analysis of some cobalt-based blue pigments / M. Llusar, A. Forés, J. A. Badenes, J. Calbo, M. A. Tena, G. Monrós // Journal of European Ceramic Society — 2001. № 21. — P. 1121-1130.
3. Makarova E.V., Barinova O.P., Vasil'kov O.O., Ermachenkov I.M., Homyakov A.V. Synthesis by spontaneous crystallization of double zinc-cobalt orthosilicate with the willemite structure and study of its optical properties.//ZH.Uspekhi himii i himicheskoy tekhnologii.TOM XXIX. 2015. №7. P.56-58.
4. Makarova E.V., Krol' I.M., Barinova O.P., Vasil'kov O.O., Ivanov P.I. Features of infrared spectra of phases in the ZnO-CoO-SiO₂ system.//ZnO-CoO-SiO₂. //ZH.Uspekhi himii i himicheskoy tekhnologii. V. XXX. 2016. №7. P.63-65.
5. Ivanov C.D, Markovska I.G, Hristova S.I. Synthesis and study of cobalt-willemite ceramic pigments. Eurasian Union of Scientists (ESU), # 5 (50), 2018, P. 55-58.
6. Forés A., Cobalt minimisation in willemite (Co_xZn_{2-x}SiO₄) ceramic pigments / A. Forés, M. Llusar, J. A. Badenes, J. Calbo, M. A. Tena , G. Monrós // Green Chemistry — 2000. V. 2. — P. 93-100.
7. Shemel I. G. Sintering of ceramics based on zinc orthosilicate alloyed with cobalt / I. G. Shemel // Technical sciences - from theory to practice: collection of articles. Art. based on materials of the XXVII int. in absentia scientific-practical. conf. (Oct. 2013) / Sib. assoc. consultants. - Novosibirsk, 2013. - No. 10 (23), part - P. 121-128.

REMOVAL OF SULFIDE AND COD FROM PETROLEUM WASTEWATER USING ELECTROCHEMICAL METHODS

Ali Zamani, Nikolaos Kokkinos, Konstantinos Dermentzis

International Hellenic University, Department of Chemistry, 65404 Kavala, Greece

ABSTRACT

Petroleum wastewater is produced in large quantities by various petroleum exploration, production, and transportation operations and furthermore by industries, such as refineries and metallurgy. Only during oil and gas extraction operations the produced wastewater amounts to about 14 billion bbls annually, constituting the industry's most important waste stream by volume. In this work the treatment of petroleum wastewater is presented using the electrochemical methods of electrocoagulation with iron electrodes, electrooxidation with boron doped diamond electrodes and electro-Fenton with iron electrodes and addition of hydrogen peroxide. A simulated petroleum wastewater was prepared by mixing heating oil and sulfide ($\text{Na}_2\text{S}\cdot 9\text{H}_2\text{O}$) with fresh water and separating the aqueous from the oily phase in a separation funnel. The initial concentrations of COD and sulfide of the obtained oily wastewater were 640 and 90 mg L^{-1} respectively. The effect of crucial parameters on oil removal, such as pH, applied current density, initial concentration, and time of electro-processing were explored. The electrocoagulation treatment is very efficient for quantitative removal of sulfide ions (>99%), but only partially for COD (25%). The electrooxidation treatment removes COD partially (36%) at room temperature and quantitatively (99%) at the elevated temperature of 60 °C. The electro-Fenton treatment removes COD (>92%) without any need for increased temperature. The proposed electrochemical treatment could present some advantages for removal of toxic pollutants, such as sulfide and COD from industrial petroleum wastewater.

Keywords: Petroleum wastewater, sulfide, COD, electroprocessing

Introduction

In general, water is treated utilizing “physical,” “chemical,” and “biological” processes [1]. The main concern in wastewater treatment (WWT) is how to keep water quality at a level appropriate before delivering it to receptors such as rivers, streams, and other watercourses in the environment [2]. The wastewater that the petroleum industry release contains significant concentrations of “hydrocarbons,” “heavy metals,” and other toxic elements [3]. Wastewater from sectors including “metallurgy,” “petroleum transportation,” and “refineries” contain petroleum-related chemicals. Oily wastewater can originate from several places, such as oil storage facilities, oil transportation, petroleum refineries and petrochemical plants [4]. Such refractory contaminants are challenging to eliminate and need a significant amount of energy. Around 3.5 to 5 m^3 of wastewater are produced for every ton of processed crude oil [5]. Produced water is the principal waste product from the exploration and production of petroleum [6]. Petroleum wastewater contains significant levels of TOC, BOD, COD, TSS, BTEX, THC, ammonium nitrogen, sulfides, and other micro-pollutants [7, 8].

Electrochemistry is the study of the interaction between chemical and electrical processes [9]. Research on wastewater and electrochemistry has grown significantly since 1995, according to a bibliometric analysis by Nabgan et al. (2022)^[10] on publications and citations compiled during a 51-year span, from

1970 to 2021. Electrochemical WWT technologies have drawn a lot of interest because of their many distinctive advantages, such as selectivity, economic effectiveness, and adaptability. The electrode material has a significant impact on how effectively petroleum refineries can treat their effluent electrochemically since it can change the oxidation and anodic processes [11]. The efficacy of the treatment is determined by the physicochemical properties of the wastewater, the electrode materials utilized, and the process type [12].

Conversion, separation, and combined methods are the three major electrochemical methodologies for wastewater treatment. Electrooxidation, electroreduction, and electrochemical destruction are notable conversion processes. Separation techniques include electro-deionization, electro-filtration, electrodeposition, electrodialysis and electro-flotation. Electrocoagulation, electro-Fenton, and electrocatalysis are among the combined processes [13]. The wastewater treatment techniques also use EAOPs when treating effluents that contain organic waste [14]. When compared to traditional WWT methods like skimmer tanks, DAF, and ASP, electrochemical WWT generates more treated wastewater while reducing secondary waste output by 50 to 90% [15]. This study has experimented with and analyzed electrocoagulation, electro-oxidation, and electro-Fenton iterative approaches for the removal of sulfide and COD.

Experimental Procedure

Materials

A simulated petroleum wastewater was created by carefully balancing sodium sulfide 9-hydrate ($\text{Na}_2\text{S}\cdot 9\text{H}_2\text{O}$), heating oil, and fresh water. The mixture was then divided into a hydrophilic and hydrophobic phase using a separating funnel. The pH of the wastewater was 7.6, the COD content is 640 mg/L, the conductivity was 4100 $\mu\text{S}/\text{cm}^2$, and the sulfide content was 90 mg/L. The sulfide ions and water-soluble organic compounds were responsible for the COD in the petroleum wastewater sample. BDD and Fe were the electrodes used in electrochemical reactions. The remarkable water molecule interacts with various chemicals and organizes itself methodically within or around the molecular architecture of other molecules, resulting in the hydrated state. The water that has been hydrated has a significant impact on the solubility properties and chemical resistance of organic compounds. Sodium sulfide (Na_2S) can be converted into ($\text{Na}_2\text{S}\cdot 9\text{H}_2\text{O}$), which increases its chemical stability, by adding nine water molecules to the original structure. Polyhedra make up the crystal structure of sodium sulfide-9-hydrate [16].

Methodology and Apparatus Setup

The experiments were conducted at a temperature of 25°C. A direct current power source (Agilent E3612A, Dual Range, 0 to 60 Vdc @ 0-0.5 A, 30 W) was used to measure the voltage and current of the electrodes. Conductivity was measured with a conductometer (WTW™ Cond 3210™ Portable Conductivity Meter). The pH value and temperature were calculated using a pH-meter (HI83141 pH Meter with Electrode and Temperature Probe). The electrochemical treatment's progress was tracked by measuring COD. COD was measured using a direct reading spectrophotometer (Merck Spectroquant Pharo 100) and a COD reactor (Thermoreactor SDS, TR 420 Spectroquant®). The electrolysis was performed at room temperature in 500 ml cylindrical glass cells with 500 rpm magnetic stirrers. For the electro-oxidation process, two BDD electrodes were used, while two iron plates with an area of 30 cm² each were used for the electrocoagulation and electro-Fenton treatments. The experiment made use of

commercially available Fe and BDD plates with effective areas of 30 cm², dimensions of 10 x 5 x 0.2 cm, and a depth of 6 cm. There was a 1.5 cm gap between each electrode. The electrodes were activated by immersing them in 5N HCl for one minute after being scraped with sandpaper to remove the oxide and passivation layer from the surfaces of the Fe and BDD. Each treated solution received 0.5 g of KCl. The additional KCl reduces the solution's significant ohmic drop and prevents corrosion on the anode's surface. To stop passivation layers from forming on the electrodes, the polarization of the cell was adjusted every 30 minutes. Every 2 and 10 minutes, samples were taken and left to settle for 24 hours before being filtered using Whatman filter paper (Grade 40) and brought in for evaluation. The following experiments were carried out following the preparation of the materials and equipment: 1. Using a Fe electrode, electrocoagulation was used to remove COD and sulfide. 2. After electrocoagulation, the remaining COD residue (408 mg/L) was eliminated by electrooxidation employing BDD electrodes at 25°C and 60°C. 3. The remaining COD residue (408 mg/L) was subsequently eliminated utilizing electro-Fenton technique by Fe electrodes.

Results and Discussion

Electrocoagulation with Fe Electrodes

Compared to other treatment technologies, electrocoagulation has benefits including lower operating costs and less energy use [17]. Recently, the research on using EC to remove oil from wastewater has garnered a lot of interest. This method has been used to successfully recover oil from several industrial effluent resources [18].

With NaCl (2.5 g/L) acting as the supporting electrolyte and Fe electrodes acting as the anode and cathode at a current density of 5 mA/cm², electrocoagulation was used to examine the treatment of wastewater. There were no modifications required because the pH of 7.6 is in the optimal neutral range. Conductivity was 4100 S/cm², and the sulfide content was 90 mg/L. After the treated solution had settled for 24 hours, samples were taken every 10 minutes, put through Whatman filters (0.45 m), and then the COD was calculated. Figure 1 shows that, within a certain time window of 10 minutes, electrocoagulation using Fe electrodes is very effective (99%) at eliminating sulfide ions, but only partially at removing COD.

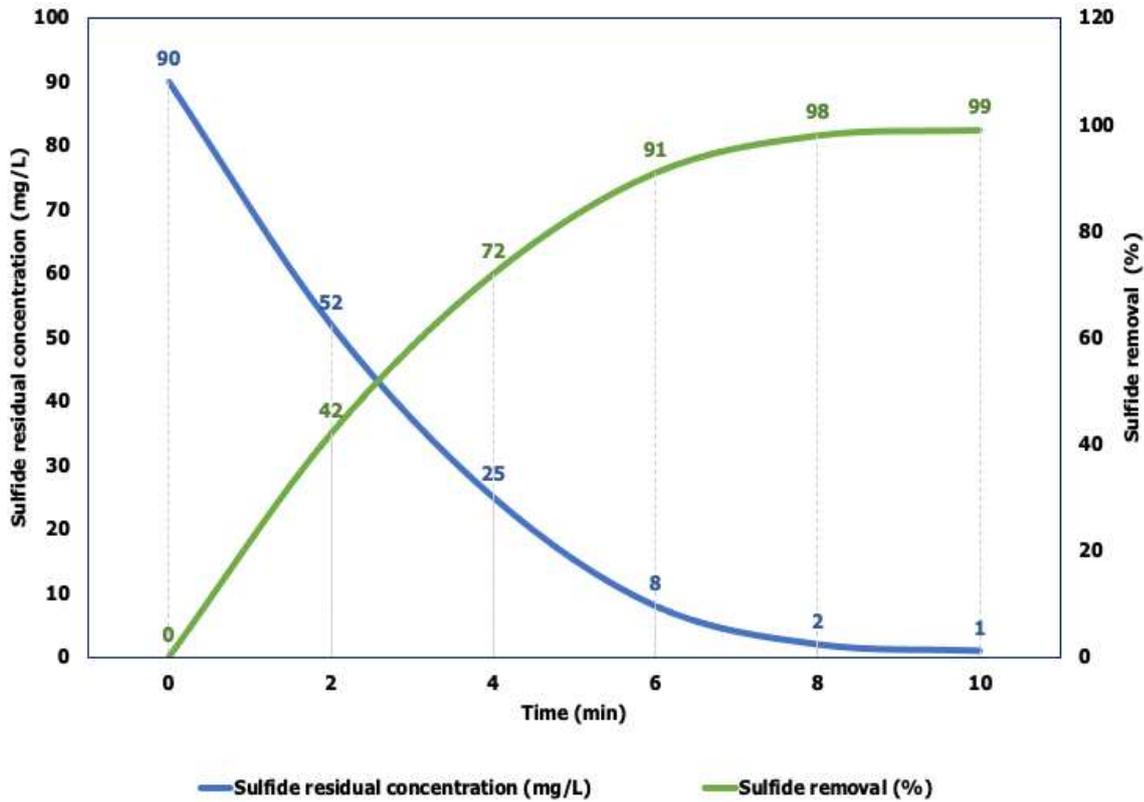


Fig. 1: Sulfide residual concentration and removal percentage by electrocoagulation with Fe-electrodes
 Figure 2 illustrates how a 36% reduction in iron electrocoagulation from an initial COD of 640 mg/L to 408 mg/L after 60 minutes of electrolysis.

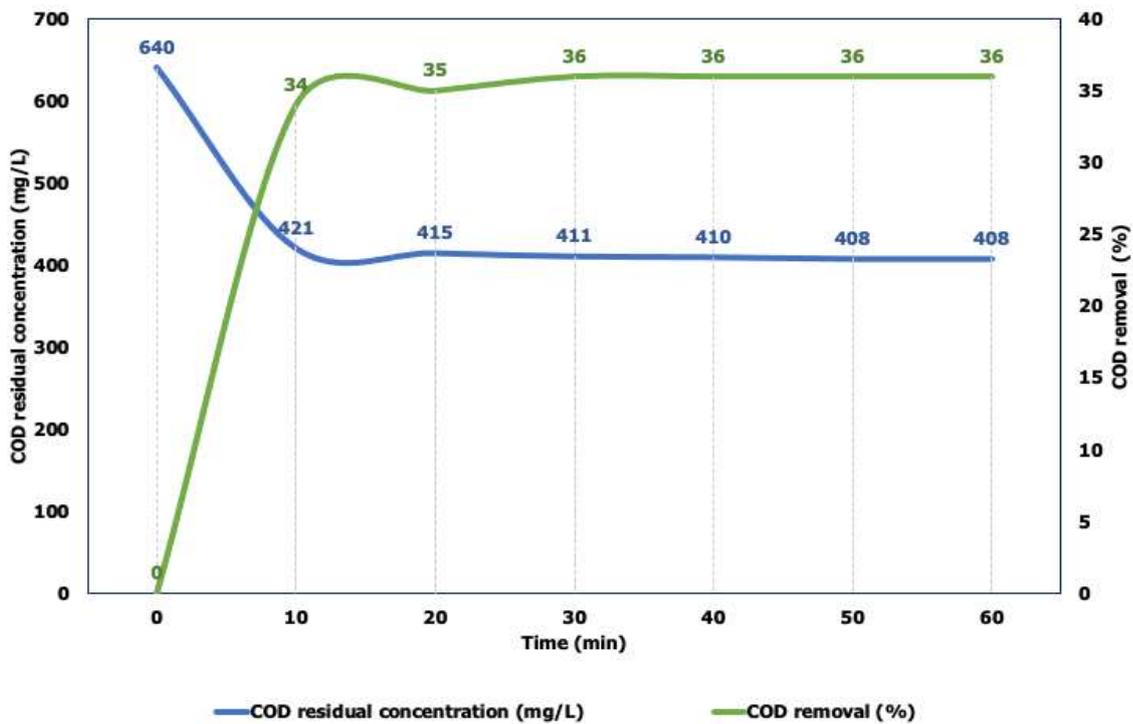


Fig. 2: COD residual concentration and removal percentage by electrocoagulation with Fe-electrodes

Bivalent Fe²⁺ and trivalent Fe³⁺ iron ions are produced by the primary reactions with iron electrodes at the sacrificial Fe anode, and hydroxide ions, OH⁻ as well as hydrogen gas are produced at the cathode:



According to the following processes, the produced Fe²⁺ and Fe³⁺, combine with the OH⁻ ions to form the well-known coagulants Fe(OH)₂ and Fe(OH)₃:



Fe²⁺ ions are electrochemically created, and sulfide ions interact with these ions to form an insoluble precipitate that is quantitatively removed by 99%:



The coagulants Fe(OH)₂ and Fe(OH)₃ adsorb organic contaminants, which are indicated as COD, and remove 36% of them from wastewater.

The results of this experiment revealed that the type of contamination, the amount of charge passed through the reaction cell, and the Fe electrodes all had an impact on how effective petroleum WWT was. The anode size, hydrodynamic conditions, inter-electrode distance, temperature, water conductivity, pollutant and anion concentration, and current density of the solution were all discovered to be significant influences on the experiment's methodology.

Iterative Electrooxidation with BDD Electrodes

Electrochemical oxidation is recognized as a highly effective technique for dissolving even the most refractory organic compounds. To anodize organic pollutants, many techniques can be applied, such as direct and indirect oxidation [19]. Either directly on the electrode surface or indirectly by generating oxidants in the solution, pollutants are eliminated throughout the electrooxidation process. Direct electrooxidation also results from the generation of chemically adsorbed oxidants (MO_{x+1}) or physically adsorbed oxidants (hydroxyl radicals, •OH) [20]. Due to the creation of OH and H₂O₂ at the BDD electrode, the electrooxidation method using "boron-doped diamond" (BDD) anodes has proven to produce remarkable results for the removal of antibiotics. Some pollutants disintegrate quickly due to BDD's considerable oxidant capability [21].

After the electrocoagulation procedure, the remaining COD residue (408 mg/L) was eliminated using an iterative electrooxidation process utilizing BDD electrodes at 25°C and 60°C. In wastewater that had not been modified, the electrooxidation treatment was carried out at 25°C and a pH of 7.6. The current density was kept constant at 20 mA/cm². Figure 3 shows the decrease in COD of the electrooxidized treated wastewater at BDD electrodes. Following 60 minutes of electro processing, the original COD of 408 mg/L decreased to 315 mg/L, suggesting a reduction of almost 23% of the COD.

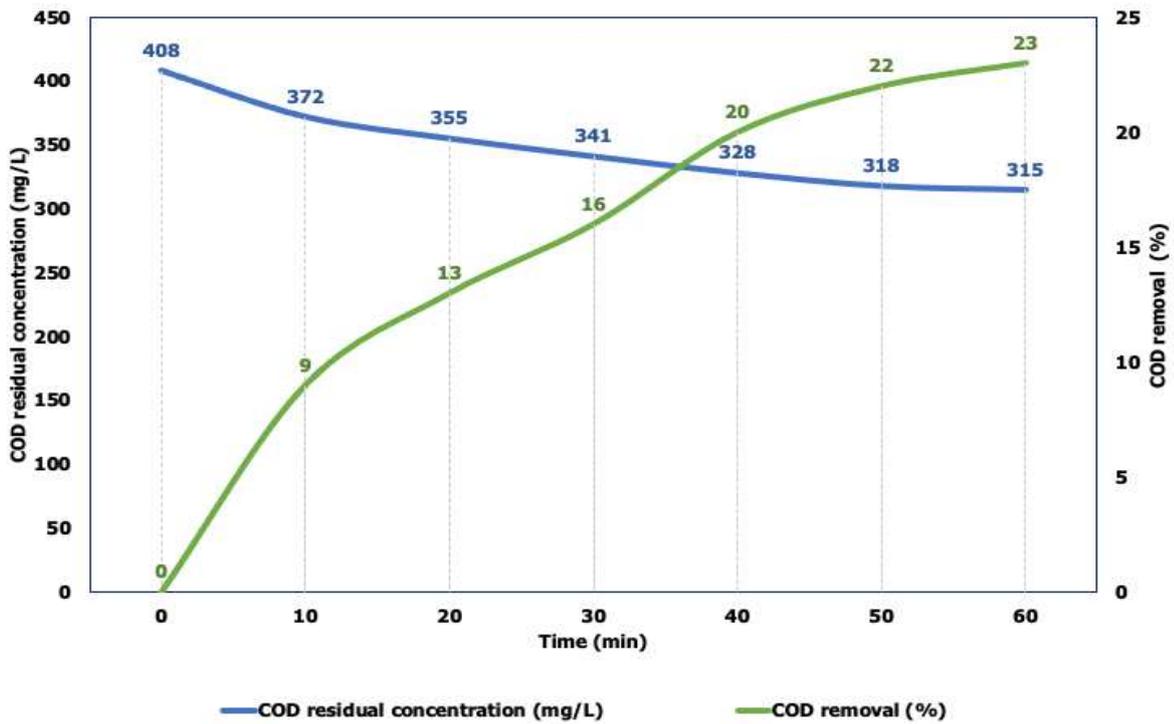


Fig. 3: Iterative electrooxidation treatment of the electrocoagulation residue for COD removal at 25⁰C To enhance anodic oxidation at BDD electrodes and provide outstanding COD removal from treated petroleum wastewater, the temperature was increased from 25°C to 60°C. As shown in figure 4, employing BDD electrodes significantly reduced COD at 60 0C by 99%.

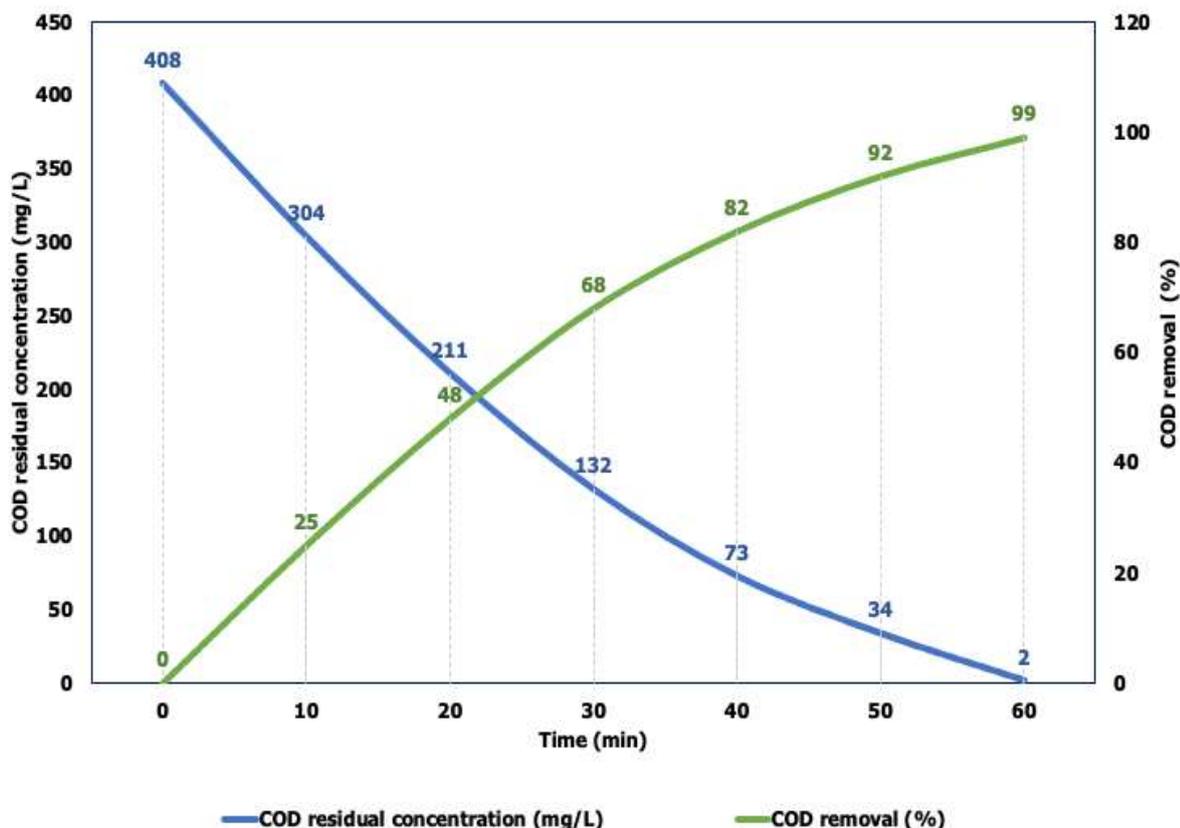


Fig. 4: Iterative electrooxidation treatment of the electrocoagulation residue for COD removal at 60°C

Due to an increase in the production of electro-generated strong oxidizing mediators like hydroxyl radicals, ozone, peroxodisulfates, chlorine, as well as an increase in the rate at which these mediators react with organic pollutants, increased temperature favors the oxidation of organic matter [22, 23]:



Iterative Electro-Fenton with Fe Electrodes

Treatment of refractory materials that are challenging to breakdown in conventional water and WWT facilities is made possible with electro-Fenton. Toxic contaminants are oxidized by hydroxyl radicals [24]. Electro-Fenton techniques have expanded significantly because they can mineralize organic pollutants more quickly than electrochemical oxidation or the Fenton reaction. One explanation for this remarkable efficiency is the continual regeneration of Fe^{2+} at the cathode [25]. In Fenton's reagent, which is an acidic combination of hydrogen peroxide and Fe^{2+} , highly reactive free hydroxyl radicals are generated:



There are two ways to electrochemically create the Fenton's reagent in-situ [26]:

(a) by cathodic reduction of oxygen to H_2O_2 and the addition of a catalytic quantity of Fe^{2+} ions:



(b) by adding H_2O_2 and anodizing a sacrificial Fe anode to produce Fe^{2+} ions in accordance with the anodic reaction:



Following electrocoagulation, the remaining COD residue (408 mg/L) was eliminated using an iterative electro-Fenton method utilizing Fe electrodes at 25°C, as illustrated in figure 5. Using the electro-Fenton treatment, 92% of COD can be eliminated without the use of higher temperatures. Petroleum effluent could be effectively treated by employing iterative electro-oxidation or electro-Fenton techniques. In this case, however, the sulfide ions would also be changed into elemental sulfur and deposited on the anodes, causing passivation of the electrode surface and unfavorable problems with current flow. We initially processed the sulfide electrocoagulation, then continue with electrooxidation and/or electro-Fenton to remove COD.

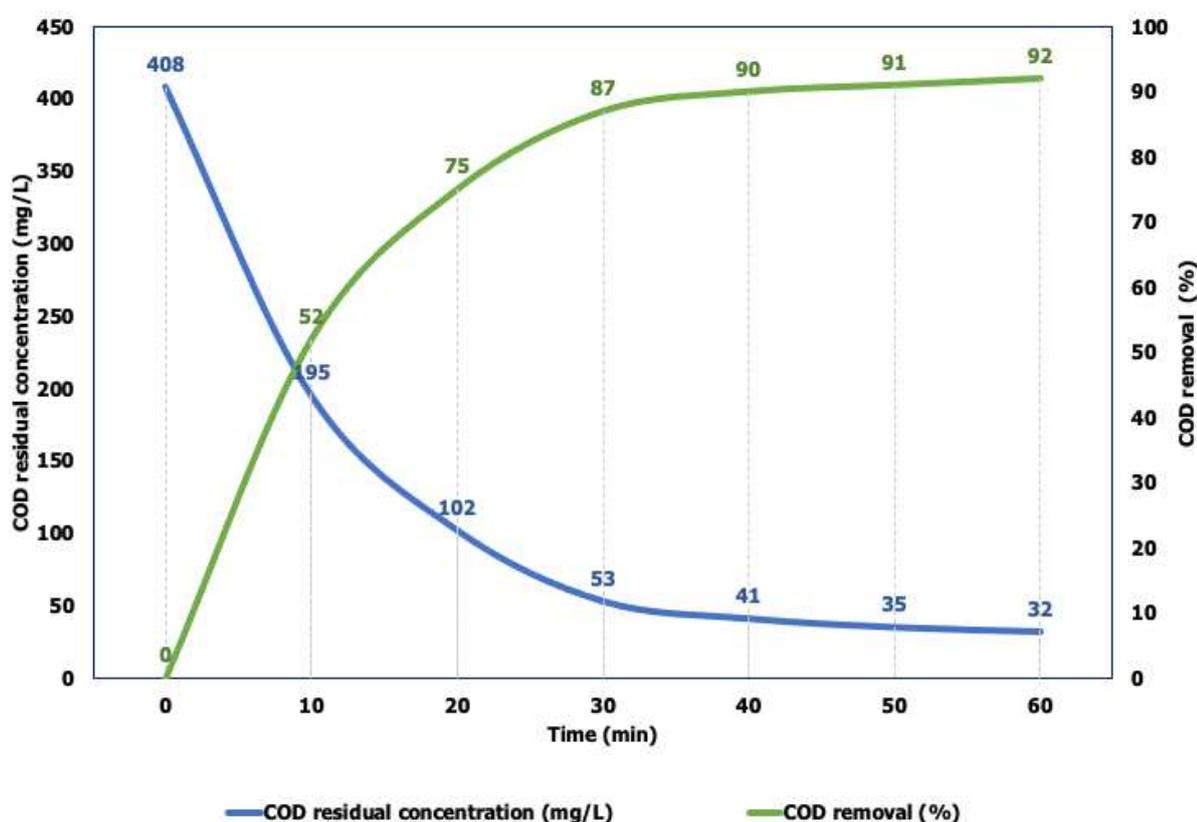


Fig. 5: Iterative electro-Fenton treatment of the electrocoagulation residue for COD removal at 25°C

Conclusion

It is critical to determine the criteria for choosing the most suitable electrochemical method since each electrochemical treatment technology has unique advantages and disadvantages. For the treatment of petroleum wastewater, electrocoagulation is frequently used. The size of the anode, the hydrodynamical circumstances, the distance between electrodes, the temperature, the water's hydrophilicity, the concentration of pollutants and anions, the type of contamination, the current charged, the type of electrodes, and the component's current density have all been found to be significant influencing factors. The results of the experiment to remove COD and sulfide showed that electrocoagulation using a Fe

electrode was successful in removing sulfur up to 99% of the total amount but was unsuccessful in removing COD. In order to remove any residual COD after electrocoagulation, electrooxidation and electro-Fenton procedures could be used as iterative electrochemical treatments. The iterative electrooxidation was carried out utilizing BDD at the two distinct temperatures of 25°C and 60°C. At 60°C, it was seen that the remaining COD had been 99% removed. The electrocoagulation was followed by an iterative electro-Fenton procedure using Fe electrodes at 25°C. Without having to raise the temperature, 92% of the COD was eliminated, according to the findings. One reason for the electro-Fenton process' excellent performance, which mineralizes organic pollutants more quickly than electrochemical oxidation or the Fenton reaction, is the continuous synthesis of Fe²⁺ at the cathode. Therefore, electro-oxidation or electro-Fenton treatments can be used to efficiently treat petroleum wastewater following electrocoagulation treatment. This indicates that, depending on the circumstances, a variety of electrochemical approaches can be used to treat petroleum wastewater.

References

1. R. L. Droste, R. L. Gehr, Theory and practice of water and wastewater treatment. Wiley, 2019.
2. X. Liu, J. Zhang, Computational fluid dynamics. Reston, Virginia: Published by American Society of Civil Engineers, 2020.
3. S. Varjani, R. Joshi, V. Srivastava, H. Ngo, and W. Guo, "Treatment of wastewater from petroleum industry: current practices and perspectives", Environmental Science and Pollution Research, vol. 27, no. 22, pp. 27172-27180, 2019. Available: 10.1007/s11356-019-04725-x.
4. M. Jain, A. Majumder, P. Ghosal and A. Gupta, "A review on treatment of petroleum refinery and petrochemical plant wastewater: A special emphasis on constructed wetlands", Journal of Environmental Management, vol. 272, p. 111057, 2020. Available: 10.1016/j.jenvman.2020.111057.
5. G. Mohanakrishna, I. Abu-Reesh and D. Pant, "Enhanced bioelectrochemical treatment of petroleum refinery wastewater with Labanah whey as co-substrate", Scientific Reports, vol. 10, no. 1, 2020. Available: 10.1038/s41598-020-76668-0.
6. S. Jafarinejad, Petroleum waste treatment and pollution control, 1st ed. Oxford: Butterworth-Heinemann, 2017.
7. L. Hui, W. Yan, W. Juan, and L. Zhongming, "A Review: Recent Advances in Oily Wastewater Treatment", Recent Innovations in Chemical Engineering (Formerly Recent Patents on Chemical Engineering), vol. 7, no. 1, pp. 17-24, 2015. Available: 10.2174/2211334707666140415222545.
8. L. Yu, M. Han, and F. He, "A review of treating oily wastewater", Arabian Journal of Chemistry, vol. 10, pp. S1913-S1922, 2017. Available: 10.1016/j.arabjc.2013.07.020.
9. A. Bard and L. Faulkner, Electrochemical methods and applications, 2nd ed. New York: Wiley-Interscience, 2001.
10. W. Nabgan et al., "A state of the art review on electrochemical technique for the remediation of pharmaceuticals containing wastewater", Environmental Research, vol. 210, p. 112975, 2022. Available: 10.1016/j.envres.2022.112975.
11. S. Ye, "Comparison of Electrochemical Treatment of Petroleum Refinery Effluents Using Electrooxidation, Electrocoagulation and Electro Fenton Process", International Journal of Electrochemical Science, pp. 6173-6182, 2016. Available: 10.20964/2016.07.20.
12. A. Hassani, M. Malhotra, A. Karim, S. Krishnan, and P. Nidheesh, "Recent progress on ultrasound-assisted electrochemical processes: A review on mechanism, reactor strategies, and

- applications for wastewater treatment”, *Environmental Research*, vol. 205, p. 112463, 2022. Available: 10.1016/j.envres.2021.112463.
13. M. Sillanpää and M. Shestakova, *Electrochemical Water Treatment Methods*, 1st ed. Butterworth-Heinemann, 2017.
 14. W. Elmobarak, B. Hameed, F. Almomani and A. Abdullah, “A Review on the Treatment of Petroleum Refinery Wastewater Using Advanced Oxidation Processes”, *Catalysts*, vol. 11, no. 7, p. 782, 2021. Available: 10.3390/catal11070782.
 15. M. Druskovic, D. Vouk, H. Posavcic, I. Halkijevic and K. Nad, “The application of electrochemical processes in oily wastewater treatment: a review”, *Journal of Environmental Science and Health, Part A*, vol. 56, no. 13, pp. 1373-1386, 2021. Available: 10.1080/10934529.2021.1999714.
 16. M. Al-Owaidi, S. Abed and E. Naser, “The Effect of Water of Crystallization on Isomerization of Liposome using Sodium Sulfide Nonahydrate”, *Journal of Global Pharma Technology*, vol. 11, no. 07, 2019.
 17. A. Shahedi, A. Darban, F. Taghipour and A. Jamshidi-Zanjani, “A review on industrial wastewater treatment via electrocoagulation processes”, *Current Opinion in Electrochemistry*, vol. 22, pp. 154-169, 2020. Available: 10.1016/j.coelec.2020.05.009.
 18. A. Shokri and M. Fard, “A critical review in electrocoagulation technology applied for oil removal in industrial wastewater”, *Chemosphere*, vol. 288, p. 132355, 2022. Available: 10.1016/j.chemosphere.2021.132355.
 19. Y. Feng, L. Yang, J. Liu, and B. Logan, “Electrochemical technologies for wastewater treatment and resource reclamation”, *Environmental Science: Water Research & Technology*, vol. 2, no. 5, pp. 800-831, 2016. Available: 10.1039/c5ew00289c.
 20. Y. Asfaha, A. Tekile and F. Zewge, “Hybrid process of electrocoagulation and electrooxidation system for wastewater treatment: A review”, *Cleaner Engineering and Technology*, vol. 4, p. 100261, 2021. Available: 10.1016/j.clet.2021.100261.
 21. X. Du et al., “Boron-doped diamond (BDD) electro-oxidation coupled with nanofiltration for secondary wastewater treatment: Antibiotics degradation and biofouling”, *Environment International*, vol. 146, p. 106291, 2021. Available: 10.1016/j.envint.2020.106291.
 22. K. Dermentzis, D. Marmanis, A. Christoforidis and K. Ouzounis, “ELECTROCHEMICAL RECLAMATION OF WASTEWATER RESULTED FROM PETROLEUM TANKER TRUCK CLEANING”, *Environmental Engineering and Management Journal*, vol. 13, no. 9, pp. 2395-2399, 2014. Available: 10.30638/eemj.2014.267.
 23. J. Rocha, M. Gomes, N. Fernandes, D. da Silva, and C. Martínez-Huitle, “Application of electrochemical oxidation as alternative treatment of produced water generated by Brazilian petrochemical industry”, *Fuel Processing Technology*, vol. 96, pp. 80-87, 2012. Available: 10.1016/j.fuproc.2011.12.011.
 24. H. He and Z. Zhou, “Electro-Fenton process for water and wastewater treatment”, *Critical Reviews in Environmental Science and Technology*, vol. 47, no. 21, pp. 2100-2131, 2017. Available: 10.1080/10643389.2017.1405673.
 25. J. Casado, “Towards industrial implementation of Electro-Fenton and derived technologies for wastewater treatment: A review”, *Journal of Environmental Chemical Engineering*, vol. 7, no. 1, p. 102823, 2019. Available: 10.1016/j.jece.2018.102823.

26. D. Stergiopoulos, K. Dermentzis, P. Giannakoudakis and S. Sotiropoulos, "Electrochemical Decolorization and Removal of Indigo Carmine Textile Dye from Wastewater", Issue 3, vol. 16, no. 3, pp. 499-506, 2014. Available: 10.30955/gnj.001330.

SYNTHESIS OF PHOSPHAZENE-BASED PLASTICIZERS AND THE EFFECTS OF SYNTHESIZED PLASTICIZERS ON THE PROPERTIES OF POLY (LACTIC ACID) FILMS

Gurkan Sayan

Kocaeli University, Department of Polymer Science and Technology, Kocaeli, Turkey
<https://orcid.org/0000-0001-9225-9199>

Ayşe Aytac

Kocaeli University, Department of Polymer Science and Technology, Kocaeli, Turkey
Kocaeli University, Department of Chemical Engineering, Kocaeli, Turkey
<https://orcid.org/0000-0002-9566-7881>

ABSTRACT

Poly (lactic acid) (PLA) is a biodegradable and bioderived aliphatic polyester derived from renewable resources such as corn and potatoes. PLA has good mechanical properties and shows elastic modulus and tensile strength in the range of 3.2-3.7 GPa and 55-60 MPa, respectively. PLA is widely used in the medical field due to its biocompatibility with the human body, including applications such as implants, surgical sutures, and medical devices. In the industry, the area where polymers are produced the most and generate the most waste is packaging products. PLA is an ideal material to be a biodegradable packaging product. An essential requirement for packaging materials is high flexibility at room temperature. Therefore, it is necessary to increase the flexibility of PLA with the use of plasticizers for flexible packaging applications. Phosphazenes are a class of compounds that contain repeating (P=N)_n units in their structure and can be found in straight chain, ring, or polymeric structures. Organic, inorganic, or organometallic side groups can be attached to phosphazene compounds, and phosphazene compounds can show different properties according to the bonded group. In this study, hybrid materials were obtained by connecting hexachlorocyclotriphosphazene with poly(ethylene glycol)monomethyl ether, inspired by inorganic-based phosphate esters with high combustion resistance, and its suitability was investigated for use as a plasticizer in PLA. Chlorine atoms have been replaced by nucleophilic substitution of Poly(ethylene glycol) monomethyl ether to the phosphazene ring. The synthesized compound was characterized by phosphorus-31 nuclear magnetic resonance (³¹P NMR), proton NMR (¹H NMR) and Fourier transform infrared spectroscopy (FT-IR). The compound synthesized with PLA was mixed at different ratios (10, 20, 30 wt.%). Films were prepared by casting from the solution. The thermal properties of the prepared films were investigated by thermogravimetric analysis (TGA) and differential scanning calorimeter (DSC). In addition, the mechanical properties were investigated by the tensile test, and it was determined the elongation at break and tensile strength values.

Keywords: poly (lactic acid), phosphazene, biodegradable polymers, packaging films.

INTRODUCTION

The packaging industry is the area where polymers are mostly used in production and the most waste is produced in the industry. According to 2015 data, approximately 146 million tons of packaging products were produced and 141 million tons were wasted (Ritchie et al. (2022, October 15). *Plastic Pollution*.

<https://ourworldindata.org/plastic-pollution>) Most of the monomers used in the manufacture of plastic products are petroleum-based, such as ethylene and propylene. They are not biodegradable and remain as waste in nature. In order to eliminate these wastes, heat treatment must be used. The use of biodegradable polymers in the packaging industry can be an alternative solution to this problem (Barnes et al. 2009; Geyer et al. 2017).

Poly(lactic acid) (PLA) is an ideal material to be a biodegradable packaging product (Auras et al. 2004). An important requirement for packaging materials is high flexibility at room temperature. Therefore, PLA needs to be plasticized for flexible packaging applications. Flexibility can be obtained by mixing PLA with biocompatible plasticizers or other compatible polymers.

Plasticizer are generally low molecular weight substances that add flexibility and workability to the polymer by entering between the polymer chains. While plasticizers are preferred, they should be chosen with the appropriate molecular weight, which can mix with the polymer matrix and will not migrate easily from the surface (Wypych, 2012). Nowadays, many alternative biocompatible plasticizers such as citrate esters, glycerol, polyethylene glycol (PEG) are used for PLA (Darie-Nita et al. 2016; Harte et al. 2012).

In this study, hybrid substances were obtained by organic binding to groups hexachlorocyclotriphosphazene and characterized with ^{31}P -NMR, ^1H -NMR and FTIR. The films were produced by the solvent casting method by mixing PLA with the obtained hybrid plasticizers. Then, the thermal and mechanical properties of the films were investigated.

MATERIALS AND METHODS

Materials

PLA (2003D) was supplied from NatureWorks Company. Hexachlorocyclotriphosphazene, sodium hydride (NaH, 60%) and polyethylene glycol methyl ether (Mw:550 g/mol) was supplied from Sigma Aldrich. Hexachlorocyclotriphosphazene, $(\text{NPCl}_2)_3$ was purified by recrystallization from hexane followed by sublimation at 40 °C (0.05Torr).

Synthesis of Hexakis(methoxyethoxyethoxy)cyclotriphosphazene (F-PEGME)

Hexachlorocyclotriphosphazene (0.52 g, 1.5 mmol) was dissolved in 50 mL dry tetrahydrofuran. NaH (0.6 g, 15 mmol, 60%) was added to the reaction medium. The reaction was cooled to approximately -10°C in an ice bath. Then poly(ethylene glycol) methyl ether (7.15 g, 14 mmol) was dissolved in dry tetrahydrofuran and added dropwise to the reaction medium over approximately 30 minutes. Reaction monitoring is done by thin-layer chromatography. The solution was stirred at room temperature for 4 hours. The crude product was isolated by filtration and removal of the solvent under reduced pressure. The product was redissolved in chloroform and was washed with small quantities of water. The organic layer was then dried with anhydrous sodium sulfate. The crude product was isolated by evaporation of the solvent. The synthesis mechanism of F-PEGME was given in Figure 1.

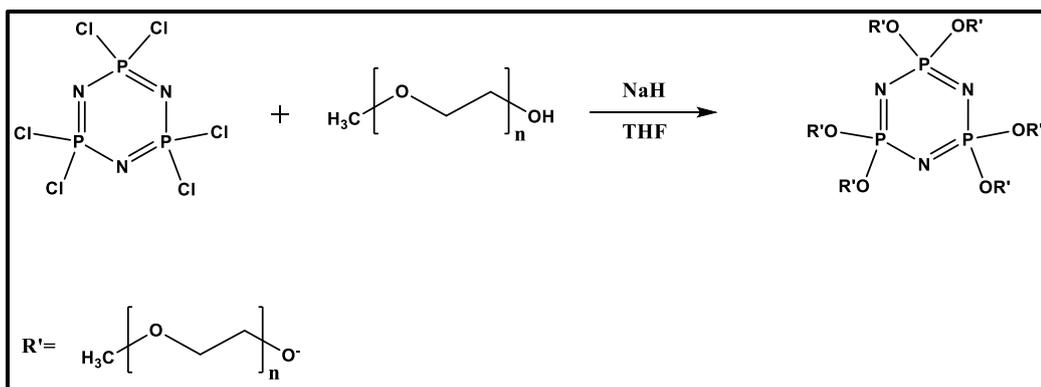


Figure 1. Synthesis mechanism of F-PEGME

Preparation of the films

The PLA granules were dried in an oven at 80°C for 24 hours under vacuum. PLA was dissolved in chloroform. Required quantities of plasticizers were weighed and added to the solution. The mixture was continued until it was completely dissolved. The mixture was then poured into petri dishes and allowed to evaporate at room conditions. Afterwards, it was kept in a vacuum oven overnight to completely remove the solvent in it. The film production is shown in Figure 2 and the film codes are given in Table 1.

Table 2. PLA/ F-PEGME films

SAMPLE CODES	PLA (%)	F-PEGME (%)
1 PLA	100	0
1 PLA_10FPEGME	100	10
1 PLA_20FPEGME	100	20
1 PLA_30FPEGME	100	30
5 PLA	100	0
5 PLA_10FPEGME	100	10
5 PLA_20FPEGME	100	20
5 PLA_30FPEGME	100	30

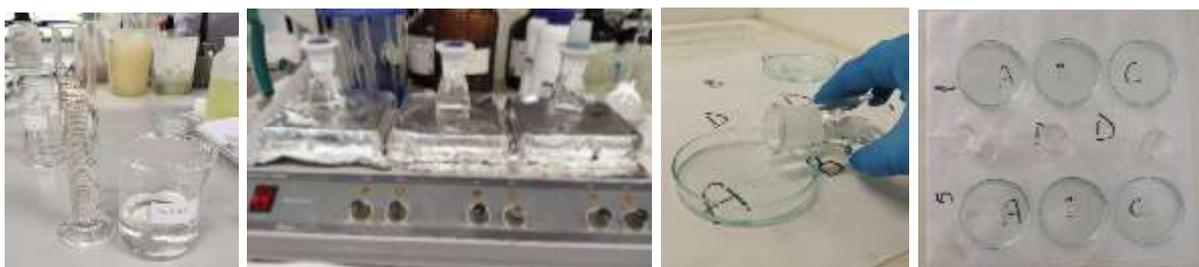


Figure 2. PLA/ F-PEGME films producing

Characterization

FTIR spectra of the films were obtained using FTIR Perkin-Elmer 100 spectrophotometer. The spectrum was scanned from 4000 cm^{-1} to 650 cm^{-1} wavelengths.

Tensile properties of the films were carried out at room temperature on an Instron universal testing machine according to the standard testing method D882-12 (ASTM) at a crosshead speed of 10 mm/min. The five specimens were tested and the averages and standard deviations of tensile strength and elongation at break were calculated and reported.

The thermal stabilities of the specimens were investigated by thermogravimetric analysis (TGA). TGA was performed from 25 °C to 600 °C, with a heating rate of 10 °C/min under nitrogen atmosphere in Mettler Toledo TGA 1 Instrument.

DSC analysis was realized by Mettler Toledo DSC 1 Star. The DSC analysis was performed with temperature ranging from 25°C to 200°C at a rate of 10°C/min, a 5 min hold, followed by cooling to -70°C a 5 min hold, and finally a second part from -70 to 200°C at a rate of 10 °C/min. The crystallization behavior was determined from DSC endotherms.

RESULTS AND DISCUSSION

Fourier Transform Infrared Spectroscopy (FTIR)

Fourier transform infrared spectroscopy (FTIR) was used to examine of structural properties of the F-PEGME. FTIR spectra of the F-PEGME were given in Figure 3. In the FT-IR (ATR, cm^{-1}) spectrum of the FPEGME compound, $\nu=2873 \text{ cm}^{-1}$ aliphatic C-H vibrations, $\nu=1226 \text{ cm}^{-1}$ P=N vibrations, $\nu=1040 \text{ cm}^{-1}$ C-O vibrations, $\nu=975 \text{ cm}^{-1}$ P-O and supports the proposed structure.

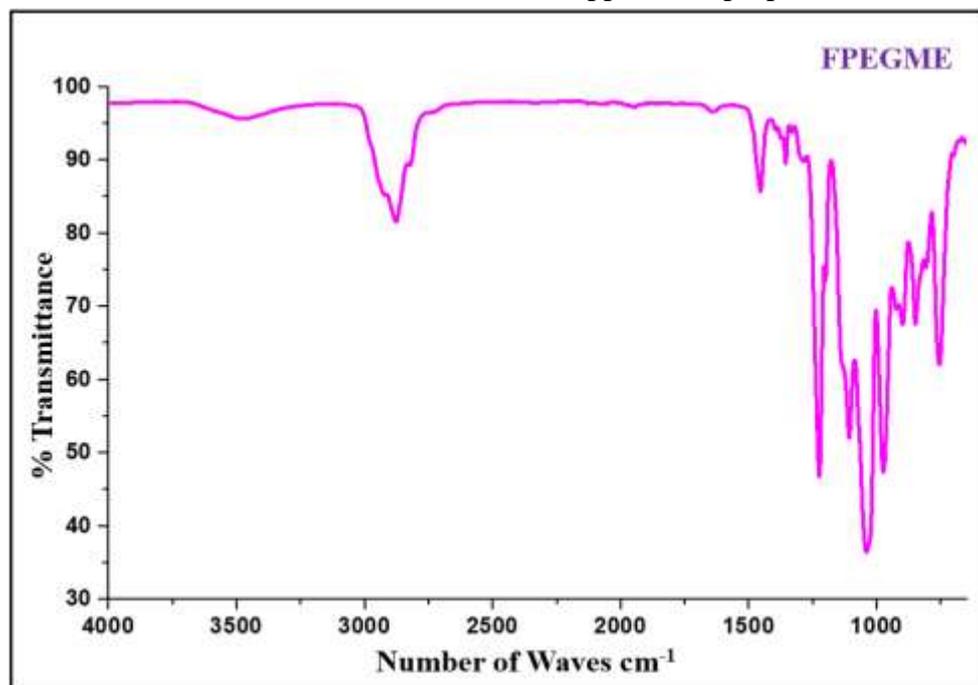


Figure 3. FTIR spectra of F-PEGME

^{31}P -NMR

^{31}P -NMR spectrum of the F-PEGME was given in Figure 4. As a result of the reaction of the trimer and PEGME in the presence of NaH, when the ^{31}P -NMR spectrum of the FPEGME compound taken in CDCl_3 at room temperature is examined, it is observed that the methoxyethoxyethoxy group is substituted

as a single intensity peak at $\delta=17.72$ ppm, supporting the binding of the 6 methoxyethoxyethoxy groups to the cyclophosphazene ring (Allcock et al. 1997).

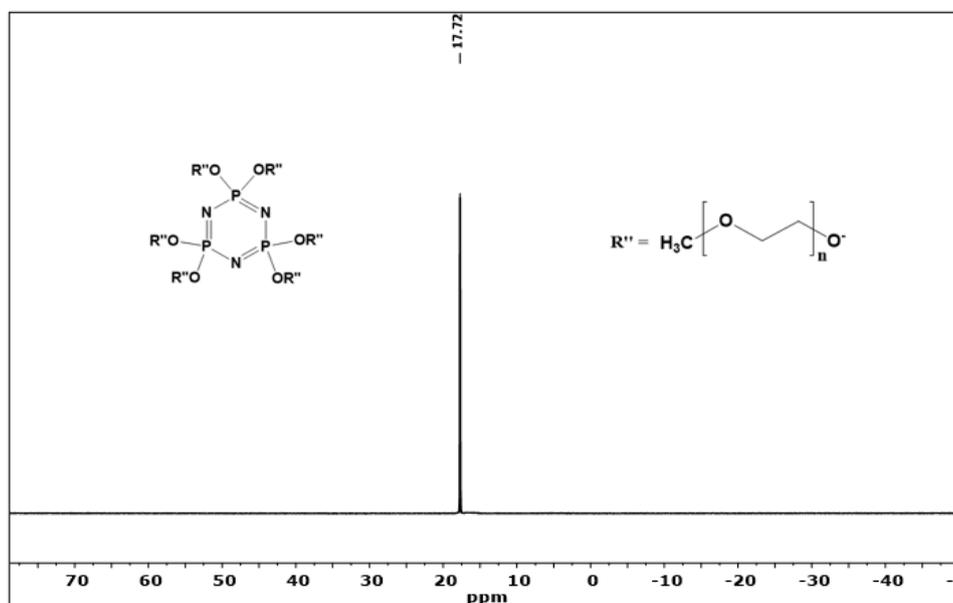


Figure 4. ^{31}P -NMR spectrum of F-PEGME

^1H -NMR

^1H -NMR spectrum of the F-PEGME was given in Figure 5. As a result of the reaction of the trimer and PEGME in the presence of NaH, when the ^1H NMR spectrum of the FPEGME compound taken in CDCl_3 at room temperature is examined, the methylene protons ($-\text{OCH}_2\text{CH}_2\text{O}-$) in the methoxyethoxyethoxy group are observed as a severe peak at $\delta=3.60$ ppm, while the protons of the methyl group are $\delta=3.30$ ppm. It is observed in and supports the structure.

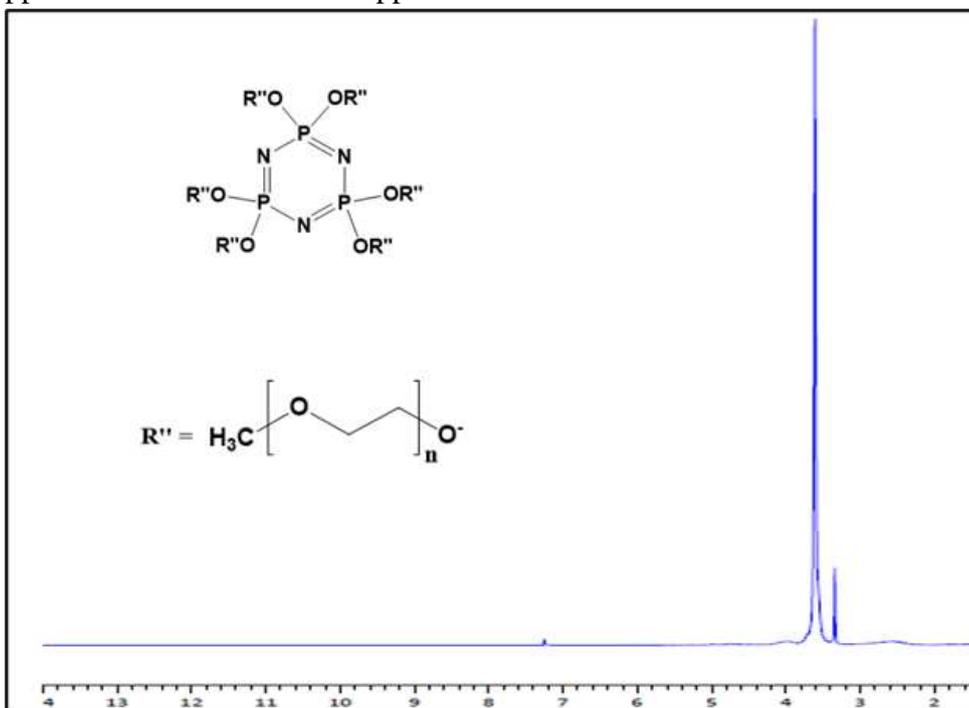


Figure 5. ^1H -NMR spectrum of F-PEGME

Tensile test

Tensile strength and elongation at break values obtained from the tensile test are given in Table 2. The tensile tests of the films were carried out in a universal test device at a tensile speed of 10 mm/min and at room temperature according to ASTM D 882 standard. Film samples were prepared in 2x8 dimensions and at least 5 samples were tested for each value. The tensile strength and elongation at break values of the film samples are given by taking the average value. Flexibility increased with the use of increasingly synthesized plasticizer in 1PLA coded samples.

Table 3. Tensile test results of the film

Sample	Tensile Strength (MPa)	Elongation at break (%)
1 PLA	42,97	9,84
1 PLA_10FPEGME	25,75	23,51
1 PLA_20FPEGME	18,67	71,03
1 PLA_30FPEGME	25,74	161,34
5 PLA	24,94	221,62
5 PLA_10FPEGME	1	138,88
5 PLA_20FPEGME	19,63	2,56
5 PLA_30FPEGME	12,49	1,09

Differential Scanning Calorimetry (DSC)

DSC measurements were carried out to determine the thermal properties of the produced PLA films. Glass transition temperature (T_g), melting temperature (T_m), Wf mole fraction and % crystallinity value (X_c) obtained from DSC analysis are given in Table 3. In general, the glass transition temperature decreased with the use of plasticizer synthesized at increasing rates.

Table 4. DSC data of all samples

Samples	T_g	T_m	% X_c
PLA	57,41	151,64	10,03
1PLA_10FPEGME	51,87	152,39	3,66
1PLA_20FPEGME	41,61	147,46	6,72
1PLA_30FPEGME	36,24	148,92	20,53
5PLA_10FPEGME	48,65	148,17	0,94
5PLA_20FPEGME	35,79	143,30	7,62
5PLA_30FPEGME	-	139,57	8,84

Thermogravimetric Analysis (TGA)

Thermal stability was evaluated using a Mettler Toledo TGA Star trademark machine. Specimens of approximately 10 mg of sample were loaded onto a platinum pan. The specimens were heated from ambient temperature to 25°C at a rate of 600°C with a heating rate of 10°C.min⁻¹ under the nitrogen atmosphere. The results of the thermo-gravimetric analysis test are summarized in Table 4. At the same time as was expected the percentage of char residue increased with the increasing hybrid plasticizers ratio for both matrices.

Table 5. TGA data of all samples

Samples	T _{d5} (°C)	%T _{d50} (°C)	T _{max} (°C)	Char 600 °C (%)
PLA	329,51	353,81	365,56	1,45
1PLA_10FPEGME	346,68	364,30	376,66	2,48
1PLA_20FPEGME	313,72	354,33	357,16	3,23
1PLA_30FPEGME	336,90	363,88	383,38	2,67
5PLA_10FPEGME	300,94	334,10	347,43	3,62
5PLA_20FPEGME	266,07	297,19	345,94	4,74
5PLA_30FPEGME	253,71	292,58	342,53	4,84

CONCLUSION

In this study, phosphazene based plasticizers were synthesized. Plasticized PLA films were prepared by solvent casting methods. Hybrid plasticizers were characterized with FTIR, ¹H-NMR and ³¹P-NMR. The mechanical and thermal properties of plasticized PLA films were investigated. A significant decrease in tensile strength was not observed with the addition of plasticizer at different rates into PLA. The elongation at break of PLA increased with the addition of plasticizer. As expected, the addition of plasticizer successfully reduced the glass transition temperature of PLA.

ACKNOWLEDGEMENT

The authors thank Kocaeli University Scientific Research Projects Coordination for financial support within the scope of Project No. FDK-2022-2978.

REFERENCES

1. Ritchie, H. and Roser, M. (2022, October 15). Plastic Pollution. Retrieved from <https://ourworldindata.org/plastic-pollution>.
2. Barnes, D. K. A., Galgani, F., Thompson, R.C., Barlaz, M., (2009). Accumulation and fragmentation of plastic debris in global environments. *Philos. Trans. R. Soc. B.* 364, 1985–1998.
3. Geyer, R., Jambeck, J. R., Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances.* 3(7), e1700782.
4. Auras, R., Harte, B., Selke, S., (2004). An Overview of Polylactides as Packaging Materials. *Macromol. Biosci.* 4, 835–864,
5. Wypych, G. (2012). *Handbook of Plasticizers 2nd Edition*, Elsevier.
6. Darie-Nita, R. N., Vasile, C., Irimia, A., Lipşa, R., Rapa, M., (2016). Evaluation of some eco-friendly plasticizers for PLA films processing. *J. Appl. Polym. Sci.* 43223.

7. Harte, I., Birkinshaw, C., Jones, E., Kennedy, J., DeBarra, E., (2012). The Effect of Citrate Ester Plasticizers on the Thermal and Mechanical Properties of Poly(DL-lactide). *J. Appl. Polym. Sci.* 37600.
8. Allcock, H. R., Ravikiran, R., O'Connor, S. J. M., (1997). Effect of Oligo(ethyleneoxy)cyclotriphosphazenes, Tetraglyme, and Other Small Molecules on the Ionic Conductivity of the Poly[bis(methoxyethoxyethoxy)phosphazene] (MEEP)/Lithium Triflate System. *Macromolecules*, 30, 3184-3190.

SYNTHESIS, CHARACTERIZATION AND COMPARATIVE STUDY OF NEW 2-PHENYLIMIDAZO [1, 2-a] PYRIDINE-3-CARBALDEHYDE DERIVATIVES:

Abdeljalil HAMDI , Mhamed AHARI, Hassan AMHAMDI,

¹Team of Applied Chemistry, Faculty of sciences and Technics Al-Hoceima, Abdelmalek Essaadi University, Tetouan, Morocco.

M. KOUDAD, A.EL AATIAOUI, M. Azzouzi

Laboratory of Molecular Chemistry, Materials and Environment (LMCME), Department of Chemistry, Polydisciplinary Faculty of Nador, Mohamed first University, Oujda, Morocco.

ABSTRACT

The inhibition of mild steel corrosion in 1.0 M HCl by some Imidazo[1,2-a]pyridines derivatives namely: 2-(4-fluorophenyl)imidazo[1,2-a]pyridine-3-carbaldehyde (**P1**) and 2-(4-nitrophenyl)imidazo[1,2-a]pyridine-3-carbaldehyde (**P2**) has been investigated using weight loss, electrochemical studies, and quantum chemical calculations. The results showed that P1 is the best corrosion inhibitor among the three compounds studied and the inhibition efficiency increases with increase in concentration for all the inhibitors. The adsorption of inhibitor molecules on mild steel surface was found to be spontaneous and obeyed the Langmuir adsorption isotherm. Potentiodynamic polarization investigations indicated that the studied inhibitors were mixed type inhibitors. Electrochemical Impedance Spectroscopic measurements show that the inhibitors form an adsorptive layer on the metallic surface.

Keywords: Mild steel, Corrosion inhibition, 2-phenylimidazo[1,2-a]pyridine-3-carbaldehyde, Weight loss, Electrochemical studies, DFT.

**DESIGN, SYNTHESIS, AND *IN VITRO* PHARMACOLOGICAL EVALUATION OF
BISTRIFLUOROMETHYL-DERIVED HYDRAZIDE-HYDRAZONES AS
ACETYLCHOLINESTERASE INHIBITORS**

Ebru Didem Cosar

Department of Pharmaceutical Chemistry, Faculty of Pharmacy,
Istanbul University, 34116, Beyazıt, Istanbul, Turkey
Institute of Health Sciences, Department of Pharmaceutical Chemistry,
Istanbul University, 34126, Fatih, Istanbul, Turkey
Department of Pharmaceutical Chemistry, Faculty of Pharmacy,
Bezmialem Vakıf University, Fatih, Istanbul 34093, Turkey
ORCID: 0000-0001-5068-0188

Efe Dođukan Dıncel

Department of Pharmaceutical Chemistry, Faculty of Pharmacy,
Istanbul University, 34116, Beyazıt, Istanbul, Turkey
Institute of Health Sciences, Department of Pharmaceutical Chemistry,
Istanbul University, 34126, Fatih, Istanbul, Turkey
ORCID: 0000-0002-5445-0600

Tülay Kayra, Nuray Ulusoy-Güzeldemirci

Department of Pharmaceutical Chemistry, Faculty of Pharmacy,
Istanbul University, 34116, Beyazıt, Istanbul, Turkey
ORCID: 0000-0002-2821-3433, ORCID: 0000-0002-4495-4282

İlhami Gülçin

Department of Chemistry, Faculty of Science, Atatürk University, 25240, Erzurum, Turkey
ORCID: 0000-0001-5993-1668

ABSTRACT

Alzheimer's disease (AD) is a multifactorial neurodegenerative disorder of the central nervous system, characterized by loss of cognitive abilities, language disorders, visual deficiency, orientation disorders, memory impairment, and severe behavior abnormalities, which finally results in a serious decline of intellectual and mental abilities and death. The global prevalence of this tragic disease has been estimated to reach 106.2 million by 2050. The pathophysiology of AD has not been able to completely illuminated yet. The main and classical hypothesis of AD is the cholinergic hypothesis, which asserts the intellectual and mental impairments of AD are caused by the low level of choline, particularly ACh in the brain, and recovering the ACh can relieve these symptoms. Although diverse therapeutic approaches have been purposed, only a few drugs have been approved by U.S. Food and Drug Administration (FDA) and European Medicines Agency (EMA). These drugs can be listed as N-methyl-D-aspartate (NMDA) receptor antagonists, Memantine, and acetylcholinesterase (AChE) inhibitors, Donepezil, Tacrine, Galantamine, and Rivastigmine. However, these drugs possess side effects such as gastrointestinal disturbances, muscle aches, vomiting, heartburn, headache, loss of cholinergic appetite, diarrhea, loss of

balance, and hepatotoxicity. There is an urgent need for developing novel, safe, and more effective drugs for the treatment of AD.

In this study, a series of novel bistrifluoromethyl-derived hydrazide-hydrazone (**Figure 1**) were synthesized (**Scheme 1**), the structural elucidation of the novel compounds (**2a-y**) was performed by IR, $^1\text{H-NMR}$, $^{13}\text{C-NMR}$ and elemental analysis.

Fluor substitution / organofluorine compound

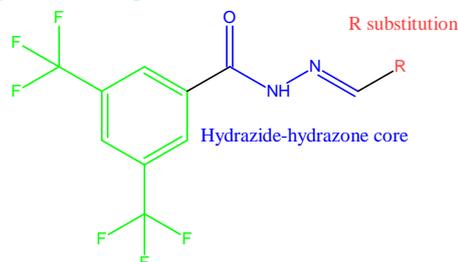
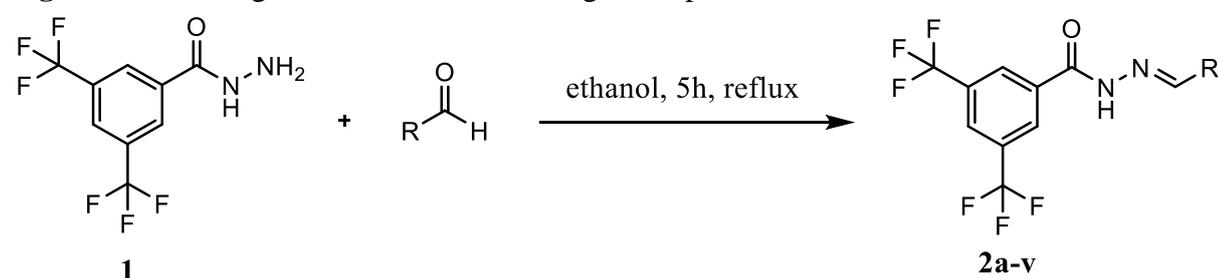


Figure 1. The design and rationale of the target compounds.



Scheme 1. Synthesis of the title compounds (**2a-y**)

Eight of the title compounds displayed better K_i values than the reference drug **Tacrine**. (5-Bromo-2-hydroxyphenyl)methylidene substituted **2l** (K_i : $0.196 \pm 0.03 \mu\text{M}$), (3-nitrophenyl)methylidene substituted **2g** (K_i : $0.206 \pm 0.04 \mu\text{M}$), (2,4-dinitrophenyl)methylidene substituted **2i** (K_i : $0.222 \pm 0.05 \mu\text{M}$), (3-ethoxy-4-hydroxyphenyl)methylidene substituted **2o** (K_i : $0.243 \pm 0.04 \mu\text{M}$), 3-(4-dimethylamino)phenylprop-2-en-1-ylidene **2t** (K_i : $0.252 \pm 0.10 \mu\text{M}$), (3,4-dimethoxyphenyl)methylidene derivative **2n** (K_i : $0.265 \pm 0.07 \mu\text{M}$), (4-methylphenyl)methylidene derivative **2d** (K_i : $0.352 \pm 0.07 \mu\text{M}$), (4-methoxycarbonylphenyl)methylidene **2r** (K_i : $0.364 \pm 0.13 \mu\text{M}$) displayed higher AChE inhibitory activity than the reference drug **Tacrine** (K_i : $0.420 \pm 0.02 \mu\text{M}$). Besides, (4-nitrophenyl)methylidene substituted **2h**, (4-fluorophenyl)methylidene substituted **2a**, (1*H*-Pyrrol-2-yl)methylidene substituted **2u** and (3-hydroxyphenyl)methylidene substituted **2k** displayed comparable AChE inhibitory activity with **Tacrine** (K_i : $0.420 \pm 0.02 \mu\text{M}$). These substitutions were found to possess significance related to inhibition of AChE enzyme.

The findings revealed the promising AChE inhibitory activity of bistrifluoromethyl-derived hydrazide-hydrazone and these derivatives could be an interesting starting point for further structural optimization to obtain new promising and more potent agents.

Keywords: Hydrazide-hydrazone, synthesis, acetylcholinesterase.

Acknowledgments

This work was supported by Istanbul University Scientific Research Project (Project Numbers: TLO-2018-32143, TYL-2021-37834).

INVESTIGACIÓN DE LOS PARÁMETROS DE FABRICACIÓN DE LOS MATERIALES COMPUESTOS MEDIANTE EL PROCESO DE TRANSFERENCIA DE RESINA (RTM)

Ahmed Ouezgan, Said Adima, Aziz Maziri

El Hassan Mallil, Jamal Echaabi

Applied Research Team on Composites, Management, and Innovation, High National School of Electricity and Mechanics (ENSEM), Hassan II University of Casablanca, Morocco.

ORCID: 0000-0003-1501-7158

RESUMEN

En los últimos años, la utilización del proceso de transferencia de resina (RTM) para la fabricación de los materiales compuestos ha adquirido gran popularidad en diversas áreas industriales como automóviles y aeroespaciales. Este estado es debido a muchas ventajas ofrecidas para el proceso RTM, incluidas buenas tolerancias dimensionales, altas propiedades mecánicas y bajo tiempo del proceso. El RTM es un proceso de fabricación en molde cerrado, consiste en inyectar la resina líquida, usualmente termoestable de baja viscosidad, en la cavidad del molde, donde previamente se ha introducido el refuerzo seco. Además de la impregnación total del refuerzo, el molde es curado a temperatura ambiente o dentro el horno, para posteriormente desmoldar la pieza. Para lograr óptimas propiedades mecánicas y buen acabado en piezas fabricadas por esta técnica, es indispensable garantizar un completo llenado del molde y una adecuada impregnación de la fibra, que solo es posible a través de un molde correctamente diseñado y un buen controlado de la presión de inyección, permeabilidad de las fibras y la viscosidad de la resina. Por lo tanto, el objetivo de este trabajo es de investigar la influencia de los parámetros mencionado previamente en la fabricación de los materiales compuestos mediante el proceso de transferencia de resina.

Palabras clave: RTM; parámetros de fabricación; presión de inyección; permeabilidad, viscosidad.

SPECIFIC ENERGY CONSUMPTION IN REVERSE OSMOSIS UNIT TO TREAT OLIVE MILL WASTEWATER

Reda Askouri, Mohamed Moussetad, Hassan Hannache, Hamdane Hasna

University Hassan II, Faculty of science Ben M'sik, Morocco

ABSTRACT

Reverse osmosis (RO) is one of the most important technologies for treating all types of wastewaters. This process requires energy, which varies depending on the properties of the wastewaters. Several studies used the Specific Energy Consumption (SEC) theory to calculate values in desalination water (DW) and brackish water (BW), as well as to optimize the performance of the treatment unit and reduce its consumption without affecting water quality. The objective of this work is to provide new theoretical relationships of SEC_N available for DW and BW, but the ultimate purpose is to use SEC_N in Olive Mill Wastewater (OMW) considering RO and renewable energy based on photovoltaic solar cells. In the first part including this assessment, we will compare the result with other literature and simulation software. Furthermore, the conductivity in OMW in this framework is $21.300\mu\text{s}/\text{cm}$, and using two types of membranes, RO SW400 HR Lanxess and SWC4-LD Hydranautics, we obtained in SEC $2.13\text{Kwh}/\text{m}^3$ and $2.22\text{Kwh}/\text{m}^3$, respectively. According to the same conductivity value, we get $2.16\text{Kwh}/\text{m}^3$ and $2.22\text{Kwh}/\text{m}^3$ for SEC_N , respectively; for the literature, we get $1.97\text{Kwh}/\text{m}^3$ and $2.02\text{Kwh}/\text{m}^3$. In the final step, the results will be followed by energy resource dimensions based on simulation and SEC_N values.

Keywords: Reverse osmosis, Desalination water; Brackish water, Specific energy consumption, Olive mill wastewater.

DETERMINATION OF THE EFFECTS OF CARROT METHYL ESTER ON THE PERFORMANCE OF A CI ENGINE

Hanbey Hazar

Firat University, Technology Faculty,
Department of Automotive Engineering, Elazig, Turkey.
0000-0001-7699-0088

Burkay Uyar

Firat University, Technology Faculty,
Department of Automotive Engineering, Elazig, Turkey.
0000-0001-7455-7053

Huseyin Sevinc

Firat University, Technology Faculty,
Department of Automotive Engineering, Elazig, Turkey.
0000-0001-7513-3412

ABSTRACT

A large part of the transportation need, which is one of the most basic needs of human beings, is met by vehicles with internal combustion engines today. The search for alternative fuels has accelerated due to the gradual decrease in the fossil fuel resources used in these vehicles and the increase in the world population. Today, biodiesel is used as an alternative fuel in diesel engines and they are produced from various vegetable, animal and waste oils. The effects of these alternative fuels produced from different sources on the performance parameters of diesel engines should be investigated in detail. In this study, carrot methyl ester (CME) was produced from carrot seed oil (CSO) by transesterification method and then mixed with diesel fuel in different ratios in a diesel engine and the engine's power-torque, brake specific fuel consumption, engine block and exhaust gas temperature values were measured. Experimental study was carried out in a single-cylinder, four-stroke, air-cooled, direct injection diesel engine. CME fuel was mixed with diesel fuel at 20%, 60% and 100% volumetric ratios. The experiments were carried out at a constant engine speed of 2000 rpm and at different loads. The results showed that the use of CME compared to diesel fuel caused a decrease in the torque values of the engine. Increasing CME ratio in the fuel mixture increased the decrease in engine torque values. On the other hand, it was determined that the fuel consumption values of the engine increased as the CME ratio in the fuel mixture increased. Compared to diesel fuel, it has been observed that the use of CME also leads to a decrease in engine block and exhaust gas temperature values. Although the use of CME causes some deterioration in the torque and fuel consumption parameters of the engine, it has been observed that CME fuel can be mixed with diesel fuel and used in compression ignition engines without any significant performance loss.

Keywords: Carrot seed oil, Carrot methyl ester, Performance, Diesel engine.

1. INTRODUCTION

Increasing human population, industrialization and technological developments have increased energy consumption globally. A large part of this needed energy is globally limited coal, natural gas, oil, etc. are met from resources. Today, most of the motor vehicles that meet the transportation needs have internal combustion engines (spark ignition and compression ignition engines). It is estimated that the worldwide liquid fuel consumption will reach 102.76 million barrels per day by the end of 2023 [1]. The significant increase in the consumption of liquid fuels used in motor vehicles and the limited amount of these resources mean that these resources will be depleted in the future. For this reason, researchers have focused their studies in recent years on the search for alternative fuels that can be used in internal combustion engines [2]. In particular, compression ignition (diesel) engines have been one of the focal engine technologies for the development of alternative fuels due to their high efficiency, higher output power and better fuel economy [3,4]. Biodiesels and bio-alcohols are seen as alternative fuels with a significant potential for use in diesel engines [5]. Biodiesels can be produced primarily from vegetable oils, animal fats, waste oils and microalgae. Vegetable oils usually contain free fatty acids, phospholipids, sterols, water and other additives. Due to this content, many vegetable crude oils cannot be used directly as fuel. There are different chemical processes for raw oils to gain fuel properties; transesterification, pyrolysis and emulsification. Among these methods, transesterification has been accepted in the literature as the most common method of producing clean, efficient and safe fuel from vegetable oils [6]. Today, there are commercially used biodiesels, and the fuel properties of these alternative fuels are close to diesel fuel, showing that biodiesel has a serious application potential. Biodiesels can also be obtained from renewable plant sources [7]. Many studies have been done on biodiesels from past to present. These studies can be summarized under three main groups:

- Biodiesel production from different raw materials,
- Biodiesel production with different process methods,
- Determining the effects of biodiesel on diesel engines.

Although biodiesel is the most promising fuel group among alternative fuels that can be used in diesel engines, it has some negative aspects in its use as a fuel. At the beginning of these; high fuel consumption (due to low calorific value), high density, high viscosity, poor atomization, low cloud and pour point, cold starting problems, potential corrosion on engine parts and high NO_x emission [8–11]. For this reason, it is necessary to determine the effects of biodiesel produced from different raw materials or with different production methods on diesel engines. In this experimental study, carrot methyl ester (CME) was produced from carrot seed oil (CSO) by transesterification technique. The effects on the engine's power/torque, specific fuel consumption, engine block temperature and exhaust gas temperature values during its use in diesel engines as an alternative fuel were investigated. Measurements were taken by mixing CME with diesel fuel and applying it at three different rates without mixing. In this way, the effects of CME, which is produced as an alternative to diesel fuel, on some engine parameters have been determined comparatively under different test conditions.

2. Material and methods

2.1. Production of carrot methyl ester

In this study, carrot methyl ester (CME) was produced from carrot seed oil (CSO) by transesterification

method, which is one of the biodiesel production methods. In the production of methyl ester, 4 g of sodium hydroxide (NaOH) and 300 ml of methyl alcohol were mixed in a magnetic stirrer, while 1000 ml of carrot oil was mixed in another magnetic stirrer and brought to 60 °C. Then, the methyl alcohol NaOH mixture was slowly poured into the oil and left for the transesterification reaction. The reaction took place at a constant temperature of 60 °C for 2 hours. The methyl ester formed at the end of the reaction was washed. Washing was done with distilled water at a ratio of 1:1 and repeated 3 times. At the end of the processes, biodiesel production was carried out. Fig. 1 shows the production of CME schematically. Also, Fig. 2 shows the produced CME.

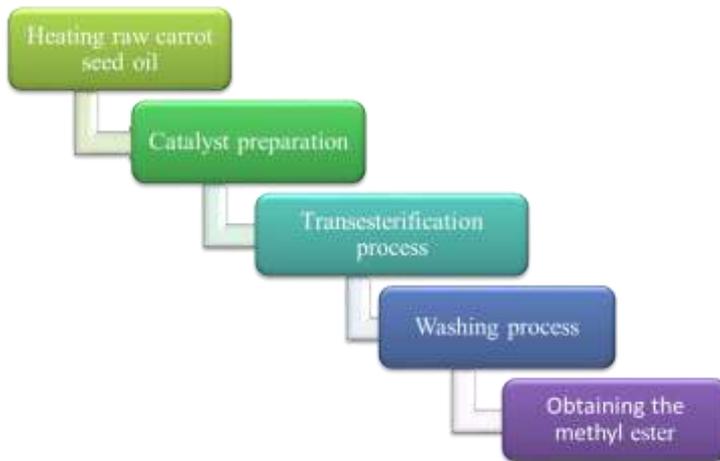


Fig. 1. Production of CME.



(a) (b)

Fig. 2. Carrot methyl ester (a) and diesel fuel (b).

2.2. Experimental test setup

The engine experiments were carried out in a single-cylinder, four-stroke, air-cooled direct injection diesel engine. The technical specifications of the test engine are given in Table 1. An engine with an electric dynamometer is integrated into the test stand for loading the test engine during operation. The engine can be run at the desired speed and load conditions on the computer-controlled test stand. Fig. 3 shows the schematic representation of the engine test stand. CME and D2 (ASTM NO2, diesel fuel) were mixed in the experiments. The experiments were carried out at 2000 rpm engine speed and five different load conditions (1kW, 1.5kW, 2kW, 2.5kW, 3kW). Torque, specific fuel consumption

(BSFC), exhaust gas temperature (EGT) and engine block temperature (EBT) values were recorded under the specified engine operating conditions. CME was used at 20%, 60% and 100% (volumetric) ratios in the experiments.

Table 1. Technical properties of the test engine.

Model	General	Power
	GP186FE	
Number of cylinders	1	
Bore/stroke (mm)	86/70	
Maximum engine power (kW)	6,6	
Type of injection	direct injection	
Injection Pressure (kg/cm ²)	200	
Type of coolant	air coolant	
Maximum engine speed (min ⁻¹)	3600	

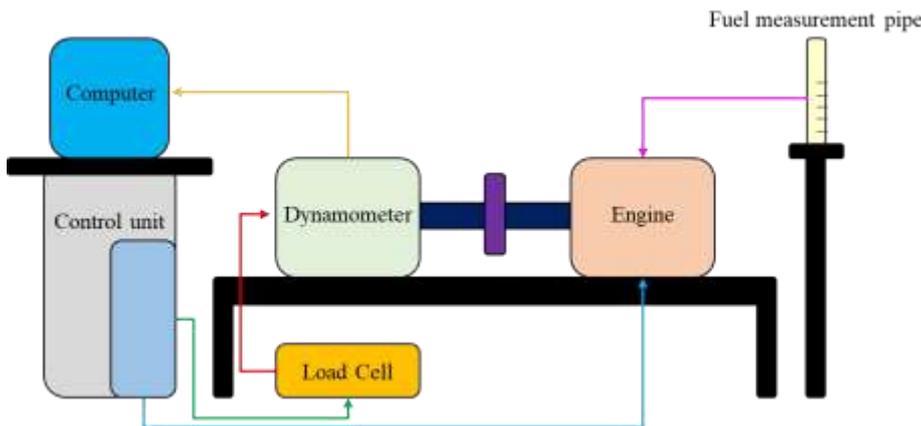


Fig. 3. Schematic representation of the engine test stand.

3. RESULTS AND DISCUSSIONS

3.1. Power – torque results

The first parameter used in the evaluation of motor performances is motor power/torque values. Fig. 4 shows the change of torque values based on different load conditions. For all test fuels, it was seen that the torque values increased as the engine load values increased. Similar changes were observed in other studies in the literature [12]. When Fig. 4 was evaluated, it was determined that the use of CME caused a decrease in the torque values of the engine. When the torque values were assessed, decrements of 3.68% in CME20 fuel, 9.16% in CME60 fuel, and 12.47% in CME100 fuel were determined compared to D2 fuel as the mean of all load conditions. This is thought to be due to the lower heating value of CME fuel compared to diesel fuel. Similarly, a decrease in torque values has been detected in many biodiesel fuels in the literature [13].

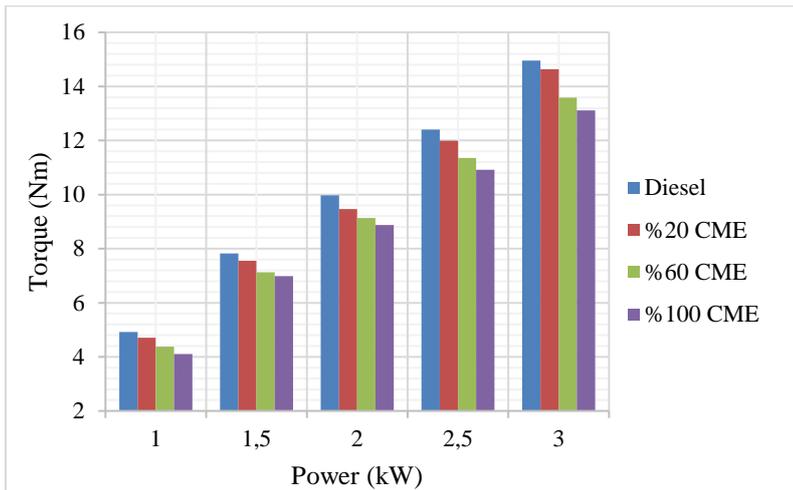


Fig. 4. Torque variations according to different load conditions.

3.2. Brake specific fuel consumption results

Brake specific fuel consumption (BSFC) values are an important criterion in evaluating fuel performance. It is the comparison of the amount of fuel used for a certain power value produced by an engine. Fig. 5 shows the BSFC changes of the biodiesel and its blends with respect to different loads at engine speed of 2000 rpm. BSFC values of CME mixtures were higher than diesel fuel under all engine loads.

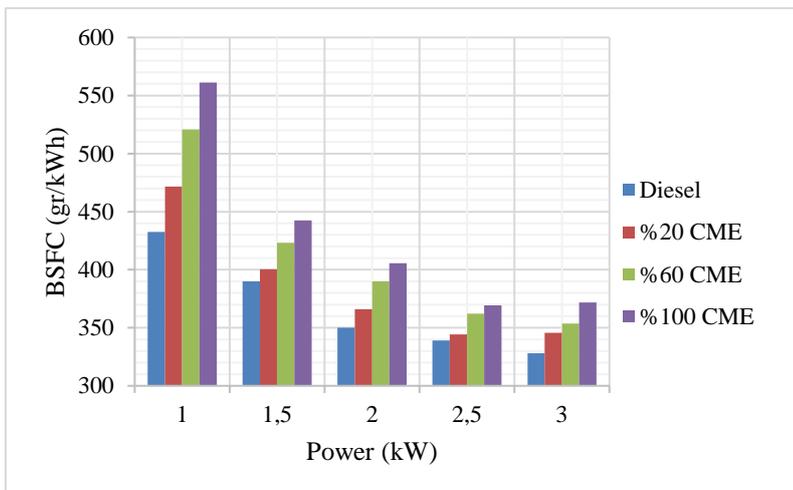


Fig. 5. BSFC variations according to different load conditions.

When the BSFC values was assessed, increases of 4.65% in CME20 fuel, 10.97% in CME60 fuel and 16.25% in CME100 fuel were determined compared to diesel as the mean of all engine loads. The BSFC levels of diesel engines depend on the relationship between the volumetric fuel injection system, fuel density, viscosity, and lower heating value. During the experiments, more fuel is sent to the combustion chamber and burned so that the CME fuel can produce the same power values as diesel fuel.

3.3. Exhaust gas temperature

Exhaust gas temperature (EGT) is a measurement used to determine the temperature values of the gases

released as a result of the combustion of the fuel injected into the combustion chamber of the engine and the air/fuel mixture formed by it. It is a parameter that can provide information about both engine performance and emission formations [15]. Fig. 6 shows the EGT values of the biodiesel and its blends with respect to different loads at engine speed of 2000 rpm. EGT data showed that EGT values of all fuels increased when engine load increased. At all load values, EGT values of diesel fuel were the highest. On the other hand, 100% CME fuel exhibited the lowest EGT values at all load conditions. When the variation of EGT values according to fuel types was analyzed, it was observed that 4.94%, 13.86% and 18.13% decrease in EGT values for 20% CME, 60% CME and 100% CME fuels, respectively, compared to diesel fuel.

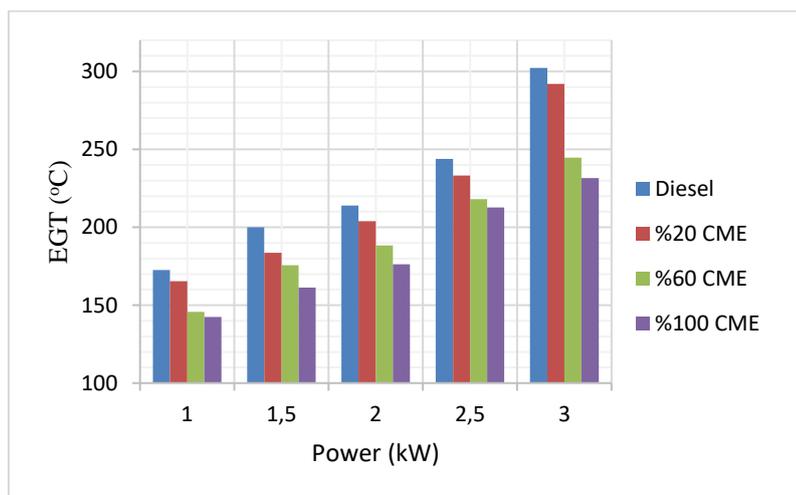


Fig. 6. EGT variations according to different load conditions.

3.4. Engine block temperature

Engine block temperature (EBT), together with EGT, is another parameter that can be used to determine the heat level released as a result of fuel combustion. Variables such as the operating conditions of the engine (rpm and load), the type of fuel used, the injection pressure and timing, and the ambient conditions affect the EBT. The heat released as a result of the combustion of a fuel used in the engine accumulates on the engine components after each cycle. In addition, there is heat released to the atmosphere by heat transfer from the engine block wall (in water-cooled engines, heat is also released through the coolant). Therefore, under constant ambient and engine operating conditions, the heating values of the fuel directly affect the EBT values. Fig. 7 shows the EBT values of the biodiesel and its blends with respect to different loads at engine speed of 2000 rpm. EBT data showed that EBT values of all fuels increased when engine load increased. At all load values, EBT values of diesel fuel were the highest. On the other hand, 100% CME fuel showed the lowest EBT values at all load conditions. When the variation of EBT values according to fuel types was analyzed, it was observed that 3.12%, 8.93% and 12.69% decrease in EBT values for 20% CME, 60% CME and 100% CME fuels, respectively, compared to diesel fuel.

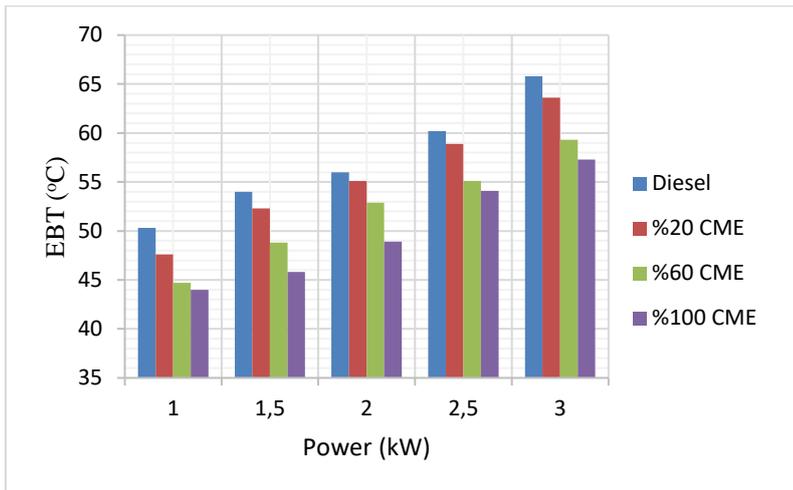


Fig. 7. EBT variations according to different load conditions.

4. Conclusions

In this experimental study, carrot methyl ester (CME) was produced from carrot seed oil (CSO) by transesterification technique. The effects on the engine's power/torque, specific fuel consumption, engine block temperature and exhaust gas temperature values during its use in diesel engines as an alternative fuel were investigated. It was concluded after the experiments that;

- Carrot methyl ester (CME) can be used as an alternative fuel in diesel engines,
- The use of CME caused a slight loss of torque in diesel engines,
- BSFC values of CME were higher than diesel fuel,
- EBT and EGT values of CME were lower compared to diesel fuel,
- CME fuel can be used in diesel engines without significant performance loss.

ACKNOWLEDGMENT

Firat University Research Fund under Project No. supported this study. TEKF.21.17. The researchers are grateful to Firat University for financial support.

REFERENCES

- [1] Global liquid fuels consumption outlook 2022 | Statista, (n.d.). <https://www.statista.com/statistics/859133/global-liquid-fuels-consumption-outlook/> (accessed 4 October 2022).
- [2] M.N. Nabi, W.K. Hussam, H. Mohammad, M. Afroz, A. Bin Rashid, J. Islam, A.N.M. Mominul, I. Mukut, Investigation of engine performance, combustion, and emissions using waste tire Oil-Diesel-Glycine max biodiesel blends in a diesel engine, (2022). doi:10.1016/j.csite.2022.102435.
- [3] S. Rami Reddy, G. Murali, A. Ahamad Shaik, V. Dhana Raju, M.B.S. Sreevara Reddy, Experimental evaluation of diesel engine powered with waste mango seed biodiesel at different injection timings and EGR rates, Fuel. 285 (2021) 119047. doi:10.1016/j.fuel.2020.119047.
- [4] H.E. Saleh, Performance and emissions characteristics of direct injection diesel engine fueled by diesel-jojoba oil-butanol blends with hydrogen peroxide, Fuel. 285 (2021) 119048. doi:10.1016/j.fuel.2020.119048.
- [5] W. Zhao, J. Yan, S. Gao, T.H. Lee, X. Li, The combustion and emission characteristics of a

- common-rail diesel engine fueled with diesel and higher alcohols blends with a high blend ratio, *Energy*. 261 (2022) 124972. doi:10.1016/j.energy.2022.124972.
- [6] L. MEHER, D. VIDYASAGAR, S. NAIK, Technical aspects of biodiesel production by transesterification—a review, *Renew. Sustain. Energy Rev.* 10 (2006) 248–268. doi:10.1016/j.rser.2004.09.002.
- [7] D. Singh, D. Sharma, S.L. Soni, S. Sharma, P. Kumar Sharma, A. Jhalani, A review on feedstocks, production processes, and yield for different generations of biodiesel, *Fuel*. 262 (2020) 116553. doi:10.1016/j.fuel.2019.116553.
- [8] A.T. Hoang, Combustion behavior, performance and emission characteristics of diesel engine fuelled with biodiesel containing cerium oxide nanoparticles: A review, *Fuel Process. Technol.* 218 (2021) 106840. doi:10.1016/j.fuproc.2021.106840.
- [9] M. Mofijur, A.E. Atabani, H.H. Masjuki, M.A. Kalam, B.M. Masum, A study on the effects of promising edible and non-edible biodiesel feedstocks on engine performance and emissions production: A comparative evaluation, *Renew. Sustain. Energy Rev.* 23 (2013) 391–404. doi:10.1016/j.rser.2013.03.009.
- [10] A.T. Hoang, A.T. Le, A review on deposit formation in the injector of diesel engines running on biodiesel, *Energy Sources, Part A Recover. Util. Environ. Eff.* 41 (2019) 584–599. doi:10.1080/15567036.2018.1520342.
- [11] S.M. Palash, M.A. Kalam, H.H. Masjuki, B.M. Masum, I.M. Rizwanul Fattah, M. Mofijur, Impacts of biodiesel combustion on NOx emissions and their reduction approaches, *Renew. Sustain. Energy Rev.* 23 (2013) 473–490. doi:10.1016/j.rser.2013.03.003.
- [12] J. Xue, Combustion characteristics, engine performances and emissions of waste edible oil biodiesel in diesel engine, *Renew. Sustain. Energy Rev.* 23 (2013) 350–365. doi:10.1016/j.rser.2013.02.039.
- [13] E. Buyukkaya, Effects of biodiesel on a DI diesel engine performance, emission and combustion characteristics, *Fuel*. 89 (2010) 3099–3105. doi:10.1016/j.fuel.2010.05.034.
- [14] R.H. De la Cruz M., Theodossiades S., An Investigation of Manual Transmission Drive Rattle, *J. Multi-Body Dyn.* 224 (2009) 167-181.
- [15] R. Kukana, O.P. Jakhar, Performance, combustion and emission characteristics of a diesel engine using composite biodiesel from waste cooking oil - Hibiscus Cannabinus oil, *J. Clean. Prod.* 372 (2022) 133503. doi:10.1016/j.jclepro.2022.133503.

INVESTIGATION OF THE EFFECTS OF ALMOND BIODIESEL ON THE ATTRIBUTES OF A DIESEL ENGINE

Hanbey Hazar

Firat University, Technology Faculty,
Department of Automotive Engineering, Elazig, Turkey.
0000-0001-7699-0088

Burkay Uyar

Firat University, Technology Faculty,
Department of Automotive Engineering, Elazig, Turkey.
0000-0001-7455-7053

Huseyin Sevinc

Firat University, Technology Faculty,
Department of Automotive Engineering, Elazig, Turkey.
0000-0001-7513-3412

ABSTRACT

Today, energy has become the primary requirement for human beings to continue their lives comfortably. Limited fossil fuel resources are among the leading energy sources worldwide. Increasing industrialization and human population lead to the rapid depletion of these limited resources and increase their costs. Especially the consumption of liquid fossil fuels by motor vehicles, the number of which is increasing day by day, has increased the need for alternative fuels. Biodiesels produced from different sources for use in vehicles with compression ignition engines are promising in this regard. In recent years, the production of biodiesel from different plant and animal oils has accelerated. The effects of these newly produced biodiesels on compression ignition engines need to be investigated in detail. In this study, almond methyl ester (AME) was produced as an alternative fuel from almond seed oil (ASO) by transesterification method. By using the produced AME in a diesel engine, the torque-power, vibration and noise values of the engine were measured and engine block temperature images were obtained with the help of thermal camera. Engine tests were carried out by mixing AME with 20% and 60% diesel fuel and using 100% AME. The experiments were carried out in a single-cylinder, four-stroke, air-cooled, direct injection diesel engine. Measurements were recorded under different load conditions at a constant engine speed. The results showed that AME resulted in lower torque values compared to diesel fuel. The increase in the AME ratio in the fuel mixture decreased the torque values. The vibration and noise values of the engine showed a slight decrease during the use of AME fuel. According to the images obtained with the thermal camera, the engine block temperatures decreased as the AME ratio in the fuel mixture increased.

Keywords: Almond seed oil, Almond methyl ester, Noise, Vibration, Diesel engine.

1. Introduction

In recent years, increasing human population, decreasing fossil fuel resources, environmental concerns and various socioeconomic factors have directed scientific studies towards the development of alternative fuels from more environmentally friendly, efficient and renewable sources [1]. Biodiesel is the most suitable alternative to diesel fuel. Biodiesel can be obtained from vegetable, animal, waste oils and micro-algae. Biodiesel does not contain petroleum products, but is compatible with conventional diesel and can be mixed with diesel in any ratio to create a stable biodiesel blend [2]. Alternative diesel fuels are made from natural, renewable resources such as vegetable oils and fats. Biodiesels produced from sources such as soybean, sunflower, palm, rapeseed, Jatropha, cotton seed and canola are frequently used in the literature [3]. Transesterification, micro emulsion and pyrolysis are the leading biodiesel production methods in the literature. Among these methods, the most remarkable way of producing biodiesel fuel in terms of its practicality and applicability is the transesterification technique [4,5]. Biodiesels are produced commercially by transesterification of vegetable oils with alcohol. Methanol and ethanol, which can be produced from biomass, are frequently used in the transesterification technique [6]. As a result of transesterification, methyl esters of crude oils are formed.

In order for biodiesel to be used as a fuel in diesel engines, it must have some fuel properties. Viscosity, density, flash point, cetane number and calorific values are some of them. In addition, in cold conditions, high melting point saturated fatty acid methyl esters can crystallize and clog the fuel line and filters [7]. Although biodiesels have been developed as an alternative to diesel fuels, there are some disadvantages arising from their physical and chemical properties. In addition to analyzing the physical and chemical properties of the new biodiesels produced, their effects on diesel engines should also be investigated.

In this study, almond seed oil methyl ester (AME) was produced from almond seed oil. In the experiments, power/torque, vibration and noise measurements were made and block temperature images were recorded with the help of a thermal camera. The produced AME was tested on a diesel engine, both pure and mixed with diesel fuel. The experiments were carried out under different conditions and the effects of AME/diesel fuel mixtures and AME fuel on the engine were analyzed comparatively.

2. Material and methods

2.1. Production of almond methyl ester

In this study, almond methyl ester (AME) was produced from almond seed oil (ASO) by transesterification method, which is one of the biodiesel production methods. In the production of methyl ester, 4 g of sodium hydroxide (NaOH) and 300 ml of methyl alcohol were mixed in a magnetic stirrer, while 1000 ml of almond oil was mixed in another magnetic stirrer and brought to 60 °C. Then, the methyl alcohol NaOH mixture was slowly poured into the oil and left for the transesterification reaction. The reaction took place at a constant temperature of 60 °C for 2 hours. The methyl ester formed at the end of the reaction was washed. Washing was done with distilled water at a ratio of 1:1 and repeated 3 times. At the end of the processes, biodiesel production was carried out. Fig. 1 shows the production of AME schematically. Also, Fig. 2 shows the produced AME and diesel fuel.

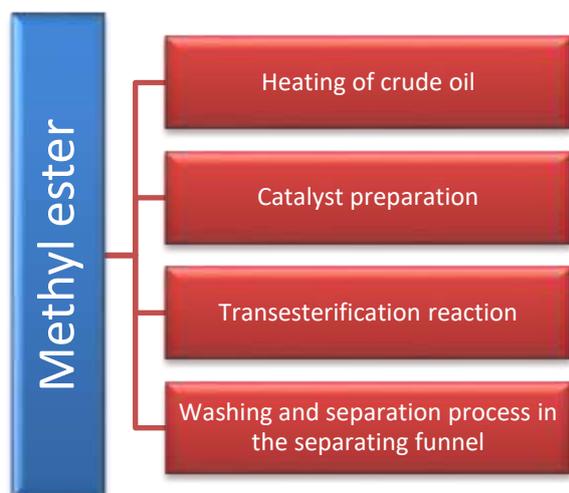
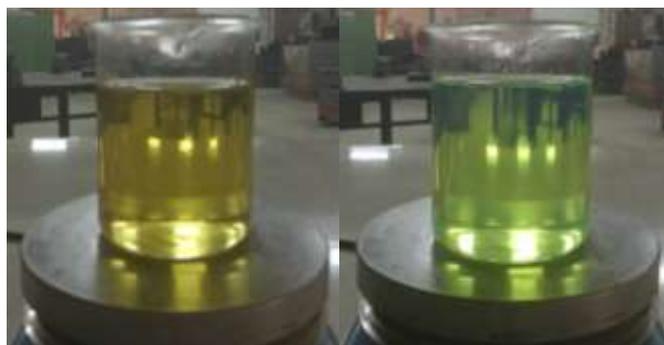


Figure 1. Production of AME



(a) (b)

Figure 2. Almond methyl ester (a) and diesel fuel (b).

2.2. Experimental test setup

A General Power GP186FE single-cylinder, four-stroke, air-cooled direct injection diesel engine was used in the experiments. Engine technical specifications are given in Table 1. The D2 (ASTM NO2, diesel fuel) used was obtained from any fuel station in Turkey. The load was applied to the engine with an electric dynamometer connected to the engine. The entire system was controlled by a computer. Experiments were carried out at 2000 rpm constant engine speed, 1kw, 1.5kw, 2kw, 2.5kw, 3kw loads. Before the analysis measurements were taken, the engine was operated with diesel fuel for a certain period of time to reach its normal operating temperature. In the experiments performed, AME was used in volumetric ratios of 20%, 60%, 100%, and the analysis results were recorded after waiting for a certain period of time to obtain the results.

Vibration measurements were made under different load and fuel operating conditions of the engine. Vibration measurements were made with 3-axis (x-y-z). First of all, the vibration values in one axis were obtained by using the RMS (root-mean-square) method. This process was repeated for vibration values in all three axes. Then, the resultant of the vibration values of the three axes, again with the RMS method, was calculated and the average vibration value of the engine was calculated [8]. The

formula used to calculate the RMS values is shown in Eq 1. During the experiments, thermal images of the engine were taken with a DALI brand thermal camera. Vibration values and thermal camera measurements were obtained at 3 kW motor load condition.

$$x_{RMS} = \sqrt{\frac{1}{n} (x_1^2 + x_2^2 + \dots + x_n^2)}$$

(1)

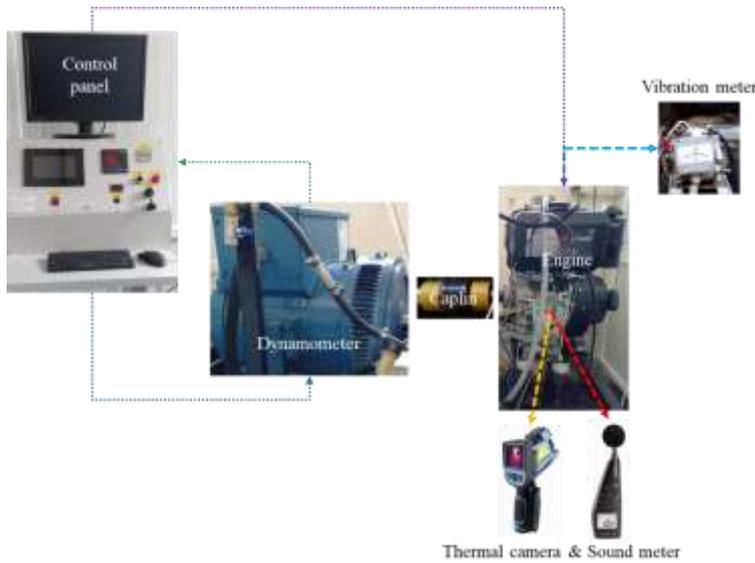


Figure 3. Engine test rig

Table 1. Technical properties of the test engine.

Model	General	Power
	GP186FE	
Number of cylinders	1	
Bore/stroke (mm)	86/70	
Maximum engine power (kW)	6,6	
Type of injection	direct injection	
Injection Pressure (kg/cm ²)	200	
Type of coolant	air coolant	
Maximum engine speed (min ⁻¹)	3600	

3. RESULTS AND DISCUSSIONS

3.1. Power – torque results

In internal combustion engines, the physical and chemical properties of the fuels affect the power and torque values produced by the engine. For this reason, different fuels produce different power and torque values in diesel engines. In Fig. 4, torque values depending on the use of AME and diesel fuel under different load conditions are shown. In general, it was observed that the torque values for all fuels increased as the engine load increased. When Fig. 4 was evaluated, it was determined that the use of AME caused a decrease in the torque values of the engine. When the change ratios were analyzed numerically, torque values decreased 4.03%, 8.82% and 12.24% in 20%, 60% and 100% AME blends,

respectively, compared to diesel fuel.

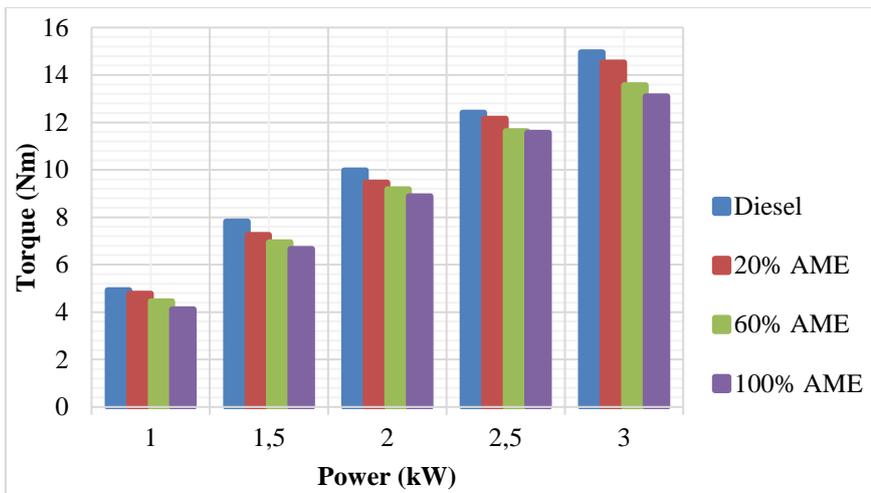


Figure 4. Torque variations according to different load conditions.

3.2. Vibration and noise

Vibrations in the engine block, which shorten the life of engine parts, can be reduced or increased by factors such as injection timing, injector injection, fuel amount and fuel type [9]. In the literature, there are studies investigating the effects of biodiesel and different fuel mixtures on engine vibration parameters using diesel engines [10]. Vibration measurements were made with three axes and total engine vibration was calculated by RMS calculation method. Fig. 5 shows vibration levels according to fuel types. Vibration values increased as the engine load increased. This was the same for all test fuels. In general, the highest vibration values were measured in the use of diesel fuel. It was determined that the addition of AME fuel caused a decrease in vibration values. When the change ratios were analyzed numerically, vibration values decreased 1.16%, 3.03% and 3.82% in 20%, 60% and 100% AME blends, respectively, compared to diesel fuel.

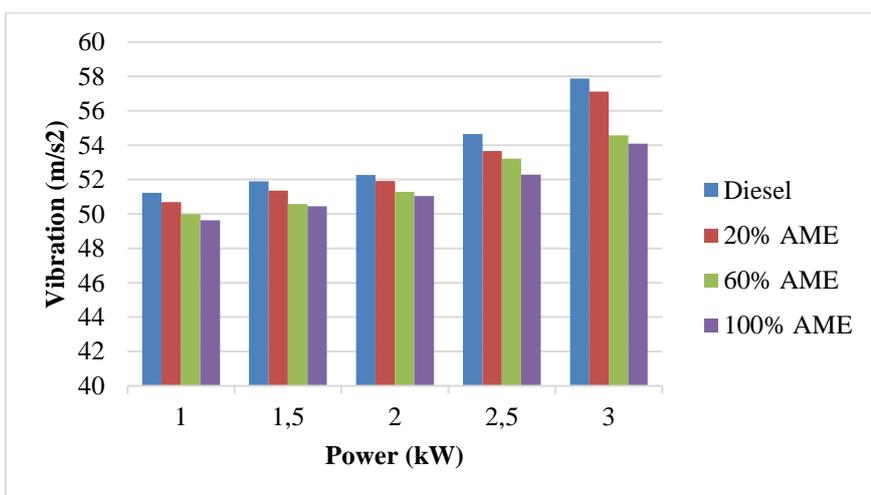


Figure 5. Vibration variations according to different load conditions.

Another parameter examined in engines is noise levels. There are three basic noise formations in

internal combustion engines: combustion noise, mechanical noise and intake/exhaust noises [11]. Fig. 6 shows the changes of noise values for fuel types used in diesel engine. The highest noise values were realized in the conditions where diesel fuel was used. On the other hand, it has been determined that the use of AME fuel reduces noise values. Compared to diesel fuel, 20% AME, 60% AME and 100% AME fuels increased the total noise by 0.51%, 1.2% and 1.65%, respectively.

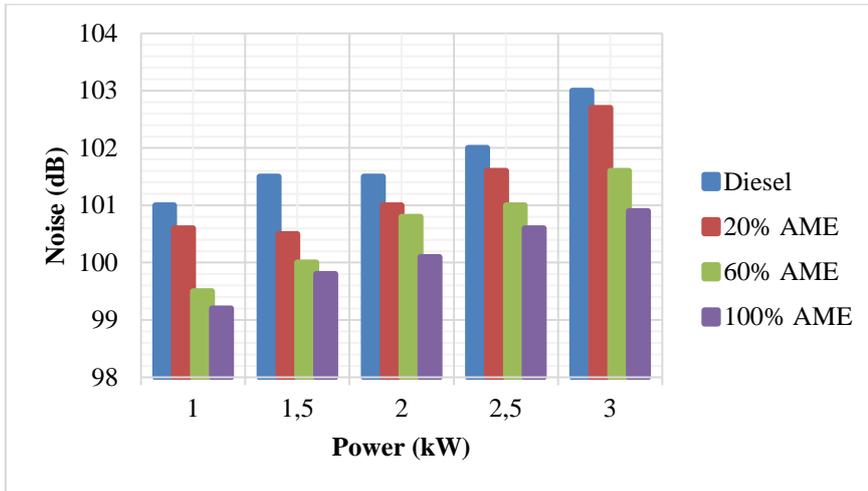
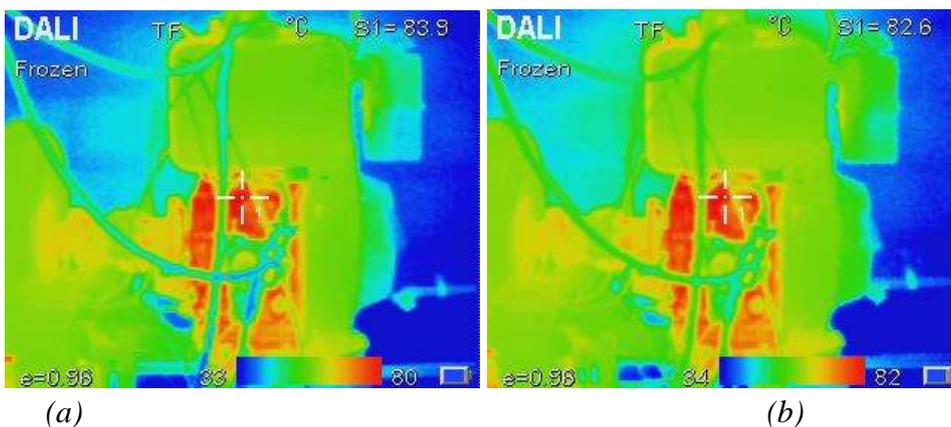


Figure 6. Noise variations according to different load conditions.

3.3. Thermal images of engine

Thermal camera images are one of the methods used to determine the peak temperature values and average temperature values on the engines. Fig. 7 shows the thermal images of the test engine obtained using different fuels. Images were acquired under load conditions of 3 kW. When the thermal images were examined, it was seen that the highest engine wall temperature occurred in diesel fuel, and the lowest wall temperature occurred in 100% AME fuel. When the engine wall temperatures were compared, it was determined that the wall temperatures of 20%, 60% and 100% AME fuels decreased by 3.75%, 4.60%, and 8.84%, respectively, compared to diesel fuel.



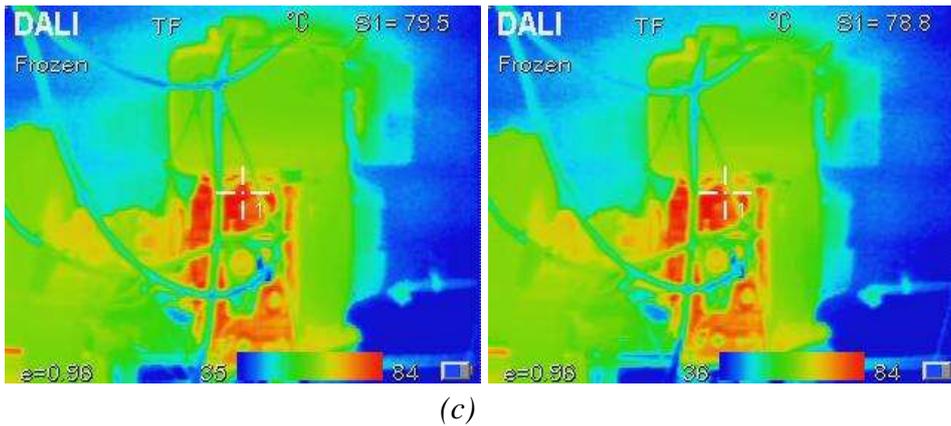


Figure 7. Thermal images of engine according to constant 3kw load conditions (a) diesel, (b) %100 AME, (c) %60 AME, (d) %20 AME.

4. Conclusions

In this experimental study, almond methyl ester (AME) was produced from almond seed oil (CSO) by transesterification technique. The effects on the engine's power/torque, vibration, and noise values during its use in diesel engines as an alternative fuel were investigated. In addition, engine thermal images were taken. It was concluded after the experiments that;

- Almond methyl ester (AME) can be used as an alternative fuel in diesel engines,
- The use of AME caused a slight loss of torque in diesel engines,
- Vibration values of AME were lower than diesel fuel,
- Noise values of AME were lower compared to diesel fuel,
- According to thermal images, usage of AME reduced the engine wall temperature.

ACKNOWLEDGMENT

Firat University Research Fund under Project No. supported this study. TEKF.21.17.

The researchers are grateful to Firat University for financial support.

REFERENCES

- [1] Enweremadu CC, Rutto HL. Combustion, emission and engine performance characteristics of used cooking oil biodiesel—A review. *Renew Sustain Energy Rev* 2010;14:2863–73. doi:10.1016/j.rser.2010.07.036.
- [2] Dwivedi G, Jain S, Sharma MP. Impact analysis of biodiesel on engine performance—A review. *Renew Sustain Energy Rev* 2011;15:4633–41. doi:10.1016/j.rser.2011.07.089.
- [3] Singh SP, Singh D. Biodiesel production through the use of different sources and characterization of oils and their esters as the substitute of diesel: A review. *Renew Sustain Energy Rev* 2010;14:200–16. doi:10.1016/j.rser.2009.07.017.
- [4] Kapilan N, Ashok Babu TP, Reddy RP. Technical aspects of biodiesel and its oxidation stability. *Int J ChemTech Res* 2009;1:278–82.
- [5] Demirbas A. Progress and recent trends in biodiesel fuels. *Energy Convers Manag* 2009;50:14–34. doi:10.1016/j.enconman.2008.09.001.
- [6] Salvi BL, Panwar NL. Biodiesel resources and production technologies – A review. *Renew*

Sustain Energy Rev 2012;16:3680–9. doi:10.1016/j.rser.2012.03.050.

[7] Kerschbaum S, Rinke G, Schubert K. Winterization of biodiesel by micro process engineering. Fuel 2008;87:2590–7. doi:10.1016/j.fuel.2008.01.023.

[8] Soyhan HS. Experimental investigation and artificial neural networks (ANNs) based prediction of engine vibration of a diesel engine fueled with sunflower biodiesel – NH₃ mixtures 2021;304. doi:10.1016/j.fuel.2021.121462.

[9] De la Cruz M., Theodossiades S. RH. An Investigation of Manual Transmission Drive Rattle. J Multi-Body Dyn 2009;224:167-181.

[10] Javed S, Murthy YVVS, Ulla R, Rao TN. Journal of Natural Gas Science and Engineering Vibration analysis of a diesel engine using biodiesel fuel blended with nano particles by dual fueling of hydrogen. J Nat Gas Sci Eng 2016;33:217–30. doi:10.1016/j.jngse.2016.05.026.

[11] Patel C, Tiwari N, Agarwal AK. Experimental investigations of Soyabean and Rapeseed SVO and biodiesels on engine noise, vibrations, and engine characteristics. Fuel 2019;238:86–97. doi:10.1016/j.fuel.2018.10.068.

ANALYSIS AND EVALUATION OF RISKS IN THE CONSTRUCTION SECTOR IN TERMS OF OCCUPATIONAL HEALTH AND SAFETY (OHS)

Ömer Saltuk BÖLÜKBAŞI

Iskenderun Technical University, Faculty of Engineering and Natural Sciences, Department of Metallurgical and Materials Engineering, İskenderun-Hatay, TURKEY.

ORCID No: <https://orcid.org/0000-0002-8862-009X>

ABSTRACT

Today, the use of risk assessment methods used in businesses within the scope of Occupational Health and Safety varies as the business lines change. Within the framework of Occupational Health and Safety, businesses whose risk assessment is required by law should determine the most appropriate risk assessment methods for their own business in order to obtain and implement more reliable and realistic. Occupational accidents and occupational diseases are a very important national and international problem and a case we encounter frequently. Although work accidents and occupational diseases are such a big problem, they can be reduced to a certain extent by taking necessary measures with determined legal practices and penal sanctions. In this study, the existing hazards in the construction sector and the risks that may arise from these hazards were determined and these risks were examined with the Fine-Kinney Method. As a result of these examinations, the risks were graded and their status was decided. Measures and suggestions that can be taken for the risks rated were determined. In our country, this sector is one of the most important sectors in terms of occupational health and safety. As a result of the researches, a significant part of the fatal occupational accidents occurs in the construction sector. For this reason, adequate awareness and awareness about work accidents and occupational diseases are among the most important factors. In this study, the risks in a building construction are determined by the Fine - Kinney method and the risks are; As a result of the determination of parameters such as probability, frequency and severity, the risk result was determined and the analysis and grading of the risks were made. During this process, it was determined that the parameters at hand could take different values by the experts and this could be used as a different method.

Keywords: Construction industry, Fine Kinney method, Risk analysis, Occupational health and safety

1. Introduction

The Fine Kinney risk analysis method is one of the systematic methods widely used for occupational health and safety risk assessment. A risk measurement result is obtained by evaluating three factors: the probability of a risk occurring, the frequency of exposure to the hazard, and the degree of severity it will result from its realization [1-3].

In this method, the probability of occurrence of the risks, the frequency of their occurrence and the severity of the effect are determined as the parameters based on. In short, the risk rating; It is the product of numerical values of probability, frequency and severity parameters [4-5].

This risk analysis and risk rating method is a method that can be used together with the past statistical data of the analyzed business and the predictions of experts. In short, this method we use is based on risk analysis, rather than just making predictions; It has been understood that the results will be much more accurate if it consists of data such as recorded accident data and near-miss [6-8]. Apart from the

possibility and frequency (frequency) of an accident, the frequency of exposure of individuals in the hazardous area, that is, these individuals at risk, should also be taken into account when arranging the Fine Kinney method. For this reason, it is possible to make better examination and evaluation in terms of accuracy and reliability compared to the Matrix Risk Analysis Method, which is another widely used method. Most businesses in the construction industry use the Fine-Kinney risk assessment method.

2. Method

In order to classify risks and make risk ratings, probability table, severity table, frequency table together with risk rating table are used. While creating these four tables, the following parameters should be considered;

- Risk of failure of security measures,
- Opportunities to take measures,
- Persons exposed to risk,
- Risk exposure relationships,
- Reliability of the security measures taken

Probability: The probability of harm or damage occurring in the process.

Table 1. Probability Scale [9,10]

Category	Value
Practically Impossible	0,2
Low Probability	0,5
Very Low Probability	1
Rare, But Possible	3
High Probability	6
Very High Probability	10

Frequency: Frequency of exposure to hazards during the process and activity.

Table 2. Frequency scale [9,10]

Category	Explanation	Value
once a year or less	Very Rare	0,5
once or several times a year	Fairly Rare	1
once or several times a month	Rare	2
once or several times a week	Sometimes	3
one or more per day	Often	6
Continuously or more than once per hour	Continually	10

Severity: It is the extent of the damage or damage to the human, workplace and environment in the event of the danger.

Table 3. Severity scale [9]

Category	Explanation	Value
Mild-Harmless or insignificant	should be	1
Minor-Low job loss, Minor damage, First Aid.	considered	3
Major- Significant damage, External treatment, Loss of working days	Important	7
Disability, Limb loss, Environmental impact	Serious	15
Death, Complete disability, Severe environmental impact	So serious	40
Multiple deaths, Major environmental disaster	Too bad	100
	Disaster	

Decision and Action Based on Risk Level: Following the rating procedures, an action plan is determined as follows.

Table 4. Decision-action scale of risk parameters. [9,10]

Order	Risk Value	Decision	Action
1	$R > 20$	Acceptable Risk	No immediate action may be required
2	$70 > R > 20$	Risk	It should be included in the Action Plan
3	$200 > R > 70$	Significant Risk	It must be carefully monitored and remedied according to the annual action plan.
4	$400 > R > 200$	High risk	It should be resolved by taking it into a short-term action plan
5	$R > 400$	Very High Risk	Immediate action should be taken by interrupting the work

3. Danger and Risks in the Construction Sector

In order to minimize the losses arising from work accidents and occupational diseases in the construction sector, all studies related to the determination of safety measures based on scientific research and the implementation of safety measures are included in the scope of occupational health and safety.

3.1 Causes of Accidents in the Construction Industry

Due to the wide working area, the construction sector is a sector that is directly affected by different geographical conditions and climatic factors. The fact that the working areas are not usually in a closed area may cause this effect to be more affected. The parameters that may affect the work accident and occupational disease in the work area can be listed as follows [11];

- Physical factors: Temperature, wind, humidity, vibration, ambient light, noise, etc.

- Chemical factors: Solid, liquid, gaseous flammable, chemical substances, explosives, etc.
- Biological factors: Disease-causing microbes, etc.
- Psychological factors: human relations and incompatibilities, etc.
- Personal factors: Individuals exhibiting unlawful behaviors, lack of personal protective equipment or not using these equipment, ignorance and unconsciousness in the context of occupational safety, not doing the job that matches their skills.

3.2 Scores of Risks Determined for the Construction Industry

As it is known, the scoring process is done as a result of statistical data. Sometimes we can see that the scoring of the same two risks is not the same. The reason for this may be that the statistical data based on the structures differ.



Figure 1. The sinking or overturning of the construction equipment due to the soft ground [12]

We consider the probability of this danger to occur as very significant risk. Accordingly, the value obtained in the probability scale;

It is determined as $P=1$

We assess the frequency of exposure to this hazard once or several times a week. Accordingly, the value obtained in the frequency scale;

It is determined as $F=3$.

In case of the realization of this danger, the damage or damage to the human, workplace and environment; disability, loss of limb and environmental effects. Accordingly, the value obtained in the severity value;

It is determined as $S=40$.

The risk value is calculated as $R=120$, $200 > R > 70$, Significant Risk, It must be carefully monitored and remedied according to the annual action plan.



Figure 2. Material handling by crane [13]

We consider it rare for this danger to materialize. Accordingly, the value obtained in the probability scale;

It is determined as $i=3$.

We assess the frequency of exposure to this hazard once or several times a week. Accordingly, the value obtained in the Frequency Scale; Risk Value

It is determined as $F=2$

In case of the realization of this danger, the damage or damage of the damage to the human, workplace and environment; death, we consider the effect of full disability. Accordingly, the value obtained in the; It is determined as $S=7$

The risk value is calculated as $R=42$, $70 > R > 20$, Risk, It should be included in the action plan

Five sample accident analyzes in the construction sector that we have done within the scope of the study are given in the table below.

Table 5. Fine-Kinney risk rating chart

Order	Danger	P	F	S	Risk Score	Risk Statement
1	Sinking/overturning of construction equipment due to soft ground	1	3	40	120	Significant Risk-Must Be Watched Carefully
2	Falling from a staircase or elevator shaft in a building	3	6	40	720	Very High Risk-Work is interrupted-immediate action is taken
3	Striking the operator as a result of the oscillation of the material transported by the crane	3	2	7	42	Significant Risk-Must Be Watched Carefully
4	Not staying at a sufficient distance from the work machines	3	2	15	90	High Risk- Should be included in the action plan in the short term
5	Not grounding the electrical source	3	2	15	90	Significant Risk-To be watched carefully

4. Conclusions and Recommendations

Today, the use of risk assessment methods used in businesses within the scope of Occupational Health and Safety varies as the business lines change. Within the framework of Occupational Health and Safety, businesses whose risk assessment is required by law should determine the most appropriate risk assessment methods for their own business in order to obtain and implement more reliable and realistic. In this study, the risks in a building construction are determined by the Fine - Kinney method and the risks are; as a result of the determination of parameters such as probability, frequency and severity, the risk score was determined and the analysis and grading of the risks were made. During this process, it was determined that the parameters at hand could take different values by the experts and this could be used as a different method.

As we can understand from here, the construction sector is a sector group that has a higher risk compared to other sectors, and in order to minimize the risk level, it is necessary to work with a sense of responsibility in the triangle of the state, employer and worker and to fulfill the responsibility of each sector.

References

- [1] Hohnen, P., & Hasle, P. (2018). Third party audits of the psychosocial work environment in occupational health and safety management systems. *Safety science*, 109, 76-85.
- [2] Gul, M., & Yucesan, M. (2022). Performance evaluation of Turkish Universities by an integrated Bayesian BWM-TOPSIS model. *Socio-Economic Planning Sciences*, 80, 101173.
- [3] Marhavidas, P. K., Filippidis, M., Koulinas, G. K., & Koulouriotis, D. E. (2020). An expanded HAZOP-study with fuzzy-AHP (XPA-HAZOP technique): Application in a sour crude-oil processing plant. *Safety science*, 124, 104590.
- [4] Cardona, O. (2005). Indicators of disaster risk and risk management: Summary report. Inter-American Development Bank.
- [5] Laitinen, H., Rasa, P. L., Lankinen, T., Lechtel, J., & Leskinen, T. (2000). Manual on monitoring working conditions in the workplace in industry. The Elmer System. Institute of occupational health of Finland: Helsinki, Finland, 3-5.
- [6] Jimenez-Puente, I. (2013). Offshore Field Development in Cold Climate: with Emphasis on Terminals (Master's thesis, Institutt for transport).
- [7] Senthil, S., Muruganathan, K., & Ramesh, A. (2018). Analysis and prioritisation of risks in a reverse logistics network using hybrid multi-criteria decision-making methods. *Journal of Cleaner Production*, 179, 716-730.
- [8] Shi, Q., Zhou, Y., Xiao, C., Chen, R., & Zuo, J. (2014). Delivery risk analysis within the context of program management using fuzzy logic and DEA: A China case study. *International Journal of Project Management*, 32(2), 341-349.
- [9] Kinney, G. F., & Wiruth, A. D. (1976). Practical risk analysis for safety management. Naval Weapons Center China Lake CA.
- [10] Özkılıç, Ö. (2014). Risk assessment: Atex directives-explosive atmospheres prevention and mitigation of major industrial accidents-quantitative risk assessment: Seveso ii and seveso directive (comah directive). TİSK (in Turkish).
- [11] Kozak, T. (2007). TS18001 (OHSAS 18001) Occupational health and safety management system: an application example in an enterprise in the construction industry. Unpublished master's thesis,

Mustafa Kemal University, Institute of Science and Technology (in Turkish).

[12] Osmancık newspaper home page URL: <http://www.osmancikgazetesi.net/haber/devrilen-is-makinasindan-mucize-kurtulus-2540.html>, Accessed: 07.08.2021 (in Turkish).

[13] News of Istanbul Truth News Site. URL:https://www.istanbulgercegi.com/manisada-is-cinayeti-halat-kopunca-vinc-operatoru-canindan-oldu_180168.html, Accessed: 03.07.2022 (in Turkish).

THE PROBLEMS CAUSED BY COPPER CONTAINING MATERIALS IN IRON AND STEEL PRODUCTION

Ömer Saltuk BÖLÜKBAŞI

Iskenderun Technical University, Faculty of Engineering and Natural Sciences, Department of Metallurgical and Materials Engineering, İskenderun-Hatay, TURKEY.

ORCID No: <https://orcid.org/0000-0002-8862-009X>

Efe ARIYOL

Iskenderun Technical University, Graduate Education Institute, Department of Metallurgical and Materials Engineering, İskenderun-Hatay, TURKEY.

ORCID No: <https://orcid.org/0000-0002-9625-4990>

ABSTRACT

Undoubtedly, one of the most common materials among metal scraps is copper-containing materials. It is undesirable to use these materials in production due to the knowledge of the negative effects of copper on iron and steel production. It is also of great importance to separate these materials due to these negative effects. Although there are different decomposition methods, in this study, the importance and positive effects of this decomposition process are emphasized, and it is aimed to create an awareness. When the literature is researched, the effects of copper on steel have been clearly revealed and information has been gained about the necessary actions. Considering the number of arc furnaces in our country, it is possible to come across copper-containing materials frequently in both domestic and imported scraps, since the amount of demanded scrap will be high in that context. Although there are different copper-containing materials in different scrap types, it is mostly seen in electronic material scraps. The use of triage to separate such materials is one of the oldest but most effective methods. It is inevitable to make a good observation to eliminate the materials that will cause discontinuity in production and to provide a stable environment, so different detection methods can be performed. As a result of this study, the negative effects of copper on iron and steel production were discussed, and it was aimed to gain a different perspective to the event with examples and real determinations.

Keywords: Metal scrap, copper, iron and steel, decomposition

1. Introduction

Considering the iron and steel production capacity in Turkey and the investments made, there are materials that are not preferred for the iron and steel industry among the metal scraps that are generated within our country and imported from abroad. One of the most important of these materials is undoubtedly the element copper. Copper is one of the most important elements in steel scrap since it is difficult to remove in the steelmaking process [1]. These materials, which are very valuable for the scrap traders in our country, enter our country mostly in imported scrap. Copper is common in end-of-life scrap, mostly from copper wires and motors in automobiles, appliances, and machinery that bond to steel during shredding [2]. Although various methods have been developed to extract such materials from scraps, it still may cause some problems in iron and steel production. Of course, the material

value of this element, which must be controlled in iron and steel production, is a well-known fact all over the world, such that the copper industry is an important wheel in the global economy as copper, which is widely used in industry or daily life [3]. For this reason, the importance of recycling and reintegrating into the system through different channels is also known. When our country is compared with the iron and steel production methods in the world, it is clearly seen that the production method with electric arc furnaces is more common in our country because there are only 3 factories in our country that produce steel from iron ore. It is among the systems that have started to be used in our country, in other words, automatic feeding systems that automatically adjust the scrap heaps ready for production. Automatic scrap separation systems are divided into two: These are divided into direct and indirect separation methods [4]. Direct separation takes place within the physical possibilities, methods such as electro magnet, water, air are the most used. In particular, the non-ferrous fraction remaining after the magnetic separation of steel is a mixture of different metals and alloys in a size range from 10 to 100 mm. The mixture consists of copper, brass, zinc, aluminum, magnesium, lead and the remaining non-magnetic stainless steel [5]. Indirect separation can be called the processes of separating materials according to their chemical properties after the use of radiation.

2. Effects of Copper Materials

When the literature is searched, copper is one of the main residual impurities in steel and has a tendency to cause serious microstructural deterioration if not controlled within certain limits [6]. Although there are different processes and limits among the companies producing billet and flat steel, when viewed from a common point of view, the limits have already been determined both as a company and in international steel standards. The production recipes of the enterprises are applied at the installation stages and as a result of the quality control trials without making any major changes. Although there are measures taken for copper, which has become the fearful dream of companies producing thin slabs, the problems that arise negatively affect the companies both in terms of material and time. Copper concentrations above 0.1% by weight cause hot tearing, a phenomenon that leads to surface cracking in hot rolling and forming [7].

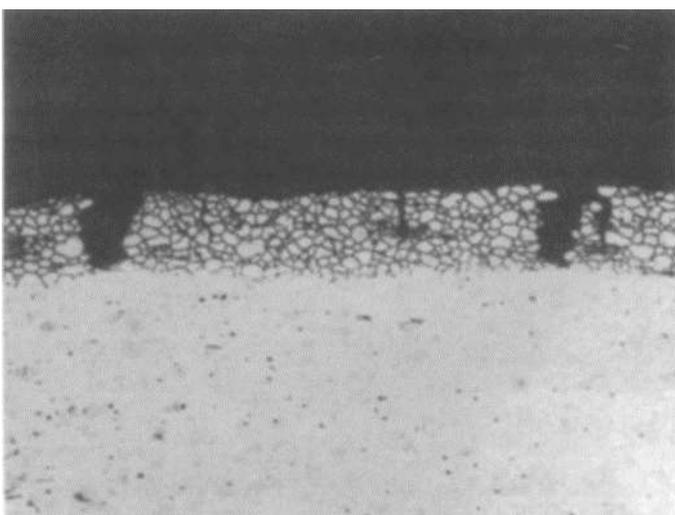


Figure 1. Hot Tearing Microstructure image [8].

Copper with a low melting point can accumulate on the edges of the slab because it is very active while the liquid steel is still hot and the inner parts are still solidifying, and this situation is called edge cracking. As can be seen in Figure 1, the bonds between the grains are broken and this causes the material to rupture directly.



Figure 2. Folding test as a result of casting with high copper content

When copper balance cannot be achieved in electric arc furnaces, the copper ratio can be balanced by separating the casting between the crucibles. In addition, errors called bleeding may occur in continuous casting machines in plants that produce steel with thin slabs.

3. Suggestions

Businesses should carefully handle their scraps in scrap yards and control their copper scraps in a different place. In general, it is possible to separate both the soil and the small unwanted parts by passing the scraps seen in the electrical components and motors over the vibrating band systems. Handling is the work of a group of people in a designated scrap heap to search for and collect parts in accordance with the instructions given to them. The handling method is both the least costly and one of the most effective methods, so it is among the most used methods. It is almost impossible to observe the imported scraps at the ship's head and to see such materials unless they are very large and conspicuous.



Figure 3. A sample scrap ship hold

Another method determined as a result of literature searches is automatic scrap feeding systems with X-ray rays. In this method, calculations are made with an algorithm to create a certain composition

according to the amount of elements in the parts exposed to X-rays from above while moving on a band. Considering the economic importance of copper scrap, this type of scrap can be added directly in special castings where copper must be added. Unused scrap can be sold to other businesses or customers for economic returns, and the business can benefit from this.

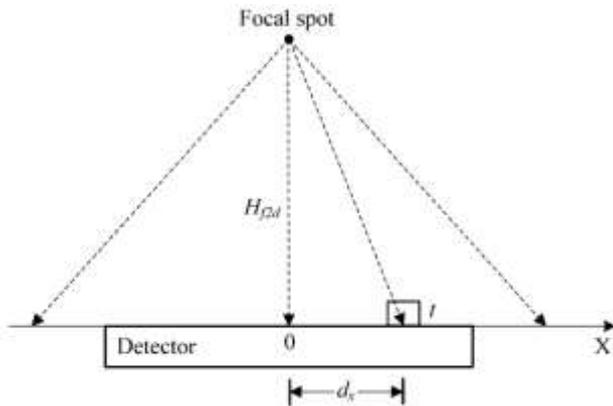


Figure 4. Propagation of detecting rays [4].

4. Results

In this study, the effects of copper-containing materials on steel and what these effects are are mentioned and necessary definitions are given. The differences in the use of scrap of the enterprises were mentioned and recommendations were made for the sorting of copper-containing scraps. The situations in the iron and steel factories that are currently producing were evaluated and it is aimed that this study will guide these companies. Different scrap detection methods and current information are presented by scanning the literature. It has been seen that automatic scrap feeding systems are more effective and open to development compared to other methods. It has been clearly seen that forming problems such as hot tearing and edge cracking occur when the copper element is added to more than 1% of the liquid steel.

References

- [1] Sellamuthu, P., Hodgson, P., & Stanford, N. (2020). Effect of copper on microstructure, recrystallization and precipitation kinetics in strip cast low carbon steel. *Materials Research Express*, 6(12).
- [2] Daehn, K. E., Cabrera Serrenho, A., & Allwood, J. M. (2017). How will copper contamination constrain future global steel recycling? *Environmental science & technology*, 51(11), 6599-6606.
- [3] Liu, S., Zhang, Y., Su, Z., Lu, M., Gu, F., Liu, J., & Jiang, T. (2020). Recycling the domestic copper scrap to address the China's copper sustainability. *Journal of Materials Research and Technology*, 9(3), 2846-2855.
- [4] Xiong, T., Ye, W., & Xu, X. (2021). Combination of Dual-Energy X-ray Transmission and Variable Gas-Ejection for the In-Line Automatic Sorting of Many Types of Scrap in One Measurement. *Applied Sciences*, 11(10), 4349.
- [5] Mesina, M. B., De Jong, T. P. R., & Dalmijn, W. L. (2007). Automatic sorting of scrap metals with a combined electromagnetic and dual energy X-ray transmission sensor. *International Journal of Mineral Processing*, 82(4), 222-232.
- [6] Sekunowo, O. I., Durowaye, S. I., & Gbenedor, O. P. (2014). Effect of Copper on Microstructure

and Mechanical Properties of Construction Steel. *International Journal of Chemical, Molecular, Nuclear, Materials and Metallurgical Engineering*, 8(8), 839-843.

[7] Liu, S., Zhang, Y., Su, Z., Lu, M., Gu, F., Liu, J., & Jiang, T. (2020). Recycling the domestic copper scrap to address the China's copper sustainability. *Journal of Materials Research and Technology*, 9(3), 2846-2855.

[8] Hot Shortness, Hot shortness is a major problem, keeping extrusion speeds disappointingly low, <https://www.sciencedirect.com/topics/engineering/hot-shortness>, Accessed: 12.10.2022.

TO PREVENT WASTE BY USING 5NEDEN, 5S, KANBAN, ANDON FROM LEAN MANAGEMENT TOOLS IN THE FIELD OF HEALTH

Dr. Öğr. Üyesi, Nihal ALOĞLU

Kahramanmaraş Sütçü İmam University, Faculty of Health Sciences.

Kahramanmaraş, Türkiye, Orcid: 0000 0003 4162 2845

Prof. Dr., İbrahim Sani MERT

Antalya Bilim University, İİSBF, Antalya, Türkiye

Orcid: 0000-0002- 2850-1865

ABSTRACT

Aim: Lean management is a deep philosophy that reveals value by eliminating waste in workflows and puts respect for employees and people at its core. Many things are a type of waste, such as overproduction, unnecessary waiting, moving from place to place, delaying production by making wrong operations, inventories, unnecessary walks, and reworking to correct what we have produced or done. In short, anything unnecessary is waste. The general purpose of this study is to reveal the gains that can be achieved by eliminating waste with the improvements to be made by using lean tools with field workers in the health sector, which is the service sector of lean management and where problems are experienced. The main aim is to reduce the stock of drugs available in the intensive care unit in a private hospital and to improve the treatment unit.

Method: In the study planned as qualitative research, Gemba (where value is created), Genchi Gembutsu (Go see the whole process in place) and Process analysis technique (drawing of business processes) were used to go to the research. During the Genchi gembutsu, determinations were made by personally observing each gemba for at least seven hours. The business processes were followed up with the employees and the waste points hidden in the processes were determined. Kaizen study was carried out by using 5 Why, process analysis, 5S, Kanban, Andon from lean tools.

Findings: In the follow-up of business processes; Presence of expired and expired drugs (waste type: error), too many drugs in the drug section (overstock), visual pollution, waste of time to search for drugs (waste and repetition), excess consumables (waste of materials) determinations were made. There was also a complaint of lack of space for the material warehouse and the treatment unit. Hospital management stated that drug consumption is high in intensive care units.

Conclusion: With the kaizen study using lean tools, a 20%-85% reduction was achieved in the drug stock. Visual pollution is over. Since the order in the injector section and the tablet medicine cabinet is maintained, redials and arrangements have been fixed. Travel to and from the warehouse to buy serum was blocked. With the kanban application, a withdrawal system was created in pharmaceuticals and first in, first out. Employee satisfaction was ensured as employee talent was used.

Keywords: Waste, Lean management, 5 Reasons, Process analysis, 5S, Kanban, Andon

1. Introduction

The basis of lean management is based on the Toyota Production System, which Japanese engineers have developed to produce all production factors in the most flexible and efficient way with the least resources, in the shortest time and without errors and waste, in such a way as to respond to customer demand. In this system, the goal is to produce value and the customer determines the value. Value is what the customer wants to buy by giving money, and all activities other than value are wasteful. All employees and business processes strive to achieve excellence through Kaizen's value-oriented work. Perfection is like an endless journey. Because it is necessary to work from today to achieve tomorrow's expectations and wishes. Waits, inventories, unnecessary transactions, repeat transactions that do not produce value in this working system, mistakes and re-transactions to correct mistakes are a waste. In order not to waste, it is aimed to perform the correct operation the first time. It is ensured that value is revealed by destroying waste. Thus, while customer satisfaction increases, there are also gains for both the employee and the business at the same time (Womak and Jones, 2015)

Similarly, the lean management system focuses on eliminating eight wastes in processes, such as unnecessary human movement, overproduction, unnecessary material movement, error, waiting, excess inventory, excessive processing, and unused talent. The elimination of waste directly in your workflow to make savings of the business, employees with less fatigue while making it unnecessary to move at the same time to save time in achieving all the gains that befalls again expressed as a waste of brain power in the processes of continuous spontaneously creates a functioning system by requiring existing employees to run

Lean management practices production and delivery time reduction, cost reduction, decrease the amount of inventory, follow-up and control such as simplification of results (Cilhoroz and Arslan, 2018: 157) show the applicability and problems in health services financial hardship be great today. Although the techniques used in lean production are not designed for the health system, wastes are the main sources of problems in health systems as well. In a study conducted in America in 1999, it was reported that about 98,000 patients a year lose their lives due to medical errors made (Dickson et al., 2005). Only 19.2 percent to newspaper reports of medical practice in Turkey faulty reflected in indiscreet, %11.6% of the medical errors that are due to carelessness %49.4% stated that this had resulted in the death of (Ertem, Oksel, Akbiyik, 2009), considering that the maximum value of human life is a healthy, lean and malpractice in the health care system that exists today is known as the philosophy of the mistakes, the wrong applications that caused the loss to be prevented even hold all kinds of is it possible?

For the formation of a lean philosophy, it must first be recognized and known. For this reason, the general purpose of this study is to show the gains that can be achieved by eliminating waste with improvements to be made using lean tools with field workers in the health sector, which is a service sector of lean management and where there are problems. The main objective is to reduce the stock of medicines available in the intensive care unit in a private hospital and to improve the treatment unit. kaizen study was conducted using 5Neden, 5S, kanban, andon from lean tools to eliminate waste in the treatment process, which is one of the waste points detected by analyzing the process.

5 Cause Analysis (Root Cause Analysis)

5 Reasons is a simple technique used to determine the main cause of the problem. In this technique, the 'why' question is constantly asked until the main cause of the problem is determined. After an average

of five questions, the cause of the problem is found. It is a technique that is easy to use, does not require forms and tools, does not need extensive training, and is a technique that works in finding the main source of problems.

5S

The 5S method is a method to reduce waste in the work area through improved workspace arrangement, visual communication and general cleaning. The 5S application does not mean being clean and tidy, nor should it be confused with a one-time or annual “spring cleaning” application. Developed by Taiichi Ohno and improving processes, which is one of the main tools that are used for Japanese words 5S move away from the term, search, inventory (tail) from the type in the development of eliminating waste with the quality and functionality in all units is effective. 5S consists of Japanese words beginning with the letter S in the form of “Seiri, Seiton, Seiso, Seiketsu and Shitsuke” (Yılmazlar, 2015:91; Akgün, 2015:1).

Seiri/ Sort: Sorting, separation, sifting, or editing this word; the place of work or service around unused, outdated, or no longer used materials from the work area are identified and removal/removal refers to. Materials that are no longer used take up space and cause employees to walk more (Buesa, 2009: 324; Kahveci, 2017; Akgün, 2015: 5).

Seiton/ Straighten: 5S is not just an item throwing job. Even if it is beneficial to dispose of unnecessary equipment, the most constant method of waste removal is to organize the remaining materials and equipment as needed. At the sorting/editing stage, employees determine how often each material is used. The most frequently used materials should be stored in the place closest to the point of use. For example, since latex gloves used in hospitals are necessary for everyone, a large number of points of presence are created to reduce movement waste (keeping materials close).

When making arrangements, it is necessary not to fall into the mistake of using cabinets with lids. It allows materials to be placed untidily, since the cabinets will be closed. Opening closed drawers and searching for the tool leads to waste. Visually, the fact that the vehicles are visible but orderly will prevent muda.

Seiso/Delete-Cleaning: After eliminating unnecessary tools and organizing the materials left behind, 5S focuses on cleaning. Cleaning of both the equipment and the work area is started. To ensure that the working area and equipment are clean and free of dirt, dust and garbage. The cleaning should be adjusted in a balanced manner as standardized work.

Seiketsu/Standardization: It is the most visible stage of the 5S. After determining the most appropriate places for the materials needed, the materials are always standardized within the service or between the services in the defined places, benefiting the employees in many units. In a hospital, with the standardization of clinics, a nurse can find any materials needed when she goes to a clinic without attracting strangers. When they go to a different unit, it is a waste of time to get used to the layout of the place. It also allows easy arrangement of materials after use.

In a workplace, it is often noticed that a tool/material is missing, but only when it is urgently needed. When 5S and visual methods are used to mark standard places, it is noticeable the moment something is missing. Not only an empty place is visible, shadow lines are visible that are labeled with what

should be in that place. This allows problems to be solved more proactively (Buesa, 2009: 324; Kahveci, 2017; Graban, 2011: 151; Akgün, 2015)

Shitsuke/Discipline-Continuity: In order to prevent the 5S from becoming a one-time event, a plan is needed to maintain and always improve our workplace order. The discipline, which is the last step of the 5S program, covers the development of methods for all personnel to adopt 5S as a habit. Here the task falls on the managers.

Andon - Visual Communication

It is a visual management method that can also be considered as a standardized business format. The goal of visual management is to make waste, problems and abnormal conditions visible to employees and managers. The aim is to solve problems by revealing them, in contrast to the old approach that foresees making things look good by hiding problems (Graban, 2011:140). Andon line stop systems is a system used as a warning tool developed by Toyota again. It is a sound, colored or illuminated stimulus that informs the situation and gives news. The main goal of this system is to ensure that the problems occurring in the service continue quickly without causing loss (Yılmazlar, 2015: 108). Andon gets its name from the andon ropes that hang above the assembly line for any employee to pull when he sees a problem. Problems are solved at the source rather than allowing the products to pass through to be solved at the end of the line (Graban, 2011: 194; Bilginer, 2016).

For example, the fact that a patient with a monitor installed in intensive care gives audible and illuminated warnings when his pulse begins to fall below normal values can be considered a good example of andon in terms of attracting the attention of the nurse and the fact that the patient's vital values have changed. Or, an example of a patient who is going to undergo surgery is the surgical preparation of a yellow lamp lit at the door of the room; a blue lamp indicates the preparation of the nurse, a red lamp indicates that the preparation for anesthesia is complete, and a green lamp indicates that the patient is ready to send to the operating room.

Kanban

Kanban is a system that determines the amount of production in processes. In order to reach the zero-stock target, it is to attract the required materials at each stage of production as needed. It is a Japanese word that means “card” or “sign” and is the name given to the inventory control system used in the production of the towing type. The biggest benefit of kanban is that it reduces excess production or stockpiling. In this system, only the ordered product is intended to be produced / stored at the time it is ordered and, in the quantity, it is ordered. Kanban is a lean method based on standardized business, 5S and visual management concepts for material and inventory management. Kanban is often a physical signal, sometimes a paper card or a plastic box. It indicates that it is time to order, from whom and in what quantity to order; it can also be an electronic signal sent by a cabinet or computer system (Kanban, 2018; Graban, 2011:152; Womak ve Jones, 2015: 107). The creation of Kanban cards ensures the smooth and trouble-free operation of the system. The Kanban approach is sometimes only thought of as a system that focuses on low inventory levels in a wrong way, while the main objectives, needed materials at the right place in the right amount, at the right time and their employees by providing support and accounts to be maintained at a level of stock is the minimum necessary to ensure that the materials(Womak Jones, 2015: 99; Kanban, 2018).The Kanban system prevents excessive stock

accumulation in addition to reducing the probability of stock depletion (Grabau, 2011:157).

2. MATERIAL AND METHODS

In the study planned as a qualitative research, determinations were made by going to the research place and observing the processes personally. The researcher followed the processes at the workplace for about seven hours at least one day a week for three months. A methodology consisting of 10 steps, determined based on literature information, has been developed for the detection and elimination of waste using lean tools. These steps are;

- * Introduction of lean management in order to receive the support of senior management,
- * Introduction of lean management to hospital employees,
- * Determination of the work area,
- * Creation of the Lean team,
- * Providing trainings to the Lean team,
- * Making gemba- genchi gembutsu,
- * Follow-up of all processes,
- * Detection of Kaizen points,
- * Implementation with lean tools,
- Receiving the results of the application.

2.1. The universe of the research: In order for the hospital management to support the study, it is necessary to recognize lean management first. For this reason, an information meeting about lean was held first to the managers of the hospital where the application will be made, and then to the group where the other employees of the hospital were present. During these meetings, intensive care units were considered as a place where waste could be more. Intensive care units of hospitals constitute the universe of the research. In this context, the Adult Intensive Care Unit of the Hospital was selected as the place of application. The reason for choosing this hospital is that it is the closest and most appropriate unit (hospital) that the researcher has the opportunity to practice with a sample approach. The hospital has been completely willing to implement the application. The necessary permissions have been obtained.

The adult intensive care unit has one isolated room and a bed in it. The unit has six patient beds, except for an isolated bed. Intensive Care Units have a storage area, a dirty room and a slide washing room each. In the unit; there is a sink, lower cabinets, dressing trolley, emergency trolley, refrigerator for medicines, textile cabinet for textile materials, stationery cabinet for documents, treatment preparation cabinet containing medicines. There is also a dialysis machine, a blood gas measuring device.

2.2. Data Collection Tool: The purpose of the lean is to eliminate any activity that does not produce value and wastes resources, that is, waste. Muda may not be noticed at most times by hiding like a virus inside the treatment and care process processes in hospitals. For this reason, it is necessary to go to the site where the works are performed, to see and to detect the waste in the processes. In this study, Gemba (going to the place where the main work is done) and Genchi Gembutsu (Go – See: Observing the process and employees from all angles by going and seeing), which are also used in the lean methodology, and data were collected by tracking business processes.

After the application area was determined, the lean team was started to be formed in order to

implement lean studies. The Lean team was created by Decisively focusing on problem solving and interdisciplinary (Graban, 2011:274; Barnas and Adams, 2014:26). The team was composed of senior management representative, hospital care services manager, quality director, adult intensive care unit responsible nurse and nurses in the unit, auxiliary staff and researcher. On the researcher's side, genchi gembutsuni was performed by visiting the gembada at least once a week for 3 months,

3. FINDINGS

While Gemba was monitoring the work processes in the Intensive Care unit of genchi gembutsu (Go – See), it was found that falaca waste was made in the treatment processes. It has been determined that there is a lot of waste in patient treatment business processes such as excess inventory, expiration of the usage period for some drugs, too close to the usage periods of some drugs, the last drug entered is used first, time, repetition of movements and unnecessary material handling, and the following kaizen (improvement) study has been applied.

Name of the Kaizen Study: Reducing the Drug Stock and Improving the Treatment Unit

Lean Tools Used: 5 Reasons, process analysis, 5 S, Kanban, Andon

Data obtained during the process follow-up: During Genchi gembutsu, it was observed that the nurses looked at the dates of the drugs very carefully every time while performing treatment. When asked why they did this, they stated that “the date is past or there may be a drug close to expiration date”. Sometimes it was observed that nurses were looking for tablet-type drugs for a long time. It was found that they walked to the warehouse to buy serum and used larger injectors than necessary to administer small doses of drugs while performing treatment, or they struggled to find the appropriate injector, confused the injectors. Carefully examine the unit for treatment of medicines is too much of injectors 2%, 5%, 10% or even less is used, although 20% of the injectors genius resides, and nested and mixed Treatment Unit were found to be complex and a pile of many things. In the treatment unit, it was not observed that the medicine eyes were full to the brim and that the new drugs that came from the pharmacy stayed on top as the medicine request was made and the old ones could not be used because they were always at the bottom. The following findings have been reached with the investigations carried out.

Wasteful:

- Finding a drug that is past its date and is close to its expiration date – (Waste type error)
- There are a lot of medicines in the medicine compartments – excess stock,
- Creating image pollution,
- It's a waste of time to search for medicines – It's a waste of time and again to act,
- Do not trifle with the use of injector size,
- Excess supply of consumables - waste of materials,
- Lack of space in the warehouse and unit,
- The administration's statement that there is a lot of drug consumption in intensive care units.

Application: Due to the fact that the use of expired drugs carries a vital risk, the improvement study was first started from drugs. By gathering with the lean team, the problem of passing the medication cycle or being close to the expiration date was analyzed for 5 reasons, which is a lean tool, and the root cause of the problem was reached. The 5 Reason analysis applications are given below.

The problem: The expiration of the dates of the drugs

Why, the history of medicines is passing? Too much medicine is required from the pharmacy.

Why is too much medicine required from the pharmacy? The nurse in charge does not know how much to ask for the medicine.

Why doesn't the nurse in charge know how much to ask for the medicine? He doesn't know how much medication to use. He thinks the drugs will be needed at the vigil.

Why doesn't he know how much he needs to use it? There is no patient-based request and the cost is unknown.

Why doesn't the nurse in charge know about the consumption? A request is being made to fill out the Medicine Section.

The nurse in charge, who could not make accurate estimates about the amount of drug use in the unit with the analysis of 5 reasons, aimed to fill the drug sections by requesting medication with the concern that there would be no medication left on duty and that there would not be enough for the patients. Because each newly withdrawn drug is left on top, the last one comes out first, it has been determined that the last use period of the remaining drugs at the bottom is recent or expired drugs. For this reason, it was decided to track and record drug flows in order to melt the drug stacks in the treatment unit, to prevent the expiration of the period of use of drugs by the first entrant, to eliminate the confusion created by the drug stacks, and to determine how much drug use there is in the unit. It was thought that it would be appropriate for the responsible nurse to follow up the drug flows by filling out the work follow-ups and the drug request form in the unit and withdrawing the drugs from the pharmacy.

When the drug consumption in the unit was learned, it was decided to carry out andon, kanban and 5S studies to prevent the use of overdue drugs by extracting them, to ensure the early use of overdue drugs so that they are not wasted, to make the treatment unit more organized and spacious.

Andon Study: Andon is the use of stimulants such as color, sound, light to make waste, problems and abnormal conditions visible to employees and managers. Since the expiration date of the drugs in the treatment unit is close to the expiration date may create a risk, they should be used first. In order to prevent drug waste, as shown in Picture 2, a red label was attached to drugs close to expiration date. Those whose expiration date was very close were affixed with red stickers saying “miad is close”. Orange labels with the words “risky drug” were pasted on the front of the compartment where high-risk drugs are located and warnings were made to prevent the error from occurring. Priority was given to the use of red-label drugs before their time runs out.

Kanban Study: Kanban is a system that determines the amount of production in processes. It is to draw the material as required at each stage of production. Kanban is a system that prevents drug waste in clinics. In order to prevent drug waste, a one-month drug follow-up was performed by creating a form to determine which drug was used in the unit and how much. In order not to touch the trust stock due to the possibility of a crisis at any moment in the intensive care unit, drug withdrawal from the

pharmacy two days a week, that is, how much medicine will be in each withdrawal without changing the request, was calculated separately for each drug. For the most commonly used drugs (usually these are in the form of ampoules), small ziplock bags were provided. Jul. Labels were pasted on the bags with the names and quantities of the drugs to be placed in them. As shown in Picture 2, the medicine compartments were divided into two with brackets formed by cutting out cardboard boxes in the unit's warehouse. Enough medicine was placed in the front compartment to last until the first pull. In the back section behind the cardboard, the medicines waiting to be bagged were placed. It was ensured that the nurses primarily used the bagless medicines in the front, the bagged medicines when they were finished, and the bags remained empty in the compartment until the medicine request, so that they could be visible. Thus, when the nurse in charge asked for the day, it was ensured that she could safely take which medicine not by estimating how much to take, but by calculating.



Picture1: Mixed stacks of drugs



Picture 2: Labeled ready-to-take drugs

5 S Operation: Elimination of Confusion of the Treatment Unit

The medicine drawers in the intensive care treatment unit were filled to the brim with stacks of medicines. It was determined that some drugs were contained in each other and that the drug name labels on the compartments were torn or did not serve the purpose and the unit had a bad appearance. the injectors were in a mixed state. The serums were being brought from the Decoy warehouse. Because it was thought that there was no place for them in the treatment unit. In order to resolve this problem, it was decided to conduct a lean study with the 5S technique with the responsible nurse, auxiliary medical personnel and other volunteer employees in the unit, who are members of the lean team.

Seiri /Sorting: First of all, drugs that have expired were sorted out. By counting, which drug, how many types of drugs have expired, were recorded and delivered to the pharmacy. The excess drugs calculated according to the monthly drug flow monitoring were removed to the warehouse. The drugs that were mixed were placed in their own box.

Seiso/Delete-Cleaning: The labels on the medicine sections in the drawers have been renewed. Dirty areas have been cleaned up.

Seiton/Edit: For risky drugs and drugs whose expiration date is close, the andon study was performed and visualized with a label. The expiration date is close to that provided by the use of the drug before.

Taking the drugs from the most commonly used, drug sections were organized. As shown in Picture 4, the injectors were sorted according to their cc and cardboard brackets were placed between them so as not to Decouple. Thus, space saving was achieved by the process of arranging injectors. Serums were also placed in the empty drawer to prevent nurses from going to the storage room to buy serums.

Seiketsu/Standardization: After calculating the weekly use of medicines, a kanban study was conducted so that the stock of medicines would not form and could be completely withdrawn. As shown in Picture 2, the bags were taken and the drugs that could be used for four days were placed. The medicine eyes were cut in half with cardboard. The first open medicines to be used were placed on the front side, and the medicines with bags were placed on the back of the cardboard. The nurse will first use the open medicines in the front, and when the open medicines are finished, the medicines in the back will be kept on the back of the carton for the first medicine request day to fill the bag, which ends by pulling it forward. Thus, the withdrawal kanban, which is a four-day medication that is constantly changing and prevented from ending, was created. In addition, shading has been done to standardize the location of the materials above the treatment unit.

Shitsuke/Discipline-Continuity: They are the nurses in charge of the service who ensure all kinds of flow and order within the unit. Due to his participation in this study as a member of the Lean team, he was assigned as the person who will provide discipline. In order to protect the system, the unit officers followed the kanban during the morning checks. The nurse in charge asked him to take as much medicine as he needed to take by taking kanban bags before taking medicine from the pharmacy two days a week. By taking six-month data from the pharmacy, the numbers of drug withdrawals began to be tracked. Thus, the kamban created was later standardized in the drug request.

The same applications were made in the sections where there are tablets. In particular, it was found that even the existing medication could not be found from the mess in the cabinet where the tablets were located, and it was requested from different clinics, and it took time to organize the drugs distributed each time. Improvements have been made to these problems with the 5S.



Picture3: Mixed injectors



Picture 4: Decoupled injectors

Gains:

Pharmaceutical Stock:

* The possibility of malpractice has been eliminated because the drugs passing the prescription have

been extracted.

* As Andon, a red label was affixed to the upcoming medications. The use of these drugs was ensured as a priority.

* It was seen that there was a decrease between 20% and 85% in the pharmaceutical stock. Table 1

Treatment Unit:

* 50% space saving was achieved with the 5S application because the drug stock decreased.

* Image pollution has ended.

* With the 5S application, order was provided in the injector section and tablet cabinet.

* Repeat calls and arrangements have been fixed.

* Going to the warehouse to buy serum was prevented.

* A more organized workspace has been created

Table 1. The Amount of Some Drug Withdrawal from the Pharmacy

Drug Name	3 3 months before the study (number)	3 3 months after the study (number)	Recovery Rate (%)
ASIST	790	620	21,52
ULCURAN	300	90	70
AVIL	100	40	60
DEKORT	236	36	84,74

4. Results and Discussion

In this study, it is aimed to reduce the drug stock and improve the treatment unit. Among the lean tools, 5 Reasons, process analysis, 5 S, kanban, andon technique were used. In order to eliminate the stock surpluses detected during the gembas, how much and what kind of medication was used in the unit was calculated by following the created medication usage form for one month. In the meantime, the 5 Reason technique was used to find the root cause of the excess stock. It was concluded that the root cause of the problem is the lack of a system for drug withdrawal from the pharmacy. In order to eliminate the identified cause and prevent excessive drug withdrawal from the pharmacy, kanban application was performed and it was determined that savings between 20% and 85% were achieved Decisively with the data obtained from the pharmacy. The drugs that are close to the end of use have been made remarkable by sticking a red label on them and it has been ensured that they are used without expiring before their use period expires. The use of large injectors for small doses was also prevented by the 5S operation in the unit. By placing serum in the drawers gained in practice, the walking waste caused by going to the warehouse was prevented. Similar to the practice we have done, O'Neill and colleagues (2011) conducted a kaizen study at Flinders Medical Center (FMC), a 500-bed teaching hospital located in Adelaide, South Australia. In the study in question, all the work processes of nurses working in two clinics were followed and they found that the nurses lost the most time preparing medicines, going to the warehouse and transporting materials, and that there was an excess of stock, and this also made the working conditions of the environment difficult to waste. In their lean study, they stated that they achieved gains in their lean studies by using lean tools such as visual communication tools and 5S process improvement to eliminate waste. Theda Care Health System

(Wisconsin) CEO Jhon Touissa states that with the 5S application, the three and a half hours wasted by a nurse in her daily eight-hour shift is reduced to just one hour (Graban, 2011:142).

5. CONCLUSIONS

One of the methods that can be used to increase patient and employee satisfaction by providing high-quality, effective and efficient services by eliminating wastage in hospitals that offer very important and expensive processes such as health care is lean management. It is possible to achieve their goals by eliminating the eight wastes found in the processes in hospitals with lean tools. Health personnel should first see the eight wastes that cannot be noticed while performing their service presentations selflessly, and then remove these wastes from their processes. In this, it is possible for them to recognize lean management and philosophy first and then to think that they can apply it later. Lean transformation is not an event that can be achieved overnight. Lean management to apply the techniques fully, to adapt them to the system if necessary and to obtain the results it will take years to get it. Only one part of the organization in each transformation project it should be addressed. This is a difficult task, but the benefits it provides are incredible.

ACKNOWLEDGMENT

This study was produced from Nihal Aloğlu's doctoral dissertation entitled "Lean Management Practice in the Health Sector: An Example of an Intensive Care Unit".

REFERENCES

- Akgün, S. (2015). Sağlık hizmetlerinde yalın yönetim "5S" yaklaşımının uygulanması. *Sağlık Akademisyenleri Dergisi*, 2(1), 1-7 DOI: 10.5455/sad.20150201001.
- Barnas, K. and Adams, E. (2016). *Beyond Heroes. Sağlık Sektörü İçin Yalın Yönetim Sistemi*, (A. Soydan. Çev.). İstanbul: Optimist Yayınları No.427
- Bilginer, M. (2016). Kök Neden Analizi Nedir? (Root Cause Analysis) <https://industryolog.com/kok-neden-analizi-nedir-root-cause-analysis/>
- Buesa, R. J. (2009). Adapting Lean to Histology Laboratories. *Annals of Diagnostic Pathology*, 13(5), 322-333. DOI: 10.1016/j.anndiagpath.2009.06.005.
- Çilhoroz, Y., Arslan, İ. (2018). Yalın yönetim yaklaşımları ve sağlık hizmetlerinde uygulamaları. *Süleyman Demirel Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 3(32), 156-185.
- Dickson, E. W., Singh, S., Cheung, D.S., Wyatt, C.C. and Nugent, A.S. (2009). Application of Lean Manufacturing Techniques in the Emergency Department. *The Journal of Emergency Medicine*, 37(2), 177-182. DOI: 10.1016/j.jemermed.
- Ertem, G., Oksel, E. ve Akbıyık, A., (2009). Hatalı tıbbi uygulamalar (malpraktis) ile ilgili retrospektif bir inceleme. *Dirim Tıp Gazetesi*; 84 (1), 1-10. www.dirim.com.
- Grabana, M. (2011). *Yalın Hastane. Kalite, Hasta Güvenliği ve Çalışan Güvenliğini Arttırmak*, (P. Şengözer. Çev.). İstanbul: Optimist Yayınları. No.224162163
- Grabana, M. (2013). The term "lean production" is 25 years old – Some thoughts on the original John Krafcik Article. [https://www.leanblog.org/2013/09/the-term-lean-production-is-25-years-old-my-thoughts-on-the-original-article\(04.02.2018\)](https://www.leanblog.org/2013/09/the-term-lean-production-is-25-years-old-my-thoughts-on-the-original-article(04.02.2018))
- Kahveci, N. (2017). Yalın Araçlar ve Problem Çözme Yöntemleri. 5. Medicabil Bilimsel Etkinlikleri. Medicabil Yalın Hastane Kongresi.

Bursa.<http://www.yalin.medikabil.com/2017/yalinHastane2017.aspx>

Kanban, (2018). Lean Manufacturing. <http://www.sciencedirect.com/science/journals/kanban>.

Kaplan, G. and Patterson, S. (2008). Seeking perfection in health care. A case study in adopting Toyota Production System methods. *Healthcare executive*, 23(3), 16-21. PMID: 18666398.

O'Neill, S., Jones, T., Bennett, D., Lewis, M., (2011). Nursing Works. The Application of Lean Thinking to Nursing Processes. *JONA* Volume 41, Number 12. ss 546-552
DOI:10.1097/NNA.0b013e3182378d37.)

Womak, J.P. and Jones, D.T. (2015). *Yalın Düşünce*. (O. Yamak, Çev.) İstanbul: Optimist yayın. No.127172173

Yılmazlar, A. (2015). *Akredite, yalın, dijital anestezi*. İzmir: İntertıp yayın evi.

ENERGY PLANS TECHNIQUE FOR OROFACIAL PAIN MANAGEMENT

Maria da Luz Rosario de Sousa; Maria Lúcia Bressiani Gil

Faculdade de Odontologia de Piracicaba - Universidade Estadual de Campinas

ABSTRACT

The technique of planes comes from knowledge of Bioenergetics, disclosed by Prof Carlos Nogueira Perez, and it is the combination of 2 meridians of the same polarity, one that goes through the arm and the other that goes through the leg/foot. These meridians come together, forming 6 pairs that are called Energetic Planes, in a total of 6, being 3 Yang and 3 Yin. Thus, these Unitary Channels unite the High with the Low and are united respecting the energetic layers of the meridian system (energy levels) that are distributed from the most Yang to the most Yin, passing through the intermediate layers. The objective of the present work will be to describe 4 clinical cases of orofacial pain using different energy plans of Yang energy, for the management of orofacial pain. In Case 1, the YangMing Plan (LI5, S7 and S45 acupoints) was used and after 21 days the patient no longer had the signs and symptoms of facial paralysis. In Case 2, the patient with lateral TMD was used the Shao Yang plane (TE6 acupoints; G2 and G44) with pain reduction measured with VAS (Visual Analog Scale) from 10.0 to 0. In case 3, the patient presented pain (VAS=10) in the region of the mandibular 3rd Molar tooth after extraction, with a reduction to 0 after application of the Shao Yang plane technique. In Case 4, the patient had neck pain with reduced mouth opening, with pain VAS=10 and mouth opening of 28mm, after using the Tai Yang plane technique (acupoints SI5; B1; B67) the VAS reduced to 2.0 with mouth opening of 40mm. This technique of planes proves to be a good option for the management of orofacial pain as a first treatment and thus, by reducing the patient's immediate pain, it can provide comfort and that there are better conditions for the continuity of the treatment.

Keywords: Energy; Meridians; orofacial pain

THE INFLUENCE OF MATHEMATICAL REASONING ON PROBLEM SOLVING SKILLS AND COMPETENCE IN CRITICAL THINKING AMONG SECONDARY SCHOOL STUDENTS

Dr. Surajo Isa Gaya

Department of Computing and Mathematics Education.
Faculty of Science and Technology Education.
Kano University of Science and Technology, Wudil.

Tanimu Bala

Department of Computing and Mathematics Education.
Faculty of Science and Technology Education.
Kano University of Science and Technology, Wudil.

ABSTRACT

The Mathematical forms today has more and more new application for everyday life and rapid growth of desired application helps to develop more and more new fields of mathematics. Reasoning skills are recognized as the key abilities for human being to create, learn, and exploit knowledge. The purpose of this study was to find out the influence of mathematical reasoning on problem solving skills and competence in critical thinking among secondary school students in wudil local government area. The research examines the difference in mathematical ability as well as the difference in mathematical ability base on sex. The study had a sample of 100 senior secondary students (50 boys and 50 girls) out the 16552 Senior Secondary School Students in the zone. Mathematics achievement test was used to measure mathematical ability and reasoning ability of students respectively. The research instrument used was validated by a team of three (3) mathematics educators and an expert an English language. Using the Kuder-Richardson 21(KR-21) formula, a reliability coefficient of 0.83 was obtained. The data was analyzed using statistical package to determine the mean, standard deviation, t-test, and one way ANOVA and Pearson's coefficient of correlation of correlation. The finding of the study showed that was a significant relationship between mathematical ability and reasoning ability. This study also showed a difference in mathematical ability and reasoning based on their level of reasoning ability.

Keywords. Mathematical Reasoning, Problem Solving Skills, Gender Differences Competence Critical Thinking.

DIFFERENT TYPES OF ENERGY COMPANY'S ROLE IN GEORGIAN POWER ENGINEERING

Maka Jishkariani

Georgian Technical University, Georgia, ORCID: 0000-0002-0162-9180

Maya Pitskhelauri

Georgian Technical University, Georgia

ABSTRACT

Georgia's demand for electricity is covered by various types of power plants. In order to eliminate the shortage of basic power and to ensure the security of supply in the energy system, it is advisable to build and commission new power plants. The task of our research is to find such a range of generating capacities, during which the sum of these capacities and the amount of generated electricity will be maximal, taking into account certain restrictions. The following factors should be taken into account in the report regarding the operating hours of the power plant and the limitations of the planned investments. Given the presented objective function and constraints, pre-defined prerequisites are met. It is concluded that the construction of an air turbine thermal power plant is not advisable under the given capital costs and environmental constraints. The geographic location of Georgia and its energy system creates opportunities for trading electricity with and between neighboring energy systems, although their differences are a challenge, as all four neighboring energy systems have different energy markets, legislation, planning and operating standards and development visions.

Keywords: Energy Company, Power Engineering, Investment

1. Introduction

This The Ministry of Economy and Sustainable Development of Georgia approved and accepted the strategic document "2020-2030 Ten-year Plan for the Development of the Transmission Network of Georgia" developed by the operator of the transmission system. It can be seen from the document that as of 2021, the installed capacity of the energy system of Georgia is 4246 MW, of which:

- The capacity of hydroelectric power stations working on flow is 919 MW;
- The capacity of regulatory hydroelectric power stations is 2381 MW;
- The capacity of wind power plants is 21 MW;
- The capacity of solar power plants is 0 MW;
- The capacity of air turbine power stations is 110 MW;
- The capacity of combined and thermal power plants is 815 MW.

About 78% of the total installed capacity in Georgia comes from hydroelectric plants. The share of regulated hydro power plants is about 56% of the installed capacity of Georgia's electro system. Electricity production was amount to 12.6 billion kWh in 2021.

In order to eliminate the shortage of basic power and to ensure the security of supply in the energy system, it is advisable to build and commission new power plants.

According to the same strategy, the total capacity of Georgia will increase to 9740 MW by 2030, from which:

- 2438 MW capacity of hydroelectric power stations working on flow;
- 4097 MW will be the capacity of regulating hydro-electric plants with reservoirs;
- 1330 MW capacity of wind stations;
- 520 MW capacity of solar plants;
- 110 MW air turbine power stations;
- 1245 MW capacity of high-efficiency combined heat and power plants.

The share of HPPs in the total installed capacity will reach 67% by 2030. Of these, the share of regulating hydroelectric power plants will 42% of the country's total capacity, which will ensure the use of water accumulated during periods of water scarcity and reducing dependence on fuel imports for thermal power plants. It should be noted that the share of wind and solar power plants will be around 18% by 2030.

An independent international company has determined the necessary investments for the country's reliable and uninterrupted supply of electricity - a total of 8 billion US dollars in 2021-2030. It should be assumed that an additional 5494 MW of capacity and 15 billion kWh of electricity will be provided during the forecast period [1].

2. Materials and Methods

Georgia's electric load or demand for electricity is covered by different types of power plants. In general, the type of production can be an individual, when produced a unique, one type of product, serial, when produced several type of product and mass, when the same types of products are produced in large quantities. Energy enterprises are a mass type, where the same type of product is produced in large numbers in relatively long period of time. The characteristic features of the energy enterprise are: Because of electricity production and consumption coincide in time, electricity storage is impossible, so this leads to the necessity of the existence of a large number of primary and backup devices; The demand for electricity varies during year, month, week and day. Since the modes of operation of energy companies are subject to certain technical and economic requirements, and the change of demand causes a change of regimes, it is necessary operating and dispatch service existence in energy enterprises; There is needed for electricity and thermal energy to maintain within the prescribed standard (voltage, frequency, pressure, temperature); Energy utilities need a labor organization, supplying, selling organization and information services [2].

The main activity of energy companies are electricity and heat production, transmission and distribution. It is the main distinguishing feature from other industrial organizations where these functions performing various fields and organizations. Generally, the electricity produced in the: hydro power plants, thermal plants, nuclear power plants, geothermal and other power plants; Heat is produced in the boilers and thermal power plants; Dispatch, transmission and distribution of electricity takes place in companies, which have the appropriate voltage power transmission and distribution lines and substations.

Produced electricity or heat shall be consistent with the kind of voltage, capacity and frequency, which is appropriate and necessary for the user. The process of electricity generation and consumption continuity characterized by the following events: here, in this case it is impossible to reveal of products defect, repair or return back. Energy production is fully depend on the consumer demand before it

reaches its users and in accordance with the changes in customer requirements manufacturer's plans changed as well. In addition, the manufacturer must continuously improve supplied energy and must follow the parameters established by standards [3].

Although market-oriented industrial production research the customer's needs and based on marketing surveys and run the numbers of product, which is designed for potential buyers, but it also does not depend on desires and needs of any single user, which inevitably requires energy company.

Obviously, users need to be in compliance with the produced energy by the voltage and frequency (electrical energy), pressure and temperature (thermal energy) quality indicators. A slight decrease the quality of electricity causes quality deterioration of manufactured products of energy user. The result can be a loss and falling manufacturer's image, not to mention the reduction in profits.

Responsibility for the energy companies are very high not only for produced electricity, as well as consumers uninterrupted power supply and reliability. In this respect it is interesting companies that produce electricity, to work together in parallel, and therefore must possess a certain capacity for reserve. Energy activities, such as generation- transmission-distribution-consumption are performed fast, virtually simultaneously and continuously. Therefore, management of individual power plant is important, which conducts operation dispatch services [4].

2.1 Organizational Structure of Hydro Power Plant

The organizational structure of the enterprise is defined relationship between the department and the individual components. The smallest enterprise also has an organizational structure. As the sole proprietor hire another worker, has been creating the organizational structure. The employee have responsibilities, rights, takes place separation of the activities and the distribution of responsibilities. If one more employee will be hired, the structure will change, some of the workers duty can be reduced or shifted to another or new members will undertake new duties. Thus, optimal union all components is the organizational structure, where resources and people are allocated optimally, coordination is ensured [5].

All activities are led by the director of the organization, which is responsible for the overall performance of the enterprise. He acts on behalf of the company, signs agreements, issue orders and disposes the assets of the enterprise. Management Office basic services are: technical, economic, commercial, operational and enterprise services. Under the authority of the chief engineer are the departments, which are related to the maintenance of production equipment, under the deputy director in charge of the departments of economics, are activities: planning, organization of labour and wages, finances. Commercial or office supplies and selling department function is logistics, operational management is carried out by the Department of Production and dispatch, which leads senior manager and ensure operational planning, manufacturing process schedule, service and control. The company services ensure warehousing and transportation departments [6].

On the industrial structure affects such factors as: for power plants -quantity, type, capacity of the basic equipment, technological connection scheme, used fuel quality; For electricity transmission and distribution enterprises - network length, the transmitted energy options, repair and maintenance volume, the geographical relief and the road conditions. Based on industrial structure will be built organizational structure of management.

Hydropower stations besides to the basic services listed above are the three main manufacturing departments: The hydraulic department - which includes a water reservoir, waterfall construction

(Dum), power plant industrial buildings and roads; Turbine department – which includes turbines and its auxiliary equipment, water and sewer systems; Electric department -which generators and all kinds of electrical equipment, electrical laboratory.

2.2. Organizational Structure of Thermal Power Plant, Condensation Power Plant

Thermal PP management organizational structure can be: Divisional and Block type. Divisional type structure of energy production is divided into the following phases: The preparation and transportation of fuel; Fuel chemical energy conversion into thermal energy of steam; Steam thermal energy conversion into mechanical energy; Mechanical energy conversion into electricity. Each phase of energy production is performed by separate departments: Thermal Transport Department; Boiler; Turbine; Electro Technic Department.

In block type structure each phase performs in a complex modular structure of energy plant (a block). Organizational structure depends on two factors:

- Capacity of Thermal Power Plant. TPPs are divided into the following categories: I - over the top of 1200 MW; II - from 600 to 1200 MW; III - from 200 to 600; IV - from 100 to 200; V - from 25 to 100; VI - up to 25 MW. From the first to the sixth group to gradually decrease the number of personnel in the department's Office.
- Fuel type. Transition from solid to liquid fuels are excluded these departments, which are related to preparation and transportation of solid fuel.

The particular case is Cogeneration Power Plant, which produces both electrical and thermal energy. The total costs are divided into two parts, electrical and thermal energy, that is guarantee of the economy. The particular case is Capacitor Power Plant where works Capacitor turbine (steam turbine modification, where steam passes through the special capacitors) [7].

2.3. Nuclear Power Plant Organizational Structure

In the reactor of Nuclear PP is performed division of the atom of nuclear fuel (for example, Uranium), which is excreted large amounts of heat. In organizational structure there are not a boiler and fuel storage, but great attention is paid to the tomb, the burial of radioactive waste.

2.4. Organizational Structure of Distribution Company

If any person or entity has the right, can to distribute electricity in certain geographical or administrative area. This type of company owns: Distribution network in the frame of 0.4 - 6 - 10 kV; Air and cable transmission lines; Communication and remote control devices. The organizational structure of distribution Energy Company is characterized by departments and offices that are connected to account of consumed electricity (accounting inspector) [8].

3. Results and Discussion

The task of our research is to find such a range of generating capacities, during which the sum of these capacities and the amount of generated electricity will be maximal, taking into account certain restrictions. Indicators are expressed by the following symbols:

- P₁ - The total guaranteed capacity of hydro-electric power stations working on flow;
- P₂ - Hydro Power Plants with large regulating reservoir;
- P₃ - Wind power plant;

- P₄ - Solar power plant;
- P₅ - Air turbine thermal power plant;
- P₆ - Combined thermal power plant;
- P₀ - Guaranteed total maximum power;
- Θ₀ - Annual volume of electricity production;
- K₀ - Total amount of capital expenditure.

The following factors should be taken into account in the report regarding the operating hours of the power plant:

- (t₁) - The Run of River Hydroelectric Power Plant work for 3000 hours during the year;
- (t₂) - Regulating power plant work on average 4500 hours per year;
- (t₃) - Wind power plant operate 3000 hours per year;
- (t₄) - Solar power plant operate 3000 hours a year;
- (t₅) - The air turbine thermal power plant work for 4500-6500 hours under the conditions of unlimited supply of fuel, but the use of imported expensive fuel for more than 4500 hours is economically inadvisable;
- (t₆) - Combined heat and power plant operate 4500 hours a year.

The goal of the research is to maximize the following two images:

$$P_0 = P_1 + P_2 + P_3 + P_4 + P_5 + P_6 \rightarrow \max$$

$$\Theta_0 = (P_1 * t_1) + (P_2 * t_2) + (P_3 * t_3) + (P_4 * t_4) + (P_5 * t_5) + (P_6 * t_6) \rightarrow \max$$

Where

P_n - Power capacity of Power Plant (1.....n) kW; t_n - Operating hour of Power Plant during the year (1.....n) hours; Θ_n - Volume of electricity production (kWh).

Such a condition can be met by any configuration, but we must take into account the limitations regarding the planned investments. Estimated cost of planned power plants was carried out.

$$(P_1 * k_1) + (P_2 * k_2) + (P_3 * k_3) + (P_4 * k_4) + (P_5 * k_5) + (P_6 * k_6) \leq K.$$

Where

K₀ - Total amount of capital expenditure (USD \$); k_n - Estimated capital costs per kW (\$/kW), It depends on the type of power plant and on the complexity of the location:

- (k₁) - Estimated capital costs per kW of a The Run of River HPP is 1500\$/kW;
- (k₂) - Estimated capital costs per kW of a HPP with a large regulating reservoir is \$1000/kW;
- (k₃) - Estimated capital costs per kW of a wind farm is \$1600/kW;
- (k₄) - Estimated capital costs per kW of a solar electric power plant is \$1800/kW;
- (k₅) - Estimated capital costs per kW of an air turbine TPP is \$710/kW;
- (k₆) - Estimated capital costs per kW of a combined heat and electric power plant is \$1000/kW;

Estimated investments should not exceed the established limit:

$$[1500\$*P_1 + 1000\$*P_2 + 1600\$*P_3 + 1800\$*P_4 + 710\$*P_5 + 1000\$*P_6] \leq 8 \text{ billion } \$.$$

Finally, based on the objective function, when there are constraints, the following condition must be satisfied:

$$[3000(h)*P_1+4500(h)*P_2+3000(h)*P_3+3000(h)*P_4+4500(h)*P_5+4500(h)*P_6] \geq 15 \text{ billion kWh}$$

After solving the model, should be eliminated 110 MW Air turbine PP. Additional capacities during capital investments are equal to:

$$1519 \text{ MW} + 1716 \text{ MW} + 1309 \text{ MW} + 520 \text{ MW} + 0 + 430 \text{ MW} = 5494 \text{ MW}.$$

Given the presented objective function and limitations, the following conditions are met:

$$P_1 + P_2 + P_3 + P_4 + 0 + P_6 \geq 5000 \text{ MW}.$$

$$\$1500*P_1 + \$1000*P_2 + \$1600*P_3 + \$1800*P_4 + 0 + \$1000*P_6 \leq 8 \text{ billion \$}.$$

$$3000(h)*P_1+4500(h)*P_2+3000(h)*P_3+3000(h)*P_4+ 0 +4500(h)*P_6] \geq 15 \text{ billion kWh}.$$

If we check the restrictions on capital investments, when $K_0 \leq 8$ billion \$, we get:

$$1500*1519+1000*1716*1600*1309+1800*520+1000*430 \leq 8 \text{ billion}$$

\$.

This condition is fulfilled. During such capital investments, the energy obtained by additional capacities is equal to:

$$3000*1519+4500*1716+3000*1309+3000*520+4500*430] \geq 15 \text{ billion kWh}.$$

This means that building an air turbine thermal power plant (P_5) under the given capital cost and environmental constraints is not feasible.

4. Conclusions

The energy system of Georgia is bordered by energy systems operating in three different synchronous zones: The energy systems of Russia and Azerbaijan operate in the IPS/UPS synchronous zone, which includes the Baltic States, Ukraine, Georgia and The CIS countries; The Turkish power system operates in the ENTSO Central European Synchronous Zone, which is The Electrical Network of European Transmission System Operators; Armenia's power system operates in Iran's synchronous zone [9].

In addition, all four neighboring energy systems have different energy markets, legislation, planning and operating standards and development visions. The geographical location of Georgia and its energy system creates opportunities for trading electricity with and between neighboring energy systems, although their differences mentioned above are a challenge.

REFERENCES

- [1]. M. Jishkariani. Electricity Tariffs in Georgia. Warsaw, Poland: *World Science* 9(49), Vol.1. 2019. doi:10.31435/rsglobal_ws/30092019/6697.
- [2]. M. Jishkariani, N. Dvalishvili and L.Kurakhchishvili. *Evaluation of Calorific of Municipal Solid Waste (MSW)*. In: Ghosh S.(eds) *Sustainable Waste Management: Policies and Case Studies*. Springer, Singapore.2020. doi.org/10.1007/978-981-13-7071-7_23.

- [3]. M. Jishkariani and S. Tsotskhalashvili. Features of Electricity Pricing in Georgia. „Energy’’#4(96),part2.Pp.188-190.2020.Available:https://www.researchgate.net/publication/348975571_Featuresof_Electricity_Pricing_in_Georgia
- [4]. M. Jishkariani. Prerequisites for Hydro Power Plant Design. „Energy’’#2(98),part 1.2021. Pp.167-171. Available: https://www.researchgate.net/publication/352855182_Prerequisites_for_Hydro_Power_Plant_Design.
- [5]. M. Jishkariani. Criteria for Estimating Greenhouse Gas Emissions from Transport. *Georgian Technical University Proceedings* #3(521). Pp.59-68. 2021. <https://doi.org/10.36073/1512-0996-2021-3-59-68>.
- [6]. M. Jishkariani, S.K. Ghosh and K. Didbaridze. Energy and Economic Indicators Influencing Circular Economy in Georgia. In: Ghosh S.K., Ghosh S.K. (eds) *Circular Economy: Recent Trends in Global Perspective*. Springer, Singapore.2021. https://doi.org/10.1007/978-981-16-0913-8_11.
- [7]. M. Jishkariani M. Assessment of Global Warming Potential of Perspective HPPs in Georgia. *11th IconSWM-CE & IPLA GLOBAL FORUM*: 1-4 Dec. 2021. Jadavpur University, Kolkata, India. Available: https://www.researchgate.net/publication/357604620_Assessment_of_Global_Warming_Potential_of_Perspective_HPPs_in_Georgia.
- [8]. M. Pitskhelauri and M. Jishkariani. Preconditions for Implementing Energy Management Systems in Georgia. *11th IconSWM-CE & IPLA GLOBAL FORUM*: 1-4 Dec. 2021. Jadavpur University, Kolkata, India. Available: https://www.researchgate.net/publication/358226844_Preconditions_for_Implementing_Energy_Management_Systems_in_Georgia.
- [9]. M. Jishkariani and M. Pitskhelauri. Renewable Resources Role in the Transition to a Circular Economy Model. 10th International Scientific-Practical Conference „*Modern Directions of Scientific Research Development*’’ 23-25 March, 2022. Chicago, USA. ISBN 978-1-73981-126-6. Available: https://www.researchgate.net/publication/359496916_Renewable_Resources_Role_in_the_Transition_to_a_Circular_Economy_Model.

A STUDY ON THE INFLUENCE OF THE ROTATING PROPELLER ARRANGES ON THE WING OF AN AIRPLANE ON THE LIFT COEFFICIENT OF AN AIRPLANE MODEL USING SOLAR ENERGY

Pham Dinh Trung

Faculty of Information Technology, Yersin University, Dalat, Vietnam

Mai Duc Nghia

Faculty of Mechanical Engineering, Air Force Officer's College, Vietnam

ORCID ID: <https://orcid.org/0000-0001-6124-3231>

ABSTRACT

The development trend of the aviation industry has become an urgent problem, so research on the features of aircraft is increasingly interesting, especially airplanes using new energy, including solar power. For a solar-powered plane, the wing must have a great length because the solar panels had arranged over the entire surface of the wing. Therefore, it is necessary to install dynamic devices in the fuselage or on the wing to ensure the aerodynamic characteristics of the flight. In this paper, the influence of the rotating propeller arranges on the wing is studied on the aerodynamic characteristics of the aircraft model using solar energy by simulation method, using Ansys fluent software. The results show when arranging rotating propellers have different lengths at the wingtips, the lift coefficient is small.

Keywords: Airplane, propeller, the wing of an airplane, lift coefficient, solar energy.

1. Introduction

In recent years, the progress of science and technology, serving socio-economic development and people's life, has been combined with environmental protection and pollution reduction, especially the use of clean and renewable energy sources, such as wind power, solar energy, geothermal energy, hydro, and biomass (Figure. 1) [9].

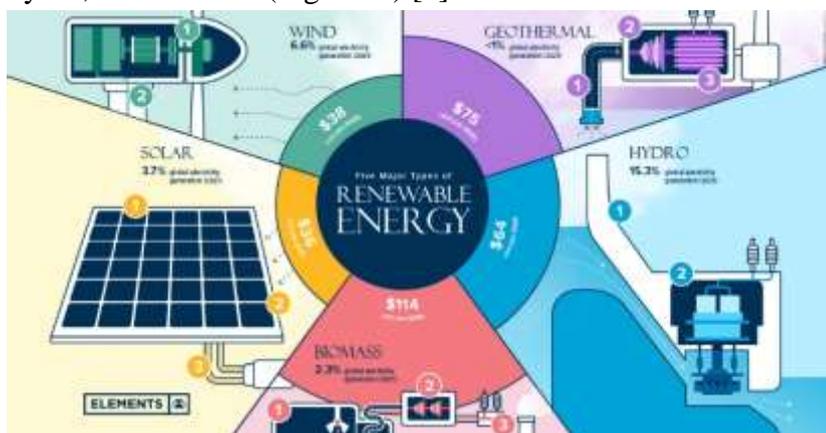


Fig.1. Five major types of renewable energy

Among them, solar energy is being studied, for the aviation industry, and the design and manufacture of aircraft using solar energy for terrain observation; meteorology; forest fire prevention,

and control is a new development problem [1, 3].

The main requirement of designing a solar-powered aircraft is to compute the maximum flight time. Therefore, it is necessary to install solar panels on the surface total of the wing. So the wings of an airplane must have large elongation.

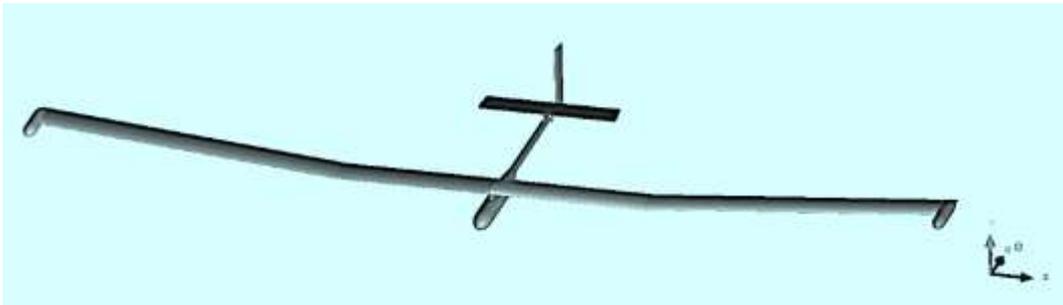
In this case, it is necessary to set the propulsion devices in the fuselage or on the wings to ensure aerodynamic characteristics in flight. So study on the impact of the airflow from the propeller to the wing of the plane needs to be determined. Thereby, there is a solution to arrange reasonable aircraft structure [2, 4].

2. RESEARCH OBJECT AND METHODS

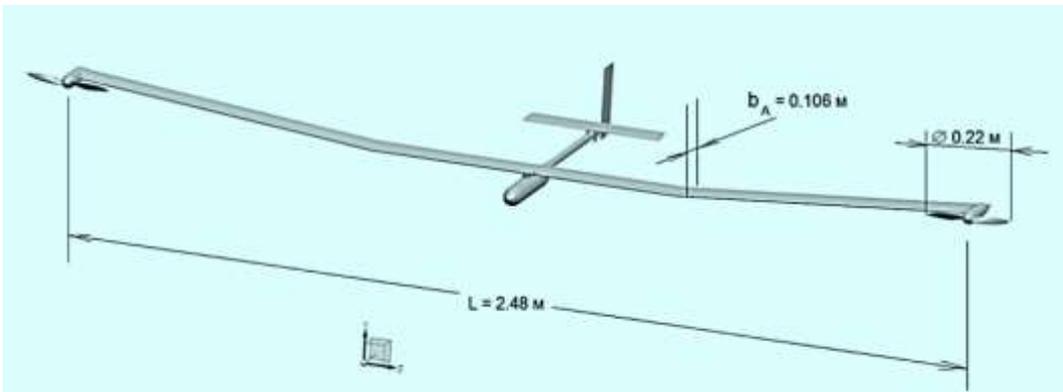
2.1. Research object

Airplane model using solar energy with aerodynamic layout options:

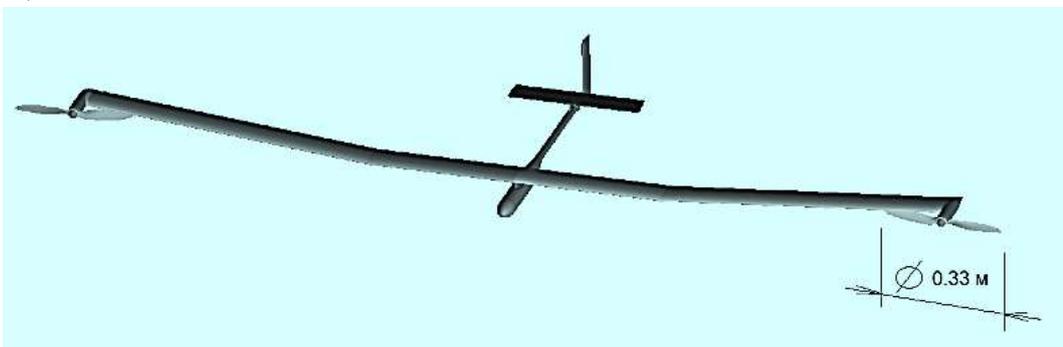
- No propeller
- A rotating propeller mounted at the wing tip with rotational speed: $n = 15.000$ rpm (Figure. 2).



a)



b)



c)

Fig.2. Research aircraft model

a) – Model without a propeller, b) – Model with a rotating propeller with a diameter of 0.22m,

c) – Model with a rotating propeller with a diameter of 0.33m

To evaluate the feasibility of manufacturing Unmanned aerial vehicles using solar energy, and to evaluate the applicability of modern technology to the development of aircraft models. The research determines the effect of the arrangement and size of the rotating propeller mounted on the wing tip of the lift coefficient.

2.2. The basis of the simulation

The study had conducted by simulation method on Ansys Fluent software, in which [7-8]:

- Continuity Equation:

$$\frac{\partial \rho}{\partial t} + \Delta \cdot (\rho \vec{V}) = 0 \quad (1)$$

- Equation of momentum:

$$\text{in the x-direction x: } \frac{\partial(\rho u)}{\partial t} + \Delta \cdot (\rho v \vec{V}) = -\frac{\partial \rho}{\partial x} + \rho f_x \quad (2)$$

$$\text{in the y-direction y: } \frac{\partial(\rho v)}{\partial t} + \Delta \cdot (\rho v \vec{V}) = -\frac{\partial \rho}{\partial y} + \rho f_y \quad (3)$$

$$\text{in the z-direction z: } \frac{\partial(\rho w)}{\partial t} + \Delta \cdot (\rho w \vec{V}) = -\frac{\partial \rho}{\partial z} + \rho f_z \quad (4)$$

- Energy equation:

$$\frac{\partial}{\partial t} [\rho(e + \frac{V^2}{2})] + \Delta [\rho(e + \frac{V^2}{2}) \vec{V}] = \rho \dot{q} - (\frac{\partial(\rho u p)}{\partial x} + \frac{\partial(\rho v p)}{\partial y} + \frac{\partial(\rho w p)}{\partial z}) + \rho \vec{f} \cdot \vec{V} \quad (5)$$

- Standard k-epsilon model:

$$\begin{cases} \frac{\partial}{\partial t} (\rho k) + \frac{\partial}{\partial x_i} (\rho k u_i) = \frac{\partial}{\partial x_j} [(\mu + \frac{\mu_t}{\sigma_k}) \frac{\partial k}{\partial x_j}] + p_k + p_b - \rho \epsilon - Y_m + S_k \\ \frac{\partial}{\partial t} (\rho \epsilon) + \frac{\partial}{\partial x_i} (\rho \epsilon u_i) = \frac{\partial}{\partial x_j} [(\mu + \frac{\mu_t}{\sigma_\epsilon}) \frac{\partial \epsilon}{\partial x_j}] + C_{1\epsilon} \frac{\epsilon}{k} (p_k + C_{3\epsilon} P_b) - C_{2\epsilon} \rho \frac{\epsilon^2}{k} + S_\epsilon \end{cases} \quad (6)$$

Where: $\mu_t = \rho C_\mu \frac{k^2}{\epsilon}$ is the modeled turbulent viscosity; $P_k = -\rho u_i u_j \frac{\partial u_j}{\partial x_i}$; $P_k = \mu_t S^2$, S is the modulus of the mean tensor stress ratio, $S = \sqrt{2S_{ij}S_{ij}}$; $P_b = \beta g_i \frac{\mu_t}{Pr_t} \frac{\partial T}{\partial x_i}$ is the effect of thrust; $Pr_t = 0.85$ is the Prandtl number; $\beta = -\frac{1}{\rho} (\frac{\partial \rho}{\partial T})_p$ is the coefficient of thermal expansion; $C_{1\epsilon} = 1.44; C_{2\epsilon} = 1.92; C_\mu = 0.09; \sigma_k = 1.0; \sigma_\epsilon = 1.3$ are the constants of the turbulent model k – ϵ [5-6].

3. RESULTS AND DISCUSSION

Calculations of the dependence of lift coefficient (C_L) and pitching moment (C_m) on the angle of attack (α) are shown in Figure. 3 and Figure. 4. When installing a rotating propeller, it leads to a decrease in force lift in the case of an angle of attack between $1 \div 8^\circ$, then the pitching moment increases rapidly, and the impact of the airflow from the propeller changes the load distribution at the tip of the wing.

In Figure. 5, the propeller diameter is 0.22m reduces the lift coefficient on the wing, and the influence area is about 18% of the length of the wing. When increasing the propeller diameter to 0.33m, the lift coefficient on the wing is the more severe the decrease, the area of influence increases to about 36% of the length of the wing.

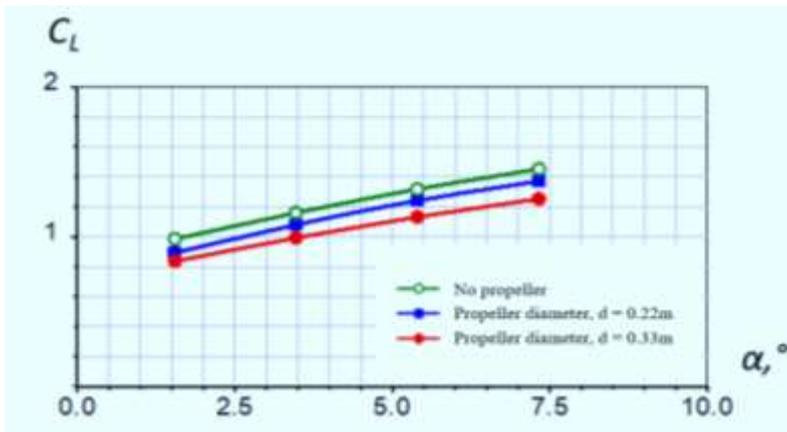


Fig. 3. The dependence of the lift coefficient on the angle of attack of the calculated model

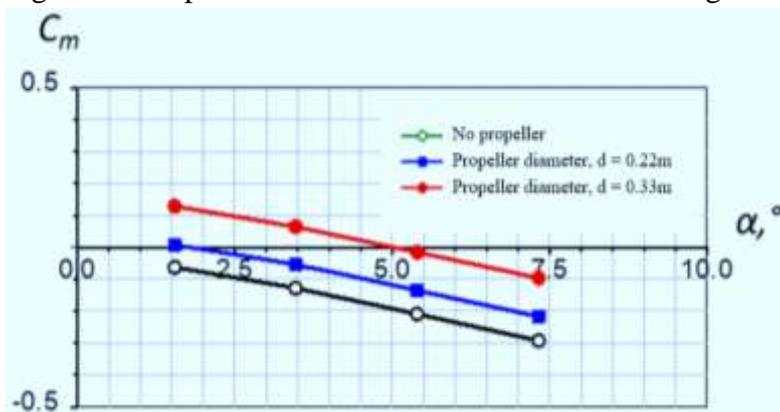


Fig. 4. The dependence of the pitching moment coefficient on the angle of attack of the calculated model

The above data shows that when the propeller arranges on the top of the wing, it creates turbulent flow, thereby causing the appearance of a non-uniform velocity field on the wing. In addition, the larger the propeller size, the greater the turbulence area on the upper and lower surfaces of the wing (Figure. 5, Figure. 6). Therefore, installing a rotating propeller with a diameter of 0.22m reduces the lift coefficient by about 10%. For the case of a rotating propeller with a diameter of 0.33m, the lift coefficient decreases by about 16%.

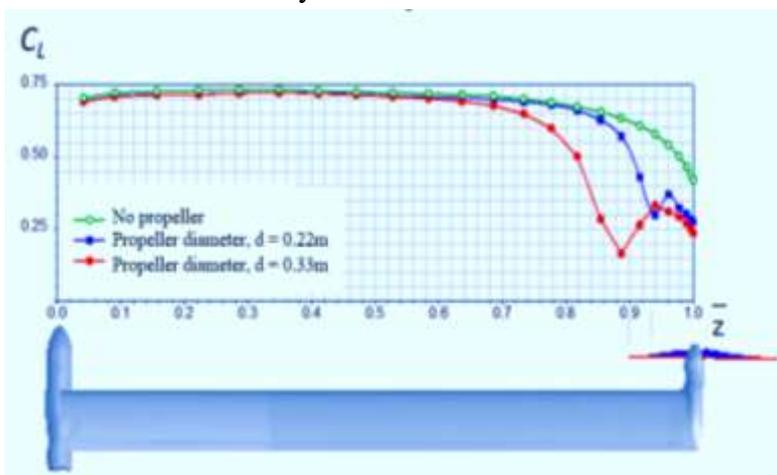


Fig. 5. Lift coefficient distribution according to the surface of the wing

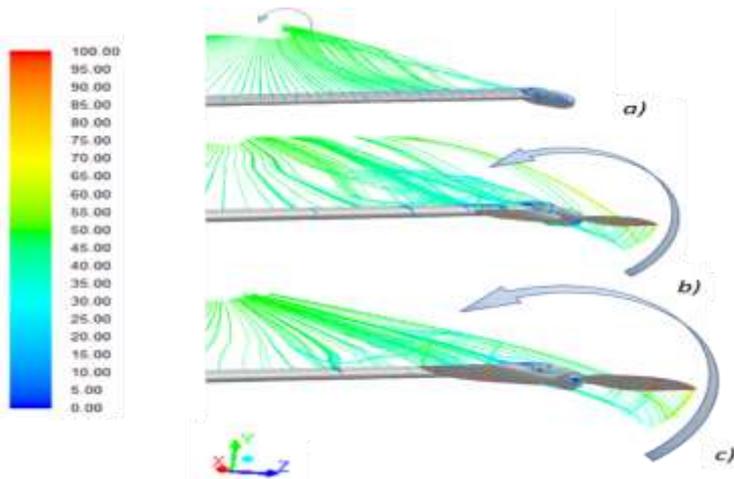


Fig. 6. Velocity Flow Field

- a) – Model without a propeller, b) – Model with a rotating propeller with a diameter of 0.22m,
 c) – Model with a rotating propeller with a diameter of 0.33m

4. CONCLUSION

The simulation results using Ansys fluent software show that the installation of rotating propellers with diameters of 0.22 m and 0.33 m on the large elongated wing of the research aircraft model has reduced the lift coefficient by about 10% and 16%, respectively, with the angle of attack varying from $1 \div 8^\circ$. It is the first basis to provide suitable solutions for designing Unmanned aerial vehicles using solar energy.

REFERENCES

1. Kudryavtsev O.V., Teperin L.L., Teperina L.N., Shustov A.V., Orfinejad F., Thein M. *Application of the principle of favorable interference to increase the aerodynamic performance of the propeller and wing configuration*. 2016. TsAGI Science Journal. 47 (8) 839-850.
2. Kornushenko A.V., Kudryavtsev O.V., Teperin L.L., Teperina L.N., Shustov A.V., Orfinejad F., Thein M. *The investigation of the preferable interference of a tractor and pusher propellers mounted on the wing tips*. 2017. TsAGI Science Journal. 48 (1) 1-9.
3. Liseitsev N. K., Samoilovskii A. A. *State-of-the-art, problems and development perspective of the aircraft, using solar energy to flight*. 2012. Trudy MAI. 55.
4. Osman Akgun¹, Ali Ihsan Golcuk¹, Dilek Funda Kurtulus, Ünver Kaynak, *Drag Analysis of a Supersonic Fighter Aircraft*, Ninth International Conference on Computational Fluid Dynamics (ICCFD9), Istanbul, Turkey, July 11-15, 2016.
5. Pátek Z, Cervenka J, Vrchota P, *Wind tunnel and CFD study of an airfoil with airbrake*, international congress of the aeronautical sciences, 2012.
6. Pavlenko O. V., Petrov A. V., Pigusov E. A. *Studies of flow-around of high-lift wing airfoil with combined energy system for the wing lifting force increasing*. 2020. Aerospace MAI Journal. 27 (4) 7-20. DOI: 10.34759/vst-2020-4-7-20.
7. Ramprasadh, *A CFD Study on Leading Edge Wing Surface Modification of a Low Aspect Ratio Flying Wing To Improve Lift Performance*, Volume 7. Number 3, International Journal of Micro Air Vehicles, 2015.

8. T Triantafyllou, T Nikolaidis, M Diakostefanis, P Pilidis, *Numerical Simulation of the Airflow Over a Military Aircraft with Active Intake*, Proceedings of the Institution of Mechanical Engineers, Part G. Journal of Aerospace Engineering, 2016, Vol 231, Issue 8, pp. 1369 - 1390. DOI: 10.1177/0954410016651294.
9. https://www.google.com/search?q=renewable+energy&sxsrf=ALiCzsYc4lEYBR5TEQ3vewFFi8O29UB3xw:1665052225091&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjdoqLzssv6AhUBsIYBHW3xC8AQ_AUoAXoECAIQAw&biw=853&bih=391&dpr=2.25#imgrc=IWe1aBjxS5nGZM.

USE OF ZR-PILLARED CLAYS FOR PHOSPHATE REMOVAL FROM WATER

Tanya Chauhan, Zoltán Németh

Faculty of Materials and Chemical Engineering, University of Miskolc, Miskolc 3515, Hungary

ABSTRACT

Aquatic ecosystems are very sensitive with respect to the concentration of phosphorus. Although it is an important element for the growth of phytoplankton, but it can be a nuisance if the concentration increases up to a certain limit. Nutrient enrichment by nitrogen and phosphorus in a water body can lead to an undesirable and unavoidable situation called eutrophication. In this study, Zr-pillared clays (Zr-PILCs) were synthesized by exchanging the cations present in the interlayer space of clay minerals with bulky polyhydroxy Zr cations. Upon further heat treatment, the polyhydroxy metal cations are converted into metal oxide pillars. These pillars provide stability and strength to the layered structure of montmorillonite. It also helps in enhancing the porosity and surface acidity of clays. Prepared materials were characterized by using different techniques such as X-ray diffraction (XRD), fourier transform infrared spectroscopy (FT-IR), zeta potential and CO₂ adsorption for the determination of specific surface area. Zr-PILCs were used for phosphates adsorption from water. The maximum phosphate adsorption capacity of Na-Zr-2.5 achieved was 29.7 mg P/g as compared to raw clay (2.1 mg P/g) at pH 4. Adsorption tests were performed in batch mode with an initial phosphorus concentration of 21.8 ± 0.18 mg/L and adsorbent loading of 1g/L at 30°C. The risk of zirconium leaching from the pillared clays during the adsorption is one of the important parameters in their practical applicability for water purification. The releasing behaviour of Zr⁺⁴ was examined by measuring the Zr⁺⁴ concentrations in the filtrate solutions obtained after phosphate adsorption experiments at different time intervals (30-240 minutes) with ICP.

Keywords: Pillared clays (PILCs), Montmorillonite, Phosphates, Adsorption

THE EFFECT OF SMART GRID APPLICATIONS ON SECURITY IN NATURAL GAS OPERATIONS

Hamza YETİK

Karabük University, Orcid: 0000-0002-2728-4248

Bahadır Furkan KINACI

Karabük University, Orcid: 0000-0001-6872-2630

İsa AVCI

Karabük University, Orcid: 0000-0001-7032-8018

Cevat ÖZARPA

Karabük University, Orcid: 0000-0002-1195-2344

Ahmet YETİK

Karabük University, Orcid: 0000-0002-7583-8874

ABSTRACT

With the developments in industry and technology, the need for energy has increased all over the world. This increase has brought energy transmission security to an important point due to natural events such as earthquakes and external effects such as sabotage in energy transmission lines. Natural gas, which is among the primary energy sources, can be transported in the form of liquefied gas (LNG), compressed gas (CNG) and pipelines. Pipes used in natural gas lines should allow the transmission and distribution of gas with safe transportation practices without being affected by its flammable, explosive and suffocating properties. Smart grid applications allow energy lines to be controlled and monitored from one or more centers. Thanks to instant data flow, relevant centers provide control and detect and analyze malfunction, sabotage, loss, and leakage situations. These instant monitoring processes bring different solutions to security needs and make control possible. The possibility of control in smart grids has an important place in solving emerging security problems. Secure energy networks are more operational and constitute systems with high reputation. In this study, the basic structure of smart grid applications will be examined, and the security effect and solution proposals in natural gas networks will be presented.

Keywords: Smart Grid, Security, Natural Gas

1. Introduction

Energy is an extremely important issue for humanity and energy is needed in all areas of life. The main energy sources are classified as oil, natural gas, coal, nuclear, hydro-electric and renewable. Energy is a mandatory factor of production in production and is one of the main indicators that reflect the economic and social development potential of a country. There is a linear relationship between energy consumption and social development, and it is seen that energy consumption increases with economic development and welfare increase (Koç & Şenel, 2013).

Natural gas, one of the primary energy sources, is a combustible gas mixture derived from fossil fuels. It is one of the most important energy sources used apart from crude oil and coal. As natural gas content; It contains 70-90% methane gas (CH₄). The rest contains ethane (C₂H₆), propane (C₃H₈), butane (C₄H₁₀) gases, and carbon dioxide (CO₂), nitrogen (N₂), helium (He) and hydrogen sulfide (H₂S) gases at low rates. Oxygen (O₂) is needed for the combustion of natural gas. 1 m³ of methane (CH₄) gas burns completely with approximately 9.5238 m³ of oxygen (O₂). Figure 1 shows the combustion reaction of methane gas.

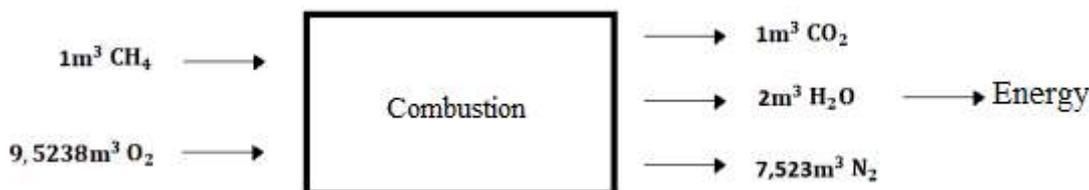


Figure 1. Input and Output Components of Methane Gas Combustion Reaction

It is predicted that natural gas will be an important energy source in the future. Its multi-faceted benefits include low greenhouse gas emissions and relatively low capital costs. As a result of these advantages, it strengthens the competitiveness of natural gas alternatives (Ríos-Mercado & Borraz-Sánchez, 2015).

The most commonly used method of transporting natural gas is pipeline transport. Except for pipeline transportation, it can be transported as liquefied gas (LNG) in pressurized tanks. However, this method makes it preferable to transport by pipeline due to the necessity of transporting at high pressure and low temperature. Pipeline transportation is used to transport products such as crude oil, natural gas and water.

Although the initial investment cost is high, it is a reliable and high carrying capacity transportation method. It has different parameters such as being fixed in the place where it is established, not being a flexible transportation method and needing international cooperation due to transit routes. The production and transportation of LNG, another transportation method, did not develop until the 1960s and has not yet reached the point where it is planned today. Thanks to new technologies, developments in natural gas liquefaction plants, regasification plants and special transport equipment increase LNG production. (Kımacı, 2019).

In today's world where technology is advancing rapidly, businesses should not be late to update in the face of innovation and changing conditions, and the business should keep up with these innovations. Otherwise, it is very difficult to survive in a competitive environment. Considering all these, businesses operating in the energy field should update their infrastructure. In today's world, where smart grids are becoming widespread, businesses that make their infrastructures smart can manage their capacities flexibly for increasing demands, increase their efficiency rates and reduce their losses in natural gas transfer. However, it is possible to host new energy sources and enable new players to join the energy market with bidirectional and flexible networks. In this study, the effect of smart grid systems on the security of natural gas companies will be examined.

2. Smart Grid and Natural Gas Operations

As a result of the developments in technology, smart grids have become important applications for natural gas companies. In this section, natural gas companies and smart grids will be discussed.

2.1. Natural Gas Operations

Natural gas distribution companies are businesses responsible for the delivery and sale of natural gas to consumers. These enterprises can be private or government-based. Natural gas, which is mainly used for heating and meeting various basic needs for households; For companies, on the other hand, it has the feature of an intermediate product that is necessary to realize their production. It is very important to know the efficiency of use so that the use of natural gas, which has such a low supply, can be rational. In addition to the use of households, it is a necessity for companies that use this product more intensively to be aware of this activity. Therefore, how this imported gas is distributed within the country is the point where its effectiveness starts in the primary sense. Stable gas supply and reduction of distribution interruptions play a crucial role in socioeconomic well-being and support sustainable development. (Basiri, Sobhani, & Sadjadi , 2020).

It is related to how efficiently and balancedly the various investments used or made by the companies that take the responsibility of distribution within the country are delivered to their final consumers, and how successfully these distribution companies transform their inputs into output (Hünerli & Aydın, 2019). Safe transportation of natural gas is an important issue as it is a flammable gas. These enterprises are responsible for ensuring the safe transportation of natural gas during the gas distribution phase. Otherwise, negative situations that may occur may have serious consequences. Therefore, natural gas distribution companies should monitor the natural gas flow with systems that provide efficient and simultaneous data.

2.2. Smart Grid

A smart grid is an automated digital integrated system that ensures distribution is secure, observable and easily controllable. From the perspective of the energy sector, the smart grid is an energy system that integrates the supply and consumption behaviors of all market participants connected to it. Economical with low losses and high availability an efficient, sustainable energy supply system targets (Dönmez, 2013). Smart grid communication is based on the IEC 61850 standard. The IEC 61850 protocol standard is the standard that allows protection, calculation, testing and monitoring to be combined into a single standard protocol (Özarpa, Avcı, Kınacı, Yetik, & Arapoğlu, 2021).

Smart grids accommodate both energy-producing and energy-consuming users in their system and provide data tracking. Compared to traditional grid systems, security in smart grids is much higher. Smart grids are also superior in terms of efficiency and economy. These systems can have traditional and renewable energy sources in the system at the same time. An overview of the smart grid is presented in Figure 2.

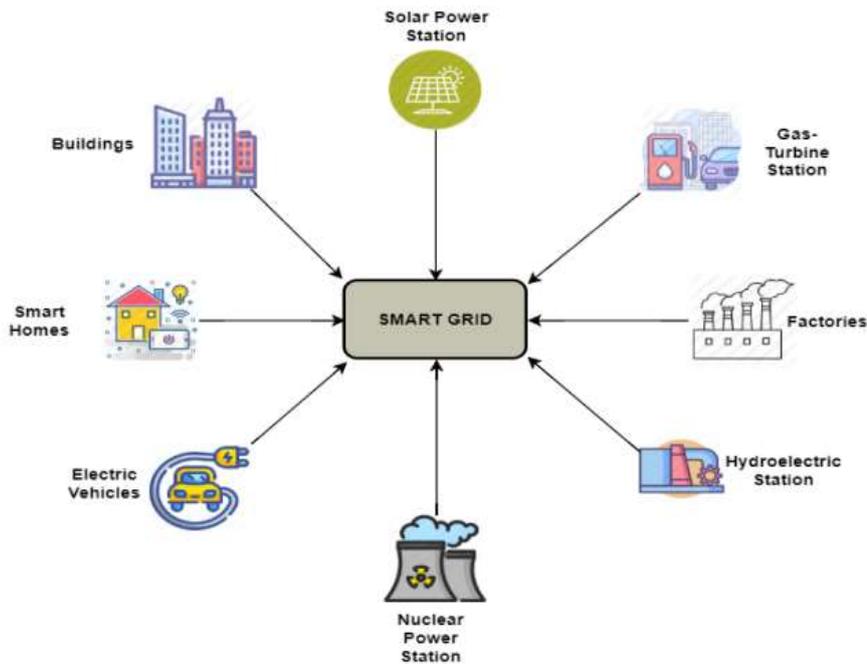


Figure 2. Overview of Smart Grids (Özarpa, Avcı, Kınacı, Yetik, & Arapoğlu, 2021)

The differences between traditional and smart grids cannot be reduced to a single point. There are huge differences between them in terms of functionality. Unlike traditional grids, smart grids incorporate the latest products and technologies. Smart grids have more advanced and complex architectures (Palensky & Kupzog, 2013).

3. Smart Grid and Security

Since the smart grid installation increases the traceability of the line, it makes it possible to perform security operations. By using two-way communication in smart grids, both service quality is increased and instant subscriber information is accessed (Bayındır & Demirtaş, 2014). Thanks to the instant data coming from the centers monitored by smart grids, fast information flow is provided and the situation can be followed. With the data obtained, security is at a much higher level compared to non-intelligent infrastructure systems. The traditional infrastructure system does not provide instant information, so interventions are made late in case of malfunction, sabotage, loss and leakage. In the light of all these factors, the risk is higher in traditional systems. One of the important advantages of data monitoring centers is the possibility of remote intervention in the network due to the system's smartness. This is one of the aspects that increase the security factor.

4. Conclusion

In the study, it has been understood that the issues of energy distribution and security in the world are of critical importance. With the development of smart systems, the concepts of smart city and smart grid have come to the fore and various models related to the subject have been put forward. However, the number of studies was low and it was concluded that it is important to conduct more studies on the subject. With the advantages provided by smart systems, information and interventions can be made quickly when negative issues such as malfunctions, sabotage, loss and leakage occur. With the instant tracking system it provides, the security level in natural gas lines will increase even more. In this study,

the advantages of smart systems in natural gas networks are mentioned and studies in the literature are examined.

References

- Animah, I., & Shafiee, M. (2020). Application of risk analysis in the liquefied natural gas (LNG) sector: An overview. *Journal of Loss Prevention in the Process Industries*, 63(103980).
- Basiri, S. K., Sobhani, F. M., & Sadjadi, S. S. (2020). Developing natural-gas-supply security to mitigate distribution disruptions: A case study of the National Iranian Gas Company. *Journal of Cleaner Production*, 254(120066), 1-12.
- Bayındır, R., & Demirtaş, K. (2014). Akıllı Şebekeler: Elektronik Sayaç Uygulamaları. *Journal of Polytechnic*, 17(2), 75-82.
- Dönmez, M. (2013). Akıllı Şebekeler ve Entegrasyon (Smart Grids and Integration). *Akıllı Şebekeler ve Türkiye Elektrik Şebekesinin Geleceği Sempozyumu*. Ankara: BTC Business Technology.
- Hünerli, Ö. C., & Aydın, Ü. (2019). Türkiye’de Faaliyet Gösteren Doğal Gaz Dağıtım Firmalarının Veri Zarflama Analizi Yöntemiyle Etkinliğinin Araştırılması. *Journal of Yaşar University*, 14, s. 133-146. doi:<https://doi.org/10.19168/jyasar.626587>
- Kınacı, B. F. (2019). *Endüstriyel Tesislerde Doğal Gaz Çelik Boru Kaynak Uygulamaları ve Kaynaklı Bağlantıların Mekanik Özelliklerinin İncelenmesi*. Sivas: Sivas Cumhuriyet Üniversitesi Fen Bilimleri Enstitüsü.
- Koç, E., & Şenel, M. C. (2013). Dünyada ve Türkiye’de Enerji Durumu-Genel Değerlendirme. *Mühendis ve Makina*, 54(639), 32-44.
- Özarpa, C., Avcı, İ., Kınacı, B. F., Yetik, H., & Arapoğlu, S. (2021). Impact of Covid-19 Pandemic on Smart Natural Gas Grids and Infrastructure Companies. *The Sixth International Conference on Smart City Applications SCA21* (s. 353-364). Safranbolu: Springer. doi:https://doi.org/10.1007/978-3-030-94191-8_28
- Palensky, P., & Kupzog, F. (2013). *Smart Grids*. Annual Reviews. doi:<https://doi.org/10.1146/annurev-environ-031312-102947>
- Ríos-Mercado, R., & Borraz-Sánchez, C. (2015). Optimization problems in natural gas transportation systems: A state-of-the-art review. *Applied Energy*(147), 536-555.

PREVENTIVE MAINTENANCE USING RECYCLED ASPHALT

Aishah H.O. Al Shehhi

Research Student, The British University in Dubai, United Arab Emirates

Gul Ahmed Jokhio

Associate Professor in Structural Engineering, The British University in Dubai, United Arab Emirates

Abid Abu-Tair

Professor in Structural Engineering, The British University in Dubai, United Arab Emirates

ABSTRACT

Roadways are one of the significant important elements in infrastructure because they are characterized simply as the point of interaction between societies and people. Any country in the world needs to create roadways so that citizens and visitors can travel easily and smoothly. Mainly roadways have been the main source by which whole economies and societies have emerged and developed over the years. They also made a positive contribution to the distribution of ideas, cultures, languages, discoveries, goods, and services of having better and safer roadways.

This study seeks to assess the application of recycled asphalt in roadways maintenance by comparing it to the current roadway maintenance procedures in terms of technical parameters in construction procedures, timelines ...etc. Furthermore, the environmental and economical requirements are highlighted and explored. This will enable the study to identify the possible benefits of using recycled asphalt pavement in roadway maintenance.

One of the benefits of using this construction material includes the economic benefits of saving on cost in material consumption, energy conservation in the processes, and environmental protection, which are imperative attributes in the development of sustainable human activities. However, other studies have indicated that asphalt has numerous disadvantages that should be considered before it can be fully adopted. Some of the challenges regard the technical aspects, mechanical considerations, and other quality concerns. . This implies that while recycled asphalt can be used as a sustainable material, there is a need to conduct an in-depth analysis to verify and quantify the effectiveness of the material, where the information is limited in the current literature. This study addresses the importance of using recycled asphalt with the integration of road maintenance procedures in the road network. This element is considered the main element of any national infrastructure development plan. The research aims to study and highlight the using recycled asphalt as a suggested sustainable method for road maintenance procedures. Therefore, the study elaborates on the historical use of recycled asphalt, its advantages, and disadvantages. Besides that, the maintenances process categories to ensure the suitable type that ensures the best quality of the network. Since roadway pavement assessment is based on quality as well as different characteristics parameters such as rutting, cracking, pavement quality Index, and roughness The realization of addressing the factors is an important matter to prevent any threats and challenges during the life cycle of the road network. This can be done by establishing a new implementing process such as using recycled asphalt in pavement rather than the traditional pavement. The new process may provide unique outcomes from environmental, social, and economic perspectives and dedicate policy and strategy to enhancing the quality of roadways.

In addition to other parameters. The selected case study for this research is the Dibba-Masafi E89 roadway in UAE where the research methodology is conducted by elaborating the current situation of the roadway performance and the conduct recycled asphalt as solution to ensure better performance.

Keywords: Recycled asphalt, Roadway maintenance, Pavement Parameter, Condition Index

ISSUES OF GEODYNAMICS OF THE EARTH'S CRUST STRUCTURE IN THE CONJUNCTION ZONE OF THE SOUTHERN SLOPE OF THE GREATER CAUCASUS WITH THE MIDDLE KURA DEPRESSION (THE REPUBLIC OF AZERBAIJAN)

Almaz Ismayilova Talat

Senior Researcher, Azerbaijan National Academy of Sciences

Republican Seismic Survey Center

ORCID ID 0000-0002-0290-4199

ABSTRACT

The article presents the results of a generalization of historical (retrospective) and modern studies on the geophysical model of the deep structure of the southern slope of the Greater Caucasus at its junction with the middle Kura depression.

The purpose of the research is to develop a geological and geophysical model, substantiate the subversion of the blocks of the Kura depression under the structures of the Greater Caucasus.

The thrust of the blocks of the Kura depression under the structure of the Greater Caucasus is accompanied in the upper part of the Earth's crust by the corresponding thrusting of the structure of the Greater Caucasus to the south along a series of general Caucasian thrusts, which increases the compression deformation and determines the seismicity of this region. The light right shear component observed in the source mechanisms for the Dashghil-Mudrese and Vandam thrusts can be explained by the somewhat higher activity of the West Caspian Fault. The light left-sided shear component along the Zanghi-Gozluchay thrust is due to the weakening of the influence of the West Caspian fault on the thrust zone, due to its probable attenuation to the north (to the north of the Zanghi-Gozluchay thrust, the zone of the West Caspian fault is not traced by geological and geophysical data).

Thus, the results of studies of the geodynamic regime in the Kura depression based on seismological, geodesic, and magnetic data testify in favor of the validity of the proposed model of the geodynamic regime of the Kura depression, the existence of a deep "detachment fault" in the Kura depression.

Keywords: Greater Caucasus, Kura depression, gravimetry, magnetometry, deep structures.

Introduction

The geodynamic processes taking place in this area are studied by modern geophysical instruments in parallel with seismological studies. As a result of inspection and analysis of factual materials collected by innovative methods, new features of the deep-tectonic structure are being studied.

Geological and geophysical characteristics of the study area. The geological structure in the junction zone of the southern slope of the Greater Caucasus with the Middle Kura depression includes structural elements of the central Tfan anticlinorium, the Zagatala-Kovdagh synclinorium, the Vandam anticlinorium, and the superimposed Alazan-Agrichay trough. The latter, within the zone under consideration, greatly expanding to the north, almost completely overlaps the Vandam anticlinorium [1].

The Tfan anticlinorium stretches in a narrow strip along the northern margin of the Zagatala zone. Within the zone, it is characterized by a significant complication of the structure of the southern flank

of the western extension of the Bazarduzu anticlinorium and the appearance of new uplifts of the lower horizons of the Aalenian, and in some cases, the Toarcian. Here, E.Sh.Shikhalibeyli (1956) singled out the independent Sarybash anticlinorium, in the cross section of which two large anticlines Attagay and Suvaghil are distinguished. Further to the west, they are replaced by the Kehnameydan and Karabchay uplifts, to the south, the third Gyumbulchay uplift appears, constituting a new rather extended single structural zone. In the section under consideration, the Tfan anticlinorium is complicated by the Major Caucasian fault-thrust, along which the northern highly elevated part of the flank is separated from its southern part, which differ significantly in the age of the deposits and the morphology of the folded structure [1,2].

To the south of the Tfansky anticlinorium is the Zagatala-Kovdagh synclinorium. This large subsidence zone stretches from the western border of Azerbaijan to the Absheron Peninsula, originating in the basin of the Belokanchay River in the form of a narrow trough filled with valangin, crumpled into small folds, the synclinorium gradually opens to the east, its section is replenished with younger Neocomian deposits. The northern boundary of the trough is fixed by a thrust between the Jurassic and Cretaceous, which causes intense crushing of the Neocomian into small folds and their overturning to the south [1, 2].

In the Zagatala zone, the trough is represented as a single rigid block, within which the Neocomian stratum experienced a general collapse in the process of subsidence, which was expressed in the formation of intensely compressed small isoclinal folds. The synclinal structure of the trough is clearly drawn with the appearance of Hauterivian and then Barremian deposits [1,2,3].

Materials and Methods

Based on a joint analysis of the main elements of seismogenic fault tectonics and the mechanisms of earthquake sources in recent years (Fig. 1), recorded on the territory of the Greater Caucasus and its southern and southeastern subsidence, and the fault-block structure, a geodynamic model of the studied region was compiled.

It seems that the modern features of geodynamics are determined by the combined action of reverse faults and faults of the general Caucasian trend and transverse strike-slip faults of the SW-NE trend, which became more active at the post-Alpine stage of tectogenesis. The result of the distribution of stress and the corresponding shifts along the system of the mentioned faults is the clockwise and counterclockwise rotation of individual blocks, as well as the horizontal movements of the blocks of the Kura depression to the north (underthrust) and blocks of the surfaces of the Greater Caucasus structure to the south (overthrust).

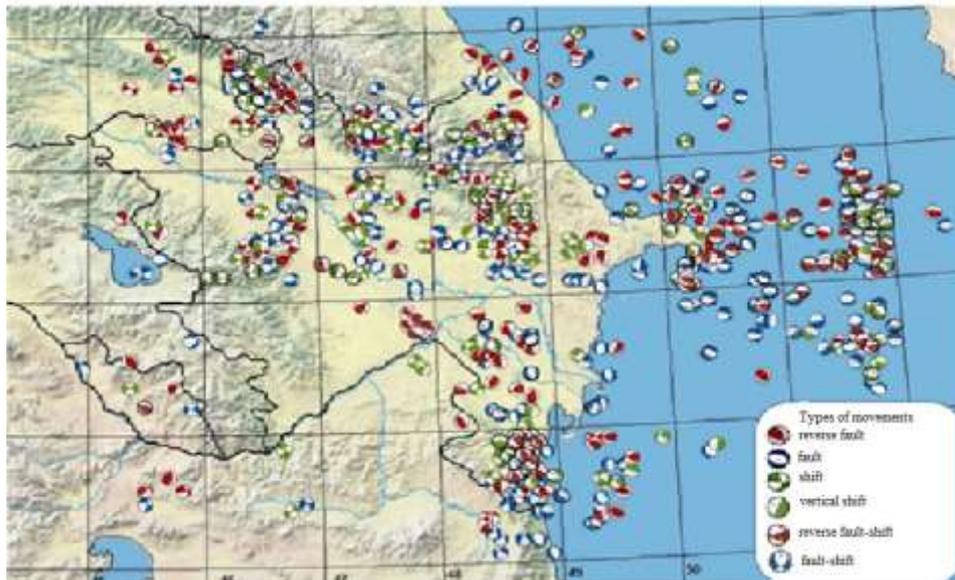


Figure 1. Distribution map of earthquake focal mechanisms in recent years

The described features of the geodynamic model of the region under study are reflected in the variations in the geomagnetic field strength. Characteristic precursor anomalies in magnetic field variations are identified, reflecting specific features of the geodynamic regime of the source area during the preparation and implementation of a strong earthquake with a specific source mechanism.

The analysis of areal magnetic observations made it possible, on the one hand, to identify long-term zones of the stress-strain state of the Earth's crust in the region, to give their geodynamic and geomagnetic characteristics, and also to trace the characteristic changes in the geomagnetic field strength over the area in these zones during the preparation and implementation of strong earthquakes. These results are in full agreement with the presented geodynamic model of the region.

The region of the meganticlinorium of the Greater Caucasus and its southern and southeastern subsidence is composed of Meso-Cenozoic rocks from the surface, represented by both sedimentary and volcanic-sedimentary rocks, characterized by low magnetization (up to 100×10^{-3} a/m). Volcanogenic and intrusive rocks of the Mesozoic age also take part in the structure of the region, breaking through the rocks of the pre-Alpine base in places. These magnetically active magmatic bodies disturbing a constant magnetic field are characterized by magnetization from 250×10^{-3} to 1400×10^{-3} a/m. Taking into account that magnetized bodies are large in size, as well as the fact that they retain magnetization to a considerable depth, where the Curie isothermal surface $\sim 5500\text{C}$ (22-32 km) occurs, one should expect a noticeable seismomagnetic effect during the preparation of earthquakes and seismotectonic movements in throughout the study area.

On the basis of the works [4,5], a diagram of the main elements of the discontinuous tectonics of the studied region was compiled (Fig. 2).

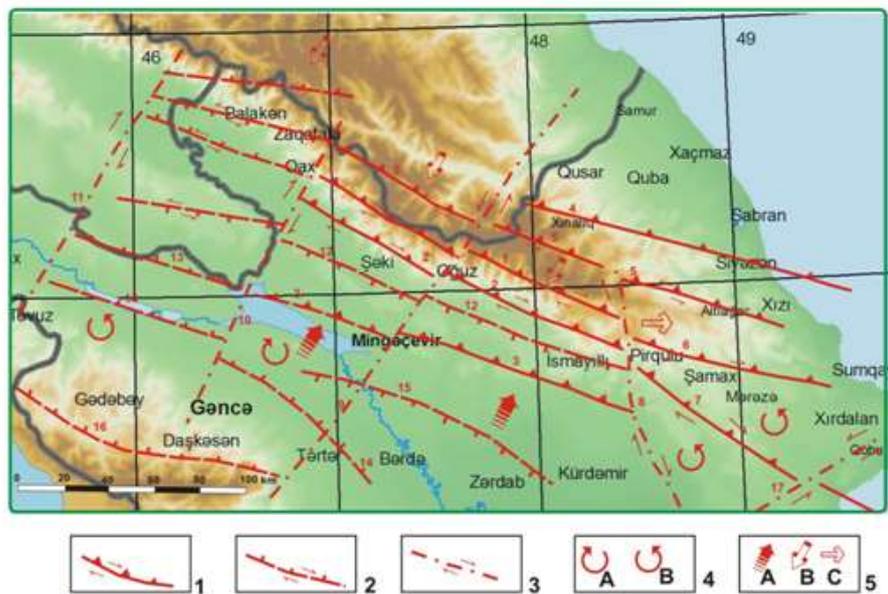


Figure 2. Scheme of the fault structure and features of the geodynamic regime of the southern slope and southeastern dipping of the Greater Caucasus.

The main seismogenic faults that determine the features of the geodynamic regime of the Earth's crust: 1 - reverse faults, 2 - faults, 3 - shifts (arrows indicate the direction of horizontal movements). Reverse faults: 1-Dashghil-Mudrese, 2-Vandam, 3-Goychay, 4-Siyazan, 5-Zanghi-Gozluchay, 6-Hermian, 7-Adzhichay-Alyat. Shifts: 8-West-Caspian, 9-Arpa-Samur, 10-Gandjachay-Alazan, 11-Gazakh-Signakh. Faults: 12-North-Adzhinour, 13-Iorsky, 14-Kura, 15-Mingachevir-Saatli, 16-Bashlybel, 17-Palmir-Absheron.

Elements of geodynamics: 4- Torsion of blocks: A-clockwise, B-counterclockwise.

Horizontal movements: A-advance, B-advance, C-retraction.

Features of the geodynamic regime of the Greater Caucasus and its southern and southeastern immersion are determined mainly by the distribution of stress deformation along the network of longitudinal (faults and overthrows) and transverse (slips) faults due to the corresponding movements along these faults of crustal blocks, with the main role here being played by transverse shears. - relics of the Hercynian structure, the movement along which resumed, in all likelihood, after the formation of the modern structure of the Greater Caucasus, starting from the end of the Late Miocene [6,7].

Results and discussion

The picture of the geodynamic regime of the region under study can be described as follows. The geodynamics of the western part of the region, the so-called Shamkir-Zagatala transverse anomalous zone with a high surface up to the Alpine base, is determined by the action of a pair of right-sided transverse strike-slip faults - Gazakh-Signakh and Gandjachay-Alazan with counterclockwise rotation of the corresponding block and is accompanied by the formation of left-handed strike-slip deformations along the faults of the common Caucasian prostrations. This position is consistent with the mechanisms

of earthquake source zones within this area, as well as with the geodynamics of a pair of right-sided strike-slip faults experimentally obtained and described by Harding and Reading [8,9]. Below is an experimental model of these authors, reflecting the geodynamic processes described above (Fig. 3).

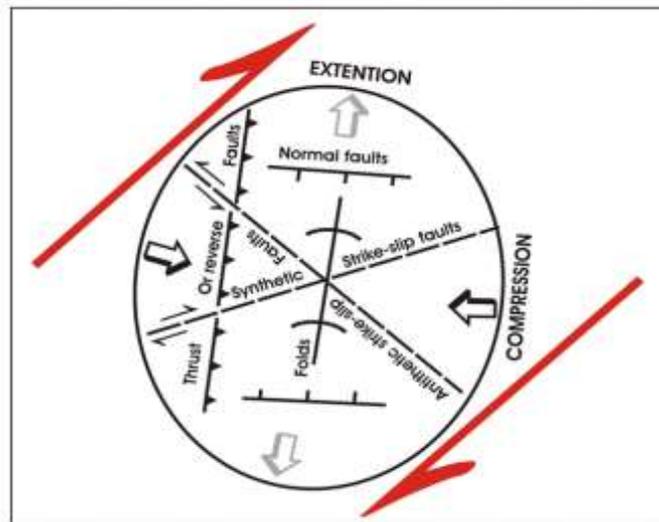


Figure 3. Structural characteristics of the Earth's crust as a result of shear deformation as a result of the action of a pair of right-sided shears.

Due to the formation and development in the Kura depression of a large crustal normal fault of the general Caucasian direction (separation and transfer fault), the structure of the Kura depression is subducted under the structure of the Greater Caucasus, which enhances the convergence (convergence) of the Lesser and Greater Caucasus.

Below is a schematic geodynamic model illustrating such a situation (Fig. 4).

The thrust of the blocks of the Kura depression under the structure of the Greater Caucasus is accompanied in the upper part of the Earth's crust by the corresponding thrusting of the structure of the Greater Caucasus to the south along a series of general Caucasian thrusts, which increases the compression deformation and determines the seismicity of this region. The light dextral strike-slip component observed in the focal mechanisms for the Dashghil-Mudrese and Vandam thrusts can be explained by the somewhat higher activity of the West Caspian Fault. The light left-sided shear component along the Zanghi-Gozluchay thrust is due to the weakening of the influence of the West Caspian fault on the thrust zone, due to its probable attenuation to the north (to the north of the Zanghi-Gozluchay thrust, the zone of the West Caspian fault is not traced by geological and geophysical data). The geodynamics of the Earth's crust blocks to the east is determined mainly by the zone of geodynamic influence of the West Caspian right-sided fault-slip. In this part of the studied region, counterclockwise torsion of blocks bounded from the north by the German and Adzhichay-Alyat thrusts is observed, as well as the block between the Zanghi-Gozluchay and German thrusts is pushed to the east, which apparently determines the features of the southeastern subsidence of the meganticlinorium. Greater Caucasus [10,11].

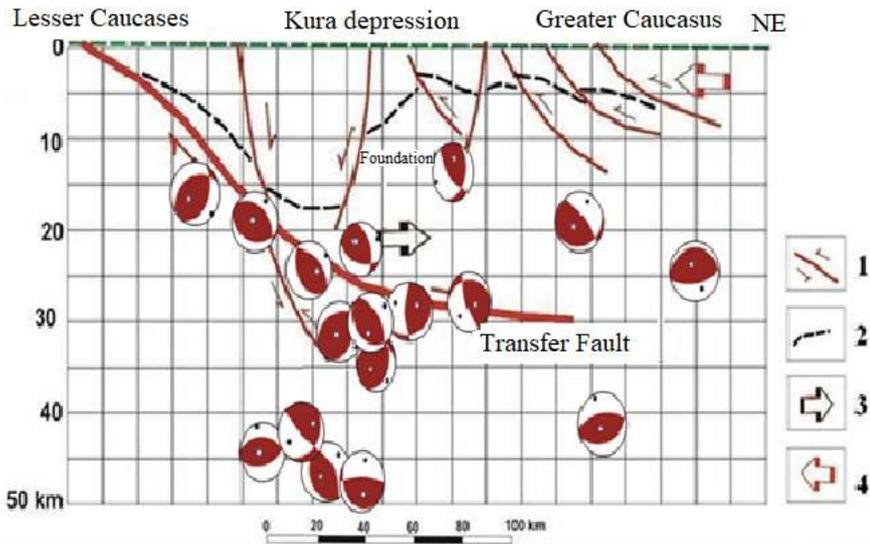


Figure 4. Schematic geodynamic model illustrating the situation of probable underthrusting of the blocks of the Kura depression under the structure of the Greater Caucasus along the plane of a gentle transport fault.

1 - Fault planes, arrows indicate the direction of movement, 2 - Surface to the Alpine base, 3 - Direction of thrust of the Kura depression under the Greater Caucasus, 4 - Direction of thrust of the structure

The above-described underthrusting of the blocks of the Kura depression under the structure of the Greater Caucasus can be interpreted as the imposition of the action of a large crustal fault - a fault in the NW-SE (common Caucasian) direction, flattening towards the lower part of the earth's crust and exfoliating this structure in the intensive stretching mode). The surface manifestation of this fault should be expected within the structure of the Lesser Caucasus, most likely in the zone of the Bashlybel fault.

The result of separation and movement to the north of large blocks in the lower part of the Earth's crust is the formation of reverse deformations along steeper dipping dislocations associated with the main fault, as well as in the upper part of the Earth's crust due to the reverse, to the south, movement of near-surface blocks along the main interface of the earth's crust - surfaces of the pre-Alpine base.

The presence of such a situation within the Kura depression is evidenced by reverse faulting deformations at great depths observed by focal mechanisms, which can be associated with reverse movement along old normal faults. The most characteristic of them is reverse fault deformation (probably along the plane of the Kura fault-normal, responsible for the formation of the Kura depression starting from the Mesozoic) at a depth of 39 km, which led to the Saatly earthquake of 2000 with $M_l=4.3$. Moreover, this situation is also supported by the presence of the Goychay overthrust here, as well as the high rates of horizontal movements in the Lesser Caucasus and the Kura depression and their significant decrease in the area of the southern slope of the Greater Caucasus [12,13].

The described features of the geodynamic model of the region under study are reflected in the variations in the geomagnetic field strength. Characteristic precursor anomalies in magnetic field variations are identified, reflecting specific features of the geodynamic regime of the source area during the preparation and implementation of a strong earthquake with a specific source mechanism. These results are in full agreement with the presented geodynamic model of the region.

Conclusion

Based on the analysis of earthquake source mechanisms, GPS observations and magnetometric data, the obtained new arguments show how the geodynamic situation in the middle and lower parts of the Kura depression is formed against the background of the development of a large crustal “detachment fault” of the general Caucasian direction, in As a result, the structures of the Kura depression under the structures of the Greater Caucasus take place in the NE direction.

The proposed model of the subduction of the blocks of the Kura basin under the structure of the Greater Caucasus should be taken as a schematic model, which, although it explains some elements of the structure and geodynamics of the region under study, however, requires significant refinement with the involvement of gravimagnetic data and a certain set of geological materials both for the Lesser and Greater Caucasus, and along the Kura depression.

References

- [1] Агамирзоев Р.А., Сейсмоструктура азербайджанской части Большого Кавказа, НАНА, Баку, «Эльм», 1987 г., с. 123.
- [2] Шихалибейли Э.Ш. Геологическое строение и развитие азербайджанской части южного склона Большого Кавказа. – Баку: АН Азерб.ССР, 1956. – 218 с.
- [3] Геология Азербайджана, Том IV Тектоника, ред. Хаин В.Е., Ализаде Ак.А. 2005. Баку, Из-во Nafta-Press, С. 214-234.
- [4] Рзаев А.Г., Етирмишли К.Дж, Казымова С.Э., Отражение геодинамического режима в вариациях напряженности геомагнитного поля (на примере южного склона Большого Кавказа) Известия, Науки о Земле. Баку 2013, № 4, с. 3-15
- [5] Кенгерли Т.Н., 2007 г. Особенности геолого-тектонического строения юго-восточного Кавказа и вопросы нефтегазоносности, *Elmi əsərlər*, №9, Гос. Нефт. Компания Респ. Азербайджан. с. 3-12.
- [6] Рзаев А.Г., Метаксас Х.П., Закавказские землетрясения 7 мая 2012 года: загадки геодинамического режима и сейсмомагнитный эффект, *Azərbaycan ərazisində seysmoproqnoz müşahidələrində kataloqu*, 2011, səh. 350-359.
- [7] Зоненшайн Л.П., Кузьмин М.И., Натанов Л.М., 1990. Тектоника литосферных плит территории СССР. Недра. Москва.Кн.1-328с. Кн.2-334с.
- [8] Harding, T.P. 1974. Petroleum traps associated with wrench faults. *Bull. Am. Ass. Petrol. Geol.*, 58, 1290-1304.
- [9] Reading, 1980. Characteristics and recognition of strike-slip fault systems *Spec. Publ. Int. Ass. Sediment.* 4, 7-26
- [10] Керимов, К.М., Шихалибейли, Э.Ш., 1992. Карта глубинного строения Черноморско-Южно-Каспийской области регионального прогиба М 1:1000000 Баку.
- [11] Рзаев, Ф.Г., Мамедли, Т.Я. 2005. Геомагнитные предвестники землетрясений и их сейсмоструктурная обусловленность. *Bilgi.*, Техніка 1. Ваку.
- [12] Етирмишли Г.Д., Рзаев А.Г., Казымов И.Э., Казымова С.Э., Ибрагимова Л.А. Моделирование геодинамической ситуации Куринской впадины на основе новейших сейсмологических, геодезических и магнитометрических данных. Бюллетень Оренбургского научного центра Уро РАН. 2018.2.11с.

[13] Отчет о работе сейсмологического отделения РЦСС при НАНА в сейсмоактивных областях Азербайджана в 2017 г., РЦСС, Баку, с. 126.

References

- [1] Agamirzoev R.A., Sejsmotektonika azerbajdzhanskoj chasti Bol'shogo Kavkaza, NANA, Baku, «Jel'm», 1987 g., s. 123.
- [2] Shihalibejli Je.Sh. Geologicheskoe stroenie i razvitie azerbajdzhanskoj chasti juzhnogo sklona Bol'shogo Kavkaza. – Baku: AN Azerb.SSR, 1956. – 218 s.
- [3] Geologija Azerbajdzhana, Tom IV Tektonika, red. Hain V.E., Alizade Ak.A. 2005. Baku, Iz-vo Nafta-Press, S. 214-234.
- [4] Rzaev A.G., Etirmishli K.Dzh, Kazymova S.Je., Otrazhenie geodinamicheskogo rezhima v variacijah naprjazhennosti geomagnitnogo polja (na primere juzhnogo sklona Bol'shogo Kavkaza) Izvestija, Nauki o Zemle. Baku 2013, № 4, s. 3-15
- [5] Kengerli T.N., 2007 g. Osobennosti geologo-tektonicheskogo stroenija jugo-vostochnogo Kavkaza i voprosy neftegazonosnosti, Elmi əsərlər, №9, Gos. Neft. Kompanija Resp. Azerbajdzhan. s. 3-12.
- [6] Rzaev A.G., Metaksas H.P., Zakatal'skie zemletrjasenija 7 maja 2012 goda: zagadki geodinamicheskogo rezhima i sejsmomagnitnyj jeffekt, Azərbaycan ərazisində seysmoproqnoz müşahidələrinkataloqu, 2011, səh. 350-359.
- [7] Zonenshajr L.P., Kuz'min M.I., Natanov L.M., 1990. Tektonika litosfernyh plit territorii SSSR. Nedra. Moskva.Kn.1-328s. Kn.2-334s.
- [8] Harding, T.P. 1974. Petroleum traps associated with wrench faults. Bull. Am. Ass. Petrol. Geol., 58, 1290-1304.
- [9] Reading, 1980. Characteristics and recognition of strike-slip fault systems Spec. Publ. Int. Ass. Sediment. 4, 7-26
- [10] Kerimov, K.M., Shihalibejli, Je.Sh., 1992. Karta glubinnogo stroenija Chernomorsko-Juzhno-Kaspijskoj oblasti regional'nogo progiba M 1:1000000 Baku.
- [11] Rzaev, F.G., Mamedli, T.Ja. 2005. Geomagnitnye predvestniki zemletrjasenij i ih sejsmotektonicheskaja obuslovlennost'. Vilgi., Texnika 1. Baku.
- [12] Etirmishli G.D., Rzaev A.G., Kazymov I.Je., Kazymova S.Je., Ibragimova L.A. Modelirovanie geodinamicheskoy situacii Kurinskoj vpadiny na osnove novejshih sejsmologicheskix, geodezicheskix i magnitometriceskix dannyh. Bjulleten' Orenburgskogo nauchnogo centra Uro RAN. 2018.2.11s.
- [13] Otchet o rabote sejsmologicheskogo otdelenija RCSS pri NANA v sejsmoaktivnyh oblastjah Azerbajdzhana v 2017 g., RCSS, Baku, s. 126.

IMPROVING THE INSTALLATION OF HEAT TREATMENT OF SUCKER RODS

Elman A. Aliyev, Leyla Z. Vazirova

Azerbaijan State Oil and Industry University, Baku, Azerbaijan

Orchid: 0000-0002-3114-511X; Orchid :0000-0003-0008-8973

ABSTRACT

Sucker rods used in oilfield, deep well pumps work under the influence of forces under severe conditions, and are also subject to corrosion. As a result, the probability of rod breakage in wells increases. The failure of sucker rods in the well causes great problems and significantly reduces oil production.

Keywords: sucker rods, well, surface hardening, high frequency current, inductor.

1. INTRODUCTION

For many years, the problem of increasing the strength of sucker rods. used for oil production in deep wells was decided in a broad direction of the choice of new alloyed steel grades. However, searches in this direction could not give a significant effect due to the increased sensitivity of alloyed steels to surface damage caused by corrosion and other possible causes.

Sucker rods used in oil production work in difficult conditions, being simultaneously exposed to a corrosive environment and variable stresses. Breaks in sucker rods create significant problems and, as a result, lead to a decrease in oil production. Heat treatment of the rods allows to obtain a fine-grained structure uniform along the entire length of the rod and high properties. However, heat treatment (normalization, improvement, etc.) does not eliminate the breakage of sucker rods during operation.

The use of induction surface hardening of pump rods in production conditions is a complex technological task, since the pump rod with a length of 7.5; 8 and 9.14 m has a diameter of 16, 19 and 25 mm. At the same time, the hardness of a rod with a thickness of 2-3 mm is HRC 42...52, and the hardness of the base of the rod is HRC 25...30, so the effect of cyclic forces is significantly reduced.

3. MATERIALS AND METHODS

To solve this problem, a device is proposed that heats the rods with a high-frequency current. The heat treatment process is fully automated. The current source of high purity is modern transistorized controlled generators. The unloading process is also automated, as a result of which manual labor is reduced to a minimum.

Unlike previous devices, the ends of the screws of the prototype device are not machined in grooves, but are held by shanks in forged conical ends. The advantage of the proposed device is the autonomous operation of each headstock, which ensures the operation of the entire unit even if one or more headstocks fail.

4. RESULTS AND DISCUSSION

The rod hardening unit is designed for surface hardening of forgings of deep pump rods (5/8 HY, 3/4 HY, 7/8 HY) by order of Shan Dong Nine-Ring Petroleum Machinery Co. LTD (China), which is based on surface induction heating of rods with high-frequency currents, followed by water quenching.

The rod is subjected to HDTV hardening after the rod heads are stamped according to the drawing of rod forgings of standard sizes (5/8 NY, 3/4NY, 7/8 NY). The unit was designed and manufactured under a contract between Shan Dong Nine-Ring Petroleum Machinery Co. LTD” and “Institute of Engineering Technology” (Baku, Azerbaijan).

5. CONCLUSION

As a result of the introduction of surface hardening of the rods, it is possible to completely abandon alloyed steel of the 15Kh2NMF grade; 15X2GMF and 14X3GMYu. The use of surface-hardened rods will significantly reduce the weight of the columns by reducing the diameter of the pump rods by one or sometimes two steps. Such a reduction in the weight of the column favorably affects the durability of pumping units, significantly reduces the power consumption for their drive, and also allows you to save metal.

REFERENCES

- [1]. Э.А.Алиев, “История развития установок термической обработки насосных штанг” *Avadanlıqlar.Tehnologiyalar.Materiallar*" Elmi texniki jurnal. №3. 2020.
- [2].Э. А. Алиев, “Путь совершенствования установок для обработки насосных штанг” *Вестник машиностроения*. Г. Москва, 02 2021.
- C.Y. Wang, J. Shi, W.Q. Cao, H. Dong, Characterization of microstructure obtained by quenching and partitioning process in low alloy martensitic steel. *Mater. Sci. Eng.* 2010, A 527, p.3442–3449
- [3]. Ming-Qiang Zhao, Chao-Dong Tan, Fu-Qing Yang, Study of sucker rod centralizer optimized design research, 2012, Vol.11, p. 51-53
- [4]. Roselita Fragoudakisa, Stelios Karditsas, Georgios Savaidis, Nikolaos Michailidis. The Effect of Heat and Surface Treatment on the Fatigue Behaviour of 56SiCr7 Spring Steel. *Procedia Engineering* Vol. 74 (2014), p.309 –312
- D.A. Porter, K.E. Easterling, *Phase Transformations in Metals and Alloys (Revised Reprint) 3rd Edition*, CRC Press, 2009. p.520
- [5].Y. Takahama, M.J. Santofimia, M.G. Mecozzi, L. Zhao, J. Sietsma, Phase field simulation of the carbon redistribution during the quenching and partitioning process in a low-carbon steel. *Acta Mater.* 2012, Vol. 60, p.2916–2926
- [6]. Семенов В.В. Работоспособность штанг насосных во взаимосвязи со структурой материала длинномерного изделия/ В.В. Семенов, В.В. Пепеляев //Нефтепромысловое:дело:НТЖ/ВНОШОЭНГ –2008. No12. –37–45p.
- [7]. J.G. Speer, D.V. Edmonds, F.C. Rizzo, D.K. Matlock, Partitioning of carbon from supersaturated plates of ferrite, with application to steel processing and fundamentals of the bainite transformation. *Curr. Opin. Solid State Mater. Sci.* 2004. vol. 8, p.219–237
- [8].Семенов В.В. Установление механических характеристик насосных штанг, их сортировка по классам прочности в процессе восстановления пространственной геометрии тела штанги. *Новые материалы и технологии в машиностроении* –Междун. науч.-технТюмГНУ: Тюмень, 2000.–124–125с
- [9]. Kang J-H, Hosseinkhani B, Williams CA, Moody MP. *Solute redistribution in the nanocrystalline structure formed in bearing steels. Scripta Mater*, 2013;Vol.69 p.630–633.

- [10].J.G. Speer, F.C. Rizzo Assunção, D.K. Matlock, D.V. Edmonds, *The quenching and partitioning process: background and recent progress*. Mater. Res. 2005. Vol. 8, p. 417–423
- [11]. Rui-Xia Zhang, Zeng-Liang Li, Dong Jiang, *Study of Sucker Rod Centralizer Disposition of Reciprocal Sucker Rod Pump*, *Oil Field Equipment*, 2008. Vol.37(12), p.28-35

SHUNT ACTIVE POWER FILTER BASED ADALINE NEURAL NETWORK FOR HARMONIC MITIGATION UNDER DISTURBED AND UNBALANCED SYSTEM

MEBAREK Abdesslam Ryad, RAHLI Chouaib, MERABET Leila, SAAD Salah, OUADA Mehdi
LSELM Research Laboratory, Department of Electromechanical Engineering, Badji Mokhtar - Annaba
University, Algeria

ABSTRACT

The use of non-linear power converters in industrial and domestic applications leads to disturbances and imbalances of the power source in the electrical system, which influences the performance of the distribution system in terms of instability, losses, harmonic generation, and voltage fluctuation. Improving power quality has become a major concern. Therefore, it is imperative to develop new technologies to meet the power quality challenges even under adverse conditions. As the dominant solution, the active shunt power filter (SAPF) is used for harmonic reduction, reactive power compensation, load balancing, and neutral current compensation. This study presents the Diphase current method based on an online ADALINE neural network, for real-time generation of the reference current feeding a shunt active power filter (SAPF) equipped with a Second-Order Generalized Integrator Phase Locked Loop (SOGI-PLL). This technique has the advantage of being flexible, robust, and adaptable to the dynamic variation of the system, it can be used in the alpha-beta or DQ frame of reference while the SOGI-PLL ensures the source balance. In order to verify the performance of the proposed control method, the studied system is subjected to disturbances caused by changes in the nonlinear load and then by changes in the source. The simulation results using MATLAB/Simulink tools show that the proposed harmonic extraction strategy provides a fast and accurate estimation of the fundamental component of the nonlinear load, reduces the reactive power, and provides a unity power factor compared to the conventional theory, with better dynamic performance tracking.

Keywords: Shunt active power filter, Diphase current method, ADALINE neural network, %THD, reactive power, Power Factory.

1. Introduction

The use of non-linear loads connected to the power system in industrial, commercial, and residential applications influences the performance of the distribution system in terms of instability, losses, harmonic generation, and voltage fluctuation and consequently contributes to the degradation of the power quality (PQ). These disturbances lead to serious consequences such as overheating of electrical equipment and conductors, subsequent degradation of electrical insulation, and malfunctioning of rotating machines, and transformers, which significantly reduces the life of the equipment. Passive power filters were among the first methods used for harmonic and reactive power compensation, however, their performance is limited due to their large size, and they can resonate with the supply impedance. To overcome these problems, shunt active power filters (ASPF) have been developed by several researchers and widely deployed in real-world cases. The basic operating principle of ASPFs is to inject into the electrical system a harmonic content equal to that caused by the non-linear load but in phase opposition (compensation current). Among other things, this capability allows it to compensate

for a wider range of current harmonics than the passive filter, compensate for reactive power and adjust the power factor to unity, and in some cases, it can balance the load by canceling the current in the neutral wire [1]. Figure 1 shows the power circuit of a SAPF operating on a three-phase system feeding a non-linear load, it includes a voltage source converter (VSI) based on an insulated gate bipolar transistor (IGBT), fed by a capacitor in the DC link that ensures a constant voltage, thanks to a proportional-integral (PI) controller that maintains it at the desired reference value. On the other hand, the switching times are decided by the control strategies, specifically, the controller consists of three main algorithms: the current harmonic detection method, the current control (switching) method, and the voltage control. The filtering quality of the SAPF depends on its efficiency in estimating and knowing in detail the harmonics of the nonlinear load, so that the control unit can quickly and accurately calculate the reference currents that will be supplied to the voltage source inverter (VSI) and thus inject the compensation currents into the point of common coupling (PCC) in order to reduce the harmonic distortion (%THD) according to IEEE 519-1992 [2, 3]. The synchronous reference frame (SRF) theory [4], also known as DQ theory, and the instantaneous active and reactive power theory (PQ theory) [5] are the most widely used methods in this field. These methods have proven their effectiveness through several studies and real-time applications. They use a low-pass filter (LPF) to extract the DC and harmonic components of the system current and power respectively, with advantages such as the fact that its computations are simple since only algebraic operations are required, it allows real-time control of the SAPF with a fast dynamic response, and under unbalanced sinusoidal source voltages, the computation of the compensation currents is very accurate. It is in this last point that the SRF method stands out, as it manages to maintain efficient operation and give accurate results even with disturbed and unbalanced source voltages, unlike the PQ method, thanks to a phase-locked loop (PLL or DQ-PLL) that allows the voltage phase shift angle to be controlled at all times, filtering out the distorted source voltage and thus generating orthogonal voltage components for each of the three phases. Despite this, the use of conventional equipment (LPF, and PLL) represents barriers and limitations to the proper functioning of these methods because they directly influence the performance of the strategy which becomes sensitive to certain disturbances in the electrical system such as load variations and also lead to inaccurate amplitude and phase delays. In this work, to overcome the inherent limitations of LPF and PLL, of DQ theory, we consider the use of the Diphase current method [6, 7] based on the artificial neural network more precisely the Adaline network for the compensation of harmonics using SOGI-PLL [8, 9] for extracting the fundamental component of voltages without DC shift or phase shift. Our proposal acts as a current controller for SAPF that is designed to achieve fast response with accurate results under unbalanced and distorted source and load conditions. Regarding the neural network to use, it is characterized by its ease of implementation, its robustness in the face of the dynamic variation of the system, and it allows a rapid, precise, and real-time estimation of the fundamental and harmonic components of the nonlinear load, [10, 11, 12]. On the other hand, the SOGI-PLL, in addition to having a simple structure, can accurately ensure phase locking even without ideal source voltage conditions, and with system variation, while eliminating the delay inherent in the Classic PLL.

The document is organized as follows: The following section presents the techniques for estimating the compensation signal based on the proposed theories, and section 3: describes the voltage control of the SOGI-PLL. The performance of the system is illustrated using computer programs on MATLAB-Simulink, and the results are discussed in Section 4. Finally, a brief conclusion is given in Section 5.

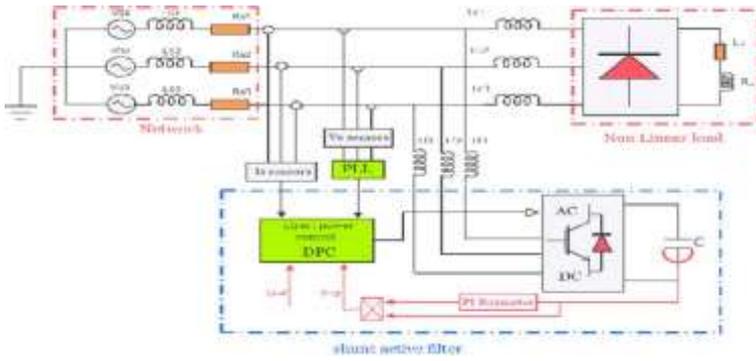


Figure 8. Shunt active power filter topologies

2. Harmonic current identification method

The Diphas currents neural method is a simple method with a linear approach based on the ADALINE neural network. This method works in the DQ -space and can be easily implemented.

2.1. ADALINE Neural Network Algorithm

The ADALINE neural network, is a linear combiner that uses the LMS algorithm for its operation. Figure 3 shows the structure of the ADALINE network where x is an input vector of dimension n and w is the weight vector. The output of the ADALINE can be computed for any input x_i as presented below :

$$y = \sum_{i=0}^n x(i)w(i) = x^T w \quad (13)$$

2.2. Learning Rules

Widrow proposed the LMS (least mean square) algorithm, which has been extensively applied in adaptive signal processing and adaptive control [23].

The μ LMS algorithm is structured as follows:

- (1) Initialise weights and learning rate μ .
- (2) Present new inputs and the desired output (y_d) of the neuron.
- (3) Calculate the output (y) according to Eq. (13)
- (4) Calculate the error : $e = y_d - y$ (14)
- (5) Update weights, at simple time k according to the equation below:

$$w(k + 1) = w(k) + \mu(y_d - y)x(k) \quad (15)$$

Where d , is the desired output, and u ($0 < \mu < 1$) is the learning rate.

The weights of the ADALINE (w_i) are enforced to converge to the values representing real harmonics content in a power distribution network.

2.3. Diphas Harmonics Currents Extraction

The Diphas Current Method works in the DQ space and provides excellent dynamic response for the online identification of fluctuating harmonics. If the system is unbalanced, the direct angle θ_d must be calculated. This can be achieved by the proposed SOGI-PLL which will be explained in more detail in the next section. According to the Fourier series, the three-phase load currents can be expressed as

$$\begin{bmatrix} i_{La} \\ i_{Lb} \\ i_{Lc} \end{bmatrix} = i_1 \begin{bmatrix} \cos(\omega t - \alpha_1) \\ \cos(\omega t - \alpha_1 - 2\pi/3) \\ \cos(\omega t - \alpha_1 + 2\pi/3) \end{bmatrix} + \sum_{n=2}^N i_n \begin{bmatrix} \cos(n\omega t - \alpha_n) \\ \cos(n\omega t - \alpha_n - 2\pi/3) \\ \cos(n\omega t - \alpha_n + 2\pi/3) \end{bmatrix} \quad (16)$$

This load current can be written in the DQ space with i_D and i_Q by applying respectively the Clarke transformation T_{32}^T and Park transformation with an angle of $(-\omega t)$:

$$\begin{bmatrix} i_D \\ i_Q \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} \cos(-\omega t) & -\sin(-\omega t) \\ \sin(-\omega t) & \cos(-\omega t) \end{bmatrix} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \begin{bmatrix} i_{La} \\ i_{Lb} \\ i_{Lc} \end{bmatrix} \quad (17)$$

Then, the Diphas currents can be expressed in the Fourier series as:

$$\begin{bmatrix} i_D \\ i_Q \end{bmatrix} = \sqrt{\frac{3}{2}} i_1 \begin{bmatrix} \cos(\alpha_1) \\ -\sin(\alpha_1) \end{bmatrix} + \sum_{n=2}^N \sqrt{\frac{3}{2}} i_n \begin{bmatrix} \cos(n-1)\omega t - \alpha_n \\ \sin(n-1)\omega t - \alpha_n \end{bmatrix} \quad (20)$$

These currents can be decomposed into two components :

- The continuous components

$$\begin{bmatrix} \bar{i}_D \\ \bar{i}_Q \end{bmatrix} = \sqrt{\frac{3}{2}} i_1 \begin{bmatrix} \cos(\alpha_1) \\ -\sin(\alpha_1) \end{bmatrix} \quad (21)$$

- The alternative components

$$\begin{bmatrix} \tilde{i}_D \\ \tilde{i}_Q \end{bmatrix} = \sum_{n=2}^N \sqrt{\frac{3}{2}} i_n \begin{bmatrix} \cos(n-1)\omega t - \alpha_n \\ \sin(n-1)\omega t - \alpha_n \end{bmatrix} \quad (22)$$

Two ADALINE are used to learn the two linear expressions shown in Eq. (20) and to estimate the DC components, \bar{i}_D , and \bar{i}_Q , of the instantaneous DQ currents.

The resulting Diphas harmonics currents are given by the following equation:

$$\begin{bmatrix} \tilde{i}_D \\ \tilde{i}_Q \end{bmatrix} = \begin{bmatrix} i_D \\ i_Q \end{bmatrix} - \begin{bmatrix} \bar{i}_D \\ \bar{i}_Q \end{bmatrix} \quad (23)$$

These currents are written in a three-phase system by applying successively transformation matrixes, $P(\omega t)$ and T_{32} . This enables computing reference currents to be injected into the power system.

$$\begin{bmatrix} i_{La} \\ i_{Lb} \\ i_{Lc} \end{bmatrix} = -T_{32}^T P(-\omega t) \begin{bmatrix} i_D \\ i_Q \end{bmatrix} \quad (24)$$

With space vector notation:

$$i_D(t) = W_D^T X_D(t) \quad (25)$$

$$i_Q(t) = W_Q^T X_Q(t) \quad (26)$$

And

$$W_D^T = \left[\sqrt{\frac{3}{2}} i_1 \cos(\alpha_1) \quad \sqrt{\frac{3}{2}} i_5 \cos(\alpha_5) \quad \dots \quad \sqrt{\frac{3}{2}} i_N \cos(\alpha_N) \right] \quad (27)$$

$$X_D^T = [1 \quad \cos(4\omega t) \quad \dots \quad \cos((N-1)\omega t)] \quad (28)$$

$$W_Q^T = \left[\sqrt{\frac{3}{2}} i_1 \sin(\alpha_1) \quad \sqrt{\frac{3}{2}} i_5 \sin(\alpha_5) \quad \dots \quad \sqrt{\frac{3}{2}} i_N \sin(\alpha_N) \right] \quad (29)$$

$$X_Q^T = [1 \quad \sin(4\omega t) \quad \dots \quad \sin((N-1)\omega t)] \quad (30)$$

The current decomposition and learning process are represented in Fig. 4. In our case, the neural network will only be applied to the i_D component, while the i_Q component will be sent as is, in order to be entirely compensated.

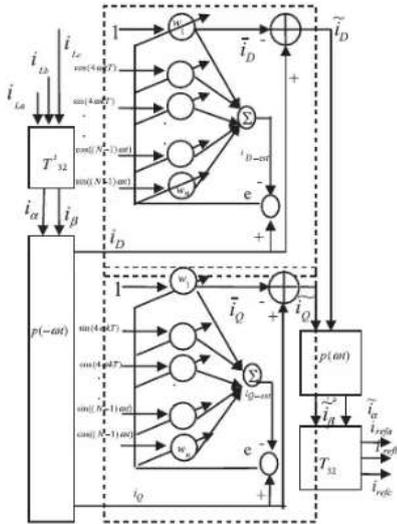


Figure 2. The harmonics identification proposed method

3. Second-Order Generalized Integrator Phase Locked Loop (SOGI-PLL)

Among the many network synchronization techniques, many rely on a phase detector that provides some immunity to voltage waveform distortions (harmonics and/or unbalances). This immunity, linked to the filtering techniques used, is often a difficult compromise with other expectations in terms of dynamic performance (phase and/or amplitude tracking).

3.1. Synchronous Reference Frame Phase-Locked Loop

The SRF-PLL is based on the dq0 frame, and it is illustrated in Figure 1. The principle of operation consists of orienting the voltage vector in the dq0 frame to be aligned with a reference phase of the three-phase voltage system. To achieve this, the quadrature component of the voltage in the dq0 frame is controlled to zero, typically through a proportional-integral (PI) controller. It is important to notice that in the synchronous frame (dq0 frame), all vectors rotating at synchronous speed are represented in a steady state by a constant, direct and quadrature component. The output of the PI is further integrated to obtain the phase angle that is used as feedback for the calculation of the dq0 transformation matrix. In the steady state, the PI output and the forward compensation represent the grid frequency ω' [1].

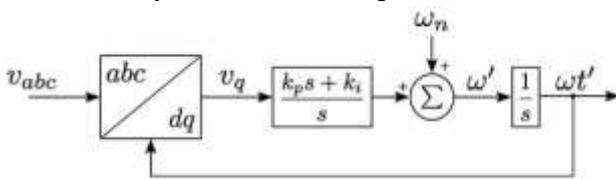


Figure 3. The conventional PLL topology

3.2. Second-Order Generalized Integrator-Quadrature Signal Generator

Second-order generalized integrators (SOGI) have been proposed to be used as phase detectors [2], in particular in the PLL structures of grid-connected inverters. They are essentially notch filters (band-pass) that can be easily tuned at a center to the grid frequency ω_0 and quality factor $k(=1/Q)$. In addition, they have the attractive advantage of providing simultaneous access to both the filtered output as well as a quadrature-shifted version of that same output (α and β axes). As such, they allow for an easy implementation that can be adapted to that of conventional DQ-based PLLs (using the Park

transform as the phase detector). There are two main particularities on this filter: one is that it presents at the center frequency two outputs with unitary gain (the input signal with 0° and with 90° phase delay); the second is that allows to adapt the center frequency. Hence, at the center frequency, the SOGI-QSG generates the direct and quadrature signals of the input filtered signal. Such behavior can be further understood by analyzing the filter block diagram in Figure 2, and the transfer functions (3) and (4). The general principle of the SOGI-based PLL is given below:

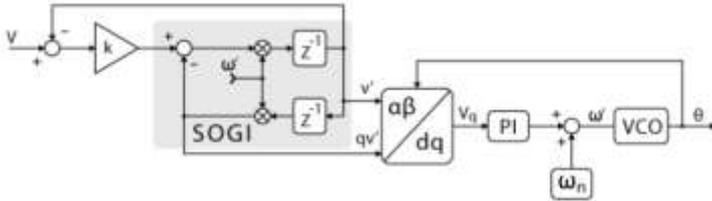


Figure 4. The SOGI-PLL topologie.

The presence of the resonance in the SOGI structure causes a continuous increase in the amplitude of the output signal. When the signal is processed by the SOGI in a digital system, there is a problem of the overflow of dedicated variables. To avoid this, the structure is closed by a feedback loop from the output signal $Y(s)$, as shown in Figure 4.

$$\frac{Y(s)}{U(s)} = \frac{k\omega_0 s}{s^2 + k\omega_0 s + \omega_0^2} \quad (3)$$

$$\frac{Y'(s)}{U(s)} = \frac{k\omega_0^2}{s^2 + k\omega_0 s + \omega_0^2} \quad (4)$$

Finally, the parameter k of amplification of the error signal $E(s)$ affects the bandwidth of the filter and the transient response. The choice of the parameter k requires a compromise between a good filtering of the signal and the dynamic response of the system.

4. Simulation and résultats

This section presents MATLAB-Simulink simulation results of the proposed methods, the system parameters are as follows: source voltage 230V, 50hz, with $R_s = 1m\Omega$ and $L_s = 1\mu H$, the load is a three-phase rectifier connected in series to a load $R = 12\Omega$ and $L = 20mH$, the compensation filter $R_f = 10m\Omega$ and $L_f = 3mH$, the value of the capacitor is 5,000 μF and the value of the reference voltage is 600V. The simulation time is $t = 0.5s$. The disturbance and the unbalance of the source will be introduced at $t = 0.2s$, the collection is done at $t = 0.3s$ with 5 samples. Imbalance is 0.8 pu applied to phase A, perturbation will be applied to phase A and B h5 of 0.05 pu.

The SAPF with the proposed identification methods namely the DQ method and the Diphas current method will be tested using SOGI-PLL, for the following cases: (1) Non-linear load, (2) Unbalanced source, (3) Non-linear source, (4) Non-linear and unbalanced source.

Cas 1 : Non-linear load												
	Before Compensation				After Compensation							
					Classic Method				Neural Method			
	%THD	%h3	%h5	%h7	%THD	%h3	%h5	%h7	%THD	%h3	%h5	%h7
Ph A	25.80	0	21.95	9.83	1.06	0	0.32	0.46	0.99	0	0.26	0.39
Ph B	25.80	0	21.95	9.83	1.06	0	0.32	0.46	0.99	0	0.26	0.39
Ph C	25.80	0	21.95	9.83	1.06	0	0.32	0.46	0.99	0	0.26	0.39
Cas 2 : Unbalanced source												
	Before Compensation				After Compensation							
					Classic Method				Neural Method			
	%THD	%h3	%h5	%h7	%THD	%h3	%h5	%h7	%THD	%h3	%h5	%h7
Ph A	29.61	5.71	25.98	5.98	1.41	0.95	0.12	0.41	1.08	0.27	0.07	0.37
Ph B	24.57	4.43	19.81	10.81	1.65	1.21	0.43	0.41	1.17	0.49	0.31	0.39
Ph C	23.73	4.71	18.50	11.07	1.67	1.25	0.35	0.39	1.17	0.44	0.34	0.31
Cas 3 : Non-linear source												
	Before Compensation				After Compensation							
					Classic Method				Neural Method			
	%THD	%h3	%h5	%h7	%THD	%h3	%h5	%h7	%THD	%h3	%h5	%h7
Ph A	19.46	3.54	11.97	11.15	1.26	0.53	0.27	0.41	1.07	0.31	0.19	0.31
Ph B	31.86	2.95	28.36	6.79	1.37	0.30	0.63	0.44	1.25	0.36	0.34	0.33
Ph C	28.74	2.35	25.05	9.19	1.40	0.33	0.41	0.46	1.23	0.09	0.27	0.30
Cas 4 : Non-linear and unbalanced source												
	Before Compensation				After Compensation							
					Classic Method				Neural Method			
	%THD	%h3	%h5	%h7	%THD	%h3	%h5	%h7	%THD	%h3	%h5	%h7
Ph A	21.96	2.24	16.95	10.42	1.20	0.40	0.45	0.41	1.08	0.03	0.32	0.35
Ph B	31.41	6.35	27.51	7.69	1.73	1.04	0.88	0.43	1.30	0.37	0.56	0.38
Ph C	26.53	7.17	21.57	10.54	1.67	0.95	0.84	0.43	1.27	0.35	0.60	0.33

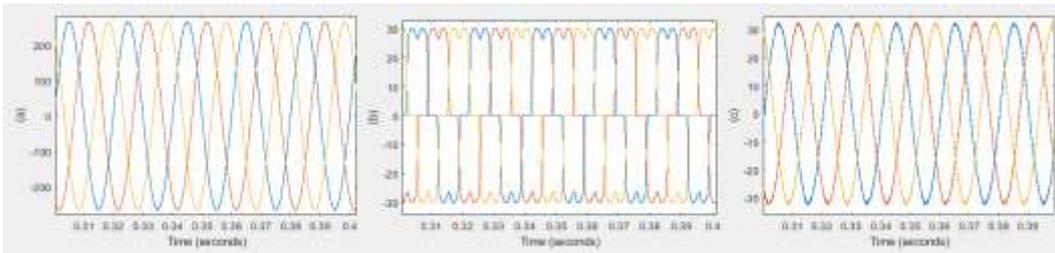


Figure 5. From right to left : (a) Source Voltage, (b) Load Current, (c) Source Current in case 1.

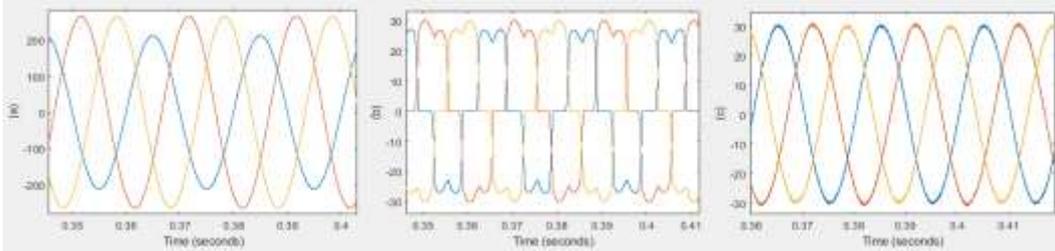


Figure 6. From right to left : (a) Source Voltage, (b) Load Current, (c) Source Current in case 2

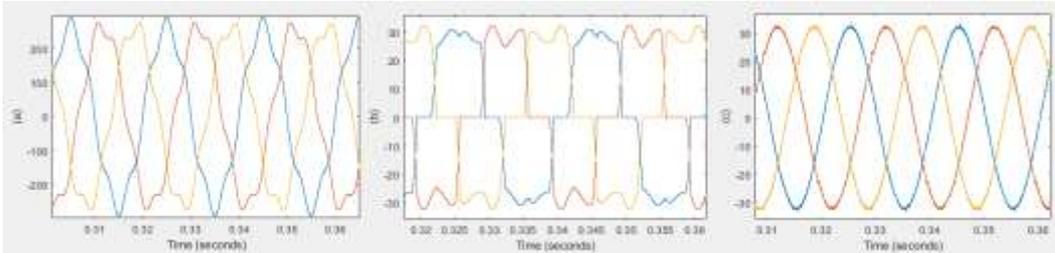


Figure 7. From right to left : (a) Source Voltage, (b) Load Current, (c) Source Current in case 3

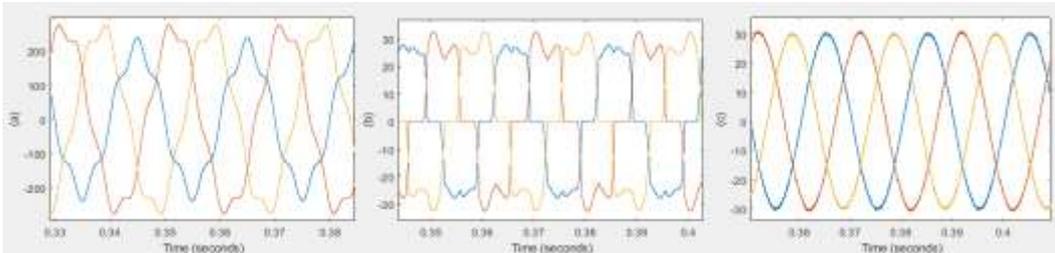


Figure 8. From right to left : (a) Source Voltage, (b) Load Current, (c) Source Current in case 4

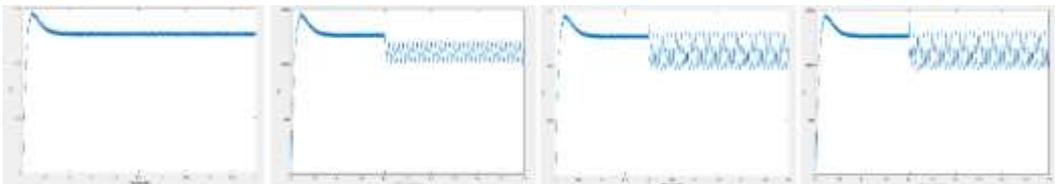


Figure 9. From right to left, the active power for the four cases

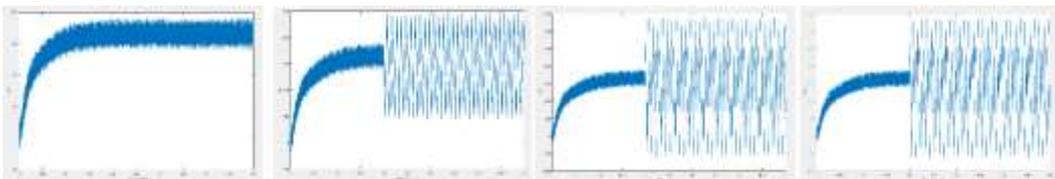


Figure 10. From right to left, the reactive power for the four cases

Figures 5(a), 5(a). 6(a). 7(a). 8(a) shows the source voltages in the 4 cases, we note the degradation of the voltage at each introduction of disturbance which affects the state of the current by increasing the

already existing harmonics due to the non-linear load but above all by the appearance of 3rd order harmonics, representative of the imbalance. Therefore, even if the voltage is disturbed, it is still followed by an imbalance represented by the 3rd-order harmonic. These repercussions are visible on the current curves; see Figures 5(b), 5(b). 6(b). 7(b). 8(b)

The three proposed methods (Diphase current method for identifying harmonics and SOGI-PLL for instantaneous phase monitoring) have proven their effectiveness and superiority over conventional methods, whether for the reduction of the % Total or individual THD of harmonics or for the detection and maintenance of the instantaneous phase of the source voltage even in the case of disturbance and unbalance, this is proven by the results of table 1 and the different figures which represent currents of perfectly sinusoidal source in the four simulation cases (see Fig. 5(c). 6(c). 7(c). 8(c)).

On the other hand, we note that whatever the case, the active power is maintained at a value of 13 kV, while the reactive power observes a reduction from six KVA to 1.5 KVA. See figures 9 and 10.

5. Conclusion

This paper presents a comparative study between the Diphase current theory approach based on the ADALINE neural network and the conventional DQ theory applied to the active shunt power filter. The objective is to compare the effectiveness of the two methods for detestation and elimination of disturbances and imbalances of nonlinear electrical sources and loads. Both methods are equipped first with a conventional PLL and then with the proposed SOGI-PLL. The tests are carried out in several cases of disturbed and unbalanced sources and loads. The simulation results indicate that the neural method gives superior and accurate results in both harmonic current detection and suppression. The source current of the three phases is sinusoidal, balanced, and in phase with the source voltage. The %THD of the source current is reduced and the power factor is equal to unity. This confirms the effectiveness of the implemented algorithms and the possibility of using the proposed approach.

REFERENCES

- [10]. M. Antoine Hanna Nohra, “ Commande de Filtres Actifs Parallèles sur un Réseau Fortement Perturbé ”, Thèse de Doctorat, Université de Toulouse, Institut National Polytechnique de Toulouse - Toulouse INP (FRANCE), 2017
- [11]. Akagi H. Active Harmonic Filter. Proceedings of the IEEE 2005; 93(12): 2128-2141.
- [12]. Djaffar Ould Abdeslam. Techniques neuromimétiques pour la commande dans les systèmes électriques :application au filtrage actif parallèle dans les réseaux électriques basse tension. Sciences de l'ingénieur [physics]. Université de Haute Alsace - Mulhouse, 2005. Français. fftel-00422996
- [13]. [1] Hoon, Yap, Radzi, Mohd Amran Mohd, Hassan, Mohd Khair, Mailah, Nashiren Farzilah, Wahab, Noor Izzri Abdul, “A Simplified Synchronous Reference Frame for Indirect Current Controlled Three-level Inverter-based Shunt Active Power Filters” Journal of Power Electronics Volume 16 Issue 5 / Pages.1964-1980 / 2016 / 1598-2092(pISSN) / 2093-4718(eISSN)
- [14]. s.k.prince, k.p.panda, and g.panda, ” kalman filter variant intelligent control for power quality improvement in photovoltaic active power filter system,” int trans electr energ syst. 2019.
- [15]. L. Merabet ,S. Saad , D. Ould Abdeslam , A. Omeiri; ‘A comparative study of harmonic currents extraction by simulation and implementation’, International Journal of Electrical Power & Energy Systems Volume 53, December 2013, Pages 507-514

- [16]. Ngac Ky Nguyen. *Approches neuromimétiques pour l'identification et la commande des systèmes électriques : application au filtrage actif et aux actionneurs synchrones*. Autre. Université de Haute Alsace - Mulhouse, 2010. Français. ffNNT : 2010MULH4851ff. fftel-00615491f
- [17]. Pinto, J., Carvalho, A., Rocha, A., & Araújo, A. (2021). Comparison of DSOGI-Based PLL for Phase Estimation in Three-Phase Weak Grids. *Electricity*, 2(3), 244–270. doi:10.3390/electricity2030015
- [18]. Dellahi, M., Maker, H., Botella, G., Alameda-Hernandez, E., & Mouhsen, A. (2020). Three-phase four-wire shunt active power filter based on the SOGI filter and Lyapunov function for DC bus control. *International Journal of Circuit Theory and Applications*. doi:10.1002/cta.2778
- [19]. L. Merabet, S.Saad, D. Ouldabdeslam and A. Merckle 'Direct neural method for harmonic currents estimation using adaptive linear element' *International Journal of Electrical Power Systems research*, Volume 152, 2017, pp. 61-70.
- [20]. Abdedjebbar Tamer a,* , Laid Zellouma a , Mohamed Toufik Benchouia b , Abdelbasset Krama a,c, Adaptive linear neuron control of three-phase shunt active power filter with anti-windup PI controller optimized by particle swarm optimization
- [21]. Janpong, S., Areerak, K., & Areerak, K. (2021). Harmonic Detection for Shunt Active Power Filter Using ADALINE Neural Network. *Energies*, 14(14), 4351.

COMPARATIVE STUDY BETWEEN DIFFERENT MPPT ALGORITHMS

RAHLI Chouaib, MEBAREK Abdesslam Ryad, Pr SAAD Salah,

Dr OUADA Mehdi, Dr MERABET Leila

LSELM Research Laboratory, Department of Electromechanical Engineering,

Badji Mokhtar - Annaba University, Algeria

ABSTRACT

Due to increasing air pollution and demand for electricity, it is necessary to limit the use of fossil fuels. Today, photovoltaic (PV) is considered a promising solution to this problem, but alone, this system provides a low voltage that must be boosted before it can be used. For this, static converters such as choppers are implemented in series with the PV. An adequate control of the chopper becomes a necessity, the most used methods are the classical method of Maximum Power Point Tracking (MPPT) with the Perturb and Observe (P&O) algorithm and the Incremental Conductance (INC) algorithm. However, the latter has several weaknesses, in particular a very long reaction time followed by a power loss. This paper presents a comparative study between the conventional methods mentioned below and the advanced method-based Fuzzy Logic (FLC), which was chosen for its robustness, fast response time, and independence from the PV structure. These techniques were studied and discussed by simulation using MATLAB/Simulink. The results prove that the FLC method provides a fast response with an accurate maximum power point tracking.

Keywords: Photovoltaic, MPPT, P&O, INC, FLC

1. Introduction

The improvement in the quality of life and the development of industry in many countries have largely contributed to the increase in energy demand worldwide [1].

The demand for energy is constantly increasing and is largely based on the consumption of fossil fuels such as oil and gas. The disadvantage of the latter is the increase of CO₂ and greenhouse gases and the depletion of natural resources, thus increasing environmental pollution. These reasons motivate researchers to discover alternative, renewable and sustainable energy sources [2].

Today, photovoltaic power generation systems have become an important energy source for a wide range of applications in different fields. Further improvements in energy conversion efficiency under different environmental conditions [3] have contributed to the expansion of the use of these renewable energy sources. These devices use maximum power point tracking (MPPT) techniques [1] to extract the maximum possible power from photovoltaic (PV) power generation systems, but this technique requires a careful control algorithm to ensure optimal results. Several algorithms have been proposed, including: P&O, INC, fuzzy logic and ANN and PSO.

The main objective of this work is to implement the P&O and Incremental Conductance (INC) and FLC algorithms in the MATLAB/Simulink program, and to determine which of these three techniques is the most appropriate for MPPT in order to establish an optimal algorithm.

2. PV modeling system

Several PV models are reported in the literature, the most popular ones being the single-diode model

and the two-diode model [5][6]. Therefore, in this work, a single diode model is used [7]. Based on the equivalent circuit presented in [8], the PV model current is presented by the following equation derived from Kirchoff's law [9].

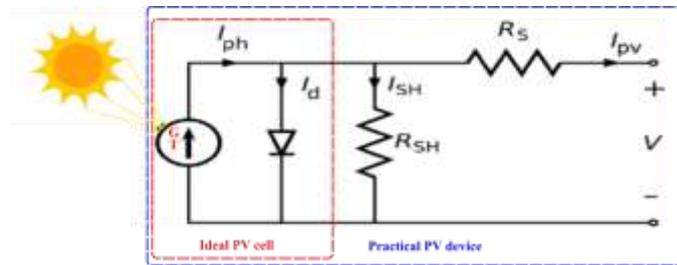


Fig 1. PV panel equivalent electric circuit.

$$I_{pv} = I_{ph} - I_d - I_{sh} \quad (1)$$

Where I_{pv} , I_d , and I_{sh} represent respectively the output current of the PV, the diode current, and the shunt resistor current. the current I_d is calculated as following [10]:

$$I_d = I_s(e^{(V_{pv} + R_s I_{pv})/V_t} - 1) \quad (2)$$

Where I_s , V_{pv} , and R_s , represent respectively the diode reverse saturation current, the output voltage of the PV, the series resistance. V_T represents the diode thermal voltage (in V), its expression is given in [10]. The shunt resistor current I_{sh} is given by:

$$I_{sh} = (V_{pv} + R_s * I_{pv})/R_{sh} \quad (3)$$

Where R_{sh} denotes the shunt resistance. we get the final expression the output current of the PV using the equations (1), (2), and (3) as following [11]:

$$I_{pv} = I_{ph} - I_s \left(e^{\frac{V_{pv} + R_s I_{pv}}{V_t}} - 1 \right) - I_{sh} = (V_{pv} + R_s * I_{pv})/R_{sh} \quad (4)$$

Electrical data at STC	Value
Puissance nom. P	210 W
Tension pour puissance nom.	26,6 V
Courant pour puissance nom.	7,9 A
Tension marche à vide	33,2 V
Courant court-circuit	8,58 A
Nombre de cellules	54

Table1. KD210G 2PU module specifications

We use a panel of the type "KYOCERA KD210GH-2PU (210Watt)", made by KYOCERA. The electrical characteristics of this type of panel, according to the technical sheet, are decreed in the table above and the characteristic curves of this module with parameter variation effect (temperature and irradiance) are presented in figure 2 and 3.

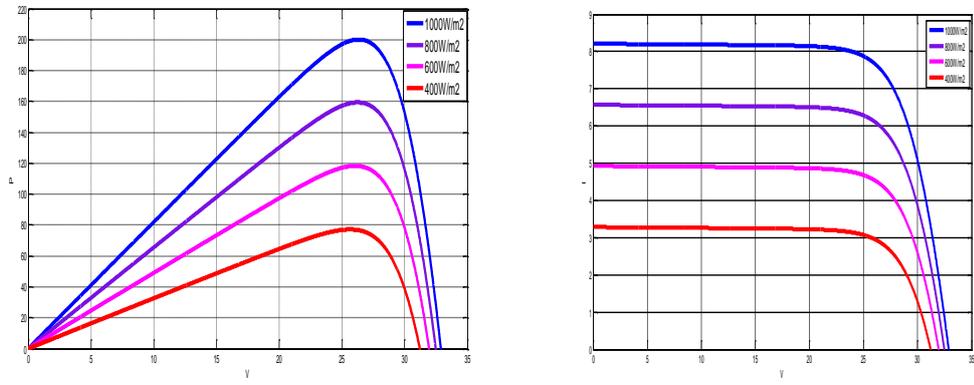


Figure2: I-V and P-V characteristic of a typical PV module for fixed Temperatures $T = 25 \text{ }^\circ\text{C}$, and varied insolation intensity

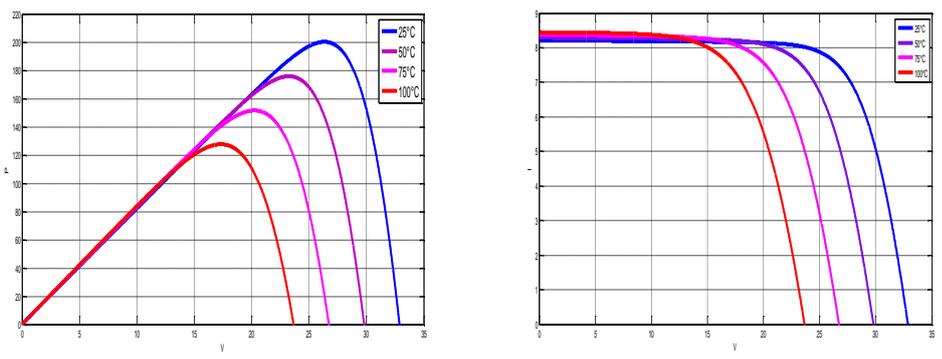


Figure3: I-V and P-V characteristic of a typical PV module for fixed insolation intensity $G = 1000\text{W/m}^2$, and varied Temperatures.

3. MPPT ALGORITHMS

3.1. Perturb and Observe (P&O):

P&O is the most frequently used technique to track the maximum power due to its simple structure [10]. The principle of MPPT P&O controls is to perturb the VPV voltage by a small amount around its initial value and analyze the behavior of the resulting PPV power variation. around its initial value and analyze the behavior of the resulting PPV power variation. Thus, as shown in Figure 4.

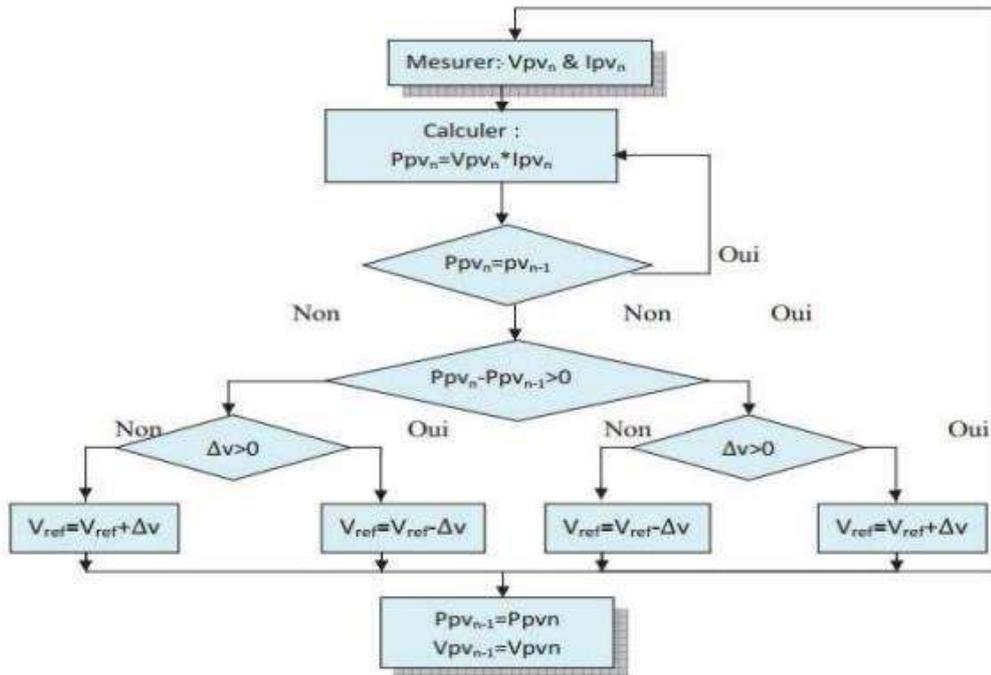


Figure 4: State-flow chart of P&O MPPT technique

3.2. Incremental Conductance MPPT (INC):

To search for the PPM, this other technique is based on the knowledge of the variation of conductance of the GPV and the consequences on the position of the operating point in relation to a MPP. Thus, the conductance of the photovoltaic module is defined by the ratio between the current and the voltage of the GPV as shown below:

$G = I/V$ and an elementary variation (increment) of conductance can be defined by:

$$dG = dI_{pv}/dV_{pv}$$

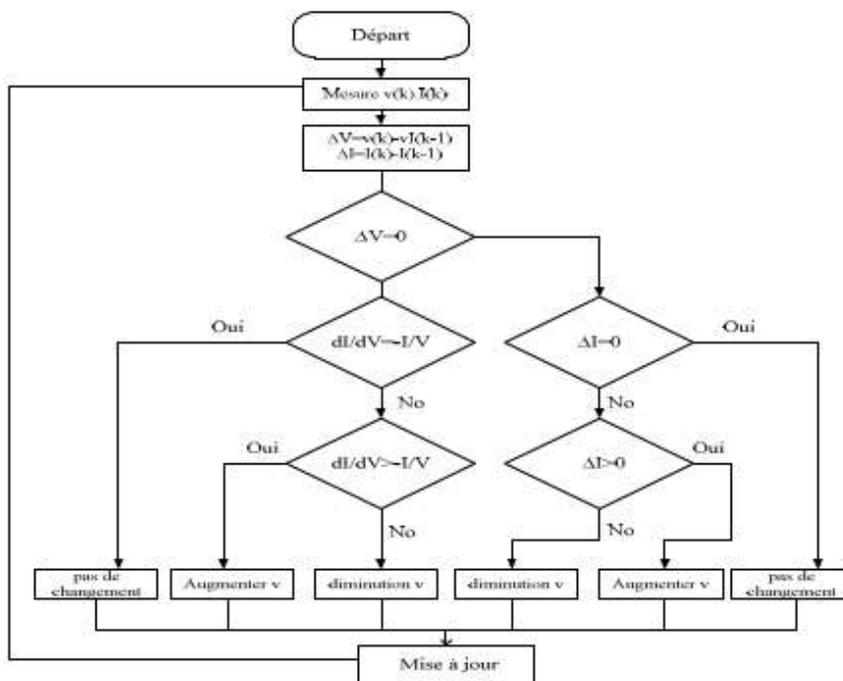


Figure5: State-flow chart of INC MPPT technique

3.3. Fuzzy logic algorithm:

Fuzzy logic intervenes knowledge and has emerged as an effective alternative for such popular systems, fuzzy alternative for such popular systems, fuzzy logic controllers have the advantages of working advantages of working with imprecise inputs, not needing a mathematical model and non-linear handling. The operation of this algorithm is in three blocks: fuzzification, inference and defuzzification figure.

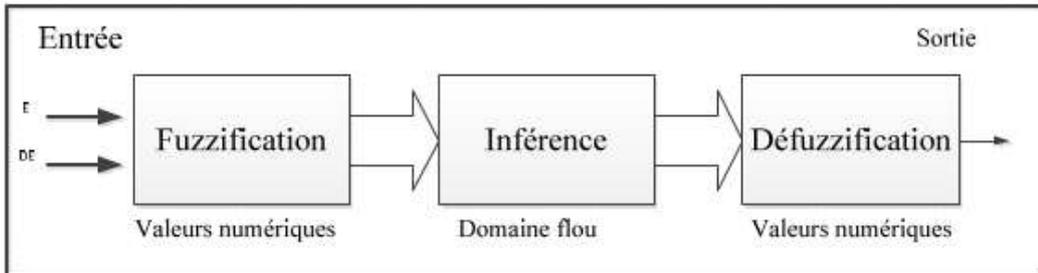


Figure6: diagram of fuzzy logic algorithm.

4. SIMULATION RESULTS AND DISCUSSION:

The PV model with its controlled DC-DC boost converter is simulated using MATLAB/Simulink software, to demonstrate the features of the MPPT algorithms based fuzzy logic in comparison with the INC and the Conventional P&O MPPT method.

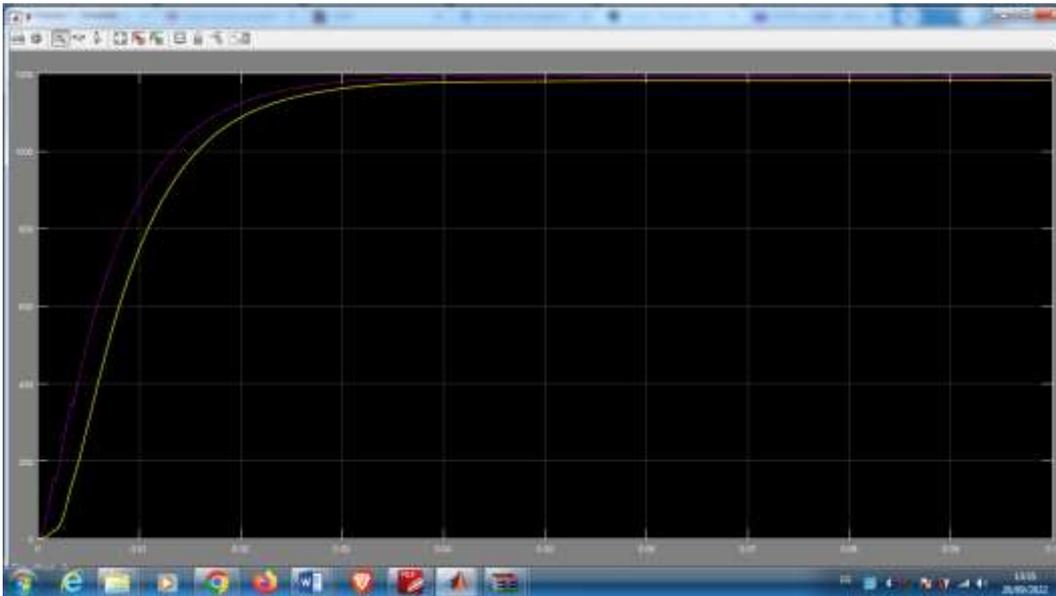


Figure7: PV power curves generated by P&O algorithm, INC algorithm.

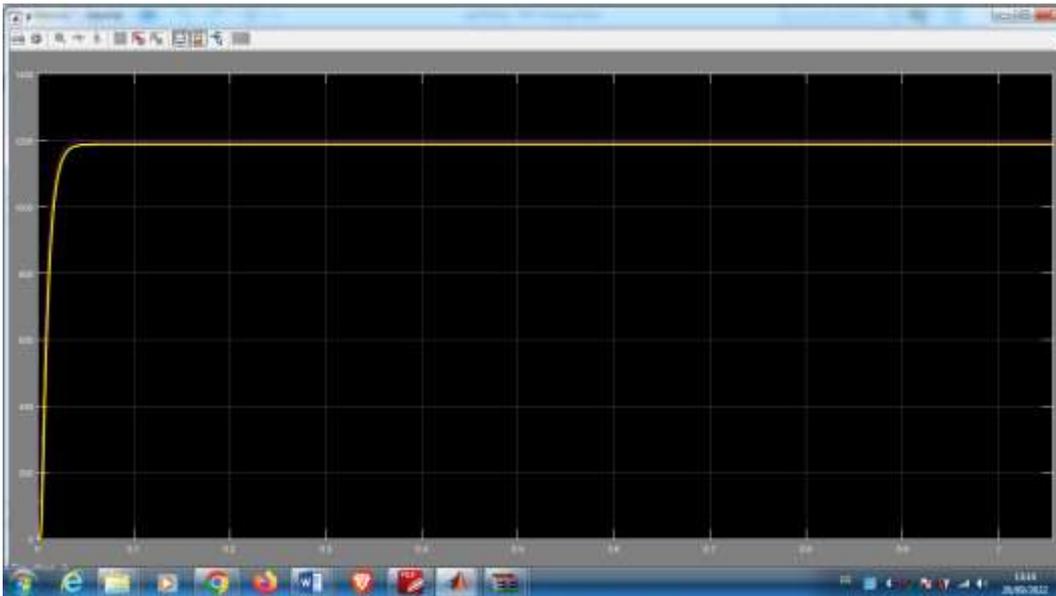


Figure8: PV power curves generated by FLC algorithm.

CONCLUSIONS

In this article, we have given a general idea about photovoltaic panels. Then, we presented the P-V and I-V characteristics of the KYOCERA KD210GH-2PU solar panel with different temperature and irradiation changes, we presented the three most popular MPPT algorithms, and finally, we ended with a simulation of the different algorithms. The objective of this work was to control the duty cycle of the boost converter in an optimal point in order to obtain the maximum possible power from a PV generator, so the simulation shows that the INC algorithm gives better results than the P&O algorithm. Moreover, both P&O and INC algorithms give better results. In addition, P&O and INC are widely used but the fuzzy logic based control shows good behavior and better performance compared to the other algorithms. good behavior and better performance compared to the other methods.

REFERENCES

- [1] M. S. Bouakkaz, A. Boukadoum, O. Boudebbouz, I. Attoui, N. Boutasseta, and A. Bouraiou, "Survey of Six Maximum Power Point Tracking Algorithms under Standard Test conditions," *Alger. J. Renew. Energy Sustain. Dev.*, vol. 03, no. 01, pp. 53–62, 2021, doi: 10.46657/ajresd.2021.3.1.6.
- [2] M. Vafaeipour, S. H. Zolfani, M. H. M. Varzandeh, A. Derakhti, and M. K. Eshkalag, "Assessment of regions priority for implementation of solar projects in Iran: New application of a hybrid multi-criteria decision making approach," *Energy Conversion and Management*, vol. 86, pp. 653–663, 2014.
- [3] A. Bouraiou *et al.*, "Analysis and evaluation of the impact of climatic conditions on the photovoltaic modules performance in the desert environment," *Energy Convers. Manag.*, vol. 106, pp. 1345–1355, Dec. 2015, doi: 10.1016/j.enconman.2015.10.073.
- [4] Makhlof M, Messai F, Nabti K, Benalla H (2012) Modeling and simulation of grid-connected photovoltaic distributed generation system. In: 1st international conference on renewable energies & vehicular technology, 26–28 Mar 2012, pp 187–193
- [5] K. Ishaque, Z. Salam, and H. Taheri, "Simple, fast and accurate two-diode model for photovoltaic

modules," *Solar Energy Materials and Solar Cells* (2011).

[6] Jubaer Ahmed, Zainal Salam, "An Enhanced Adaptive P&O MPPT for Fast and Efficient Tracking Under Varying Environmental Conditions" *IEEE Transactions on Sustainable Energy* July 2018.

[7] Tawfik Radjai, Jean Paul Gaubert, Lazhar Rahmani and Saad Mekhilef. "Experimental verification of P&O MPPT algorithm with direct control based on Fuzzy logic control using CUK converter", *International Transactions on Electrical Energy Systems* 2015; DOI: 10.1002/etep.2047

[8] Chaib ibtissam., Berkouk El Madjid, Gaubert Jaun Paul. "Study of Fuzzy Logic controller based MPPT and the P&O for the Z-source inverter integrated in PV system". 978-1-5386-4988-6/18/\$31.00 ©2018 IEEE.

[9] Ammar Ghalib, Al-Gizi, Sarab Jwaid Al-Chlahawi, "Study of FLC Based MPPT in Comparison with P&O and InC for PV Systems, " 2016 International symposium on Fundamentals of Electrical Engineering University Politehnica of Bucharest, Romania, 2016.

[10] Ouada, M., Meridjet, M.S., Talbi, N. Optimization photovoltaic pumping system based BLDC using fuzzy logic MPPT control, *Proceedings of 2013 International Renewable and Sustainable Energy Conference, IRSEC 2013*, 2013, pp. 27–31, 6529718

PREVENTION OF GALACTOSEMIA

Hajiyeva N.M.

Baku State University, Baku, Azerbaijan

ABSTRACT

For the first time, a heterozygous state of two identical mutations of the GALT gene was identified using a complex of molecular genetic methods between x and y, a couple who wanted to become parents in Baku. As a result of the genetic analysis, a mutation of the GALT gene was found, causing a deficiency of the galactose-1-phosphaturidyltransferase enzyme.

Galactosemia is an autosomal recessive disease related to deficiency of one of three different enzymes involved in the metabolism of galactose: galactokinase (GALK), galactose-1-phosphate uridyltransferase (GALT) or UDP-galactose-4-epimerase (GALE). Classic galactosemia is due to GALT deficiency and is the most common. Longitudinal studies have shown that in spite of early diagnosis and early treatment of children with galactosemia detected in the mass screening programme, the results are poor and mental retardation as well as other complications are of similar severity as in children diagnosed clinically without screening. In many investigations it was also proved that some impairments developed already in the prenatal period. Our procedure strategy in galactosemic children and their families include; diagnosis of new cases on the basis of clinical symptoms selective screening in high-risk families, prophylactic lactose-free diet for mothers during pregnancy. Such management can help to prevent death in the early period of life. (5,6)

Keywords: galactosemia, galactose-1- phosphaturidyltransferase, GALT, Next Generation Sequencing, Preimplantation Genetic Diagnosis.

INTRODUCTION

In galactosemia, a hereditary exchange disease, D-galactose, which is a component of milk sugar-lactose, undergoes phosphorylation and turns into galactose-1-phosphate. Deficiency of the enzyme galactose-1-phosphate-uridyltransferase, which plays a key role in the exchange process, does not ensure the breakdown of galactose into glucose, and as a result, excess sugar poisons the brain and causes galactosemic oligophrenia in the patient, cataracts in the eyes, hepatomegaly and cirrhosis of the liver, and retardation of physical and mental development. Thus, as a result of the lack of absorption of galactose sugar by the body, its amount in the blood increases and causes disease.

Because the genetics of the hereditary exchange disease galactosemia is heterogeneous, its genetic forms are also related to the lack of various enzymes. The disease is caused by a malfunction of three different genes located on autosomal chromosomes number one, nine, and seventeen. The inheritance type of all three genes is autosomal recessive.

Just as the genetics of the hereditary exchange disease galactosemia is different, its clinical features are also diverse. A mild condition of galactosemia results in non-digestion of milk by the body and the formation of cataracts in the eye. Duarte variant form of the disease passes without symptoms and a tendency to liver diseases is observed in a person.

Medical-genetic consultation is prospective and retro-prospective. Prospective medical-genetic counseling consists of genetic counseling of parents with genetic risk family without previous children.

For this purpose, young people should be consulted, the presence of hereditary diseases in the family and generation should be clarified, and the carrier of these hereditary diseases should be studied in young people by means of appropriate analyses. Since galactosemia exchange disease belongs to the autosomal recessive type of inheritance, both parents must be heterozygous carriers of galactose-1-phosphatidyltransferase enzyme for the disease to occur in a child. Prevention of the disease should be developed for a family with a genetic risk. (4.)

This hereditary condition is passed from parent to child as an autosomal recessive disease. This means that a child needs to inherit two copies of the defective gene (one from each parent) in order to have the disease.

By galactose-1-phosphateurydiltransferase enzyme deficit, the metabolism of galactose disaccharide: galactose cleavage into two glucose molecules is damaged. Cataract, hepatomegaly following with liver cirrhosis is observed in patients with later development of physical and mental retardation (3.).

Genetics of galactosemia disease is heterogeneous. Genes participating in galactose metabolism are located in the chromosomes 1, 9 and 17. Gene GAL1 is located in p13 of the short shoulder in chromosome 9. Gene GALK is positioned in site 23-25 q of the long shoulder of chromosome 17, and gene GALE is located in the short shoulder of the chromosome 1 in site p35-p36. Inheritance type for all three types of galactosemia gene is autosome-recessive (1,2,3).

MATERIALS AND METHODS

In the genetic laboratory, blood was taken from the parents and the presence of mutations in the relevant genes was checked.

From the DNA material obtained with the Gentra Puregene kit from the peripheral blood of x(female) and y(male), carrier test- sequence and deletion/duplication test was performed by NGS-Next Generation Sequencing method and the following results were found. (6,7,8)

RESULTS AND DISCUSSION

Born in 1989 - female, the date of the analysis was 10.11.2020.

No	Result-	Gen	Variant	Heredity
1	Carrier: Biotinidase deficiency	BTD	c.1330G.>C (p/Asp444 His)	autosomal ressesiv
2	Carrier: Alpha-thalassemia	HBA1/HBA2	HBAI: Deletion (Entire coding sequence)	autosomal ressesiv
3	CarrierI Galactosemia (GALT-related)	GALT	c/-119_ -116del (Non-coding)	autosomal ressesiv

Born 1991, male, date of analysis 10.11.2020

Result-y	Gen	Variant
Daşıyıcı: Galactosemia (GALT-related)	GALT	c/-119_ -116del (Non-coding)

RESULTS AND DISCUSSION

Born 1986, female, date of analysis 08.12.2020

№	Result-x	Gen	Variant	Heredity
1	Carrier: Alpha-thalassemia	HBA1/HBA2	HBA2:c.4271>C (p.* 143Glnext*31)	autosomal ressesiv
3	Carrier: Galactosemia (GALT-related)	GALT	c/-119_ -116del (Non-coding)	autosomal ressesiv
	Result -y	Gen	Variant	Heredity
	Daşıyıcı:Galactosemia (GALT-related)	GALT	c/-119_ -116del (Non-coding)	

Based on the result, artificial insemination with selection of healthy embryos using prenatal diagnosis or PGD-preimplantation Genetic Diagnosis method and consultation of a geneticist is recommended in the next pregnancy. (5.)

CONCLUSIONS

1. For the first time we have conducted molecular-genetic analysis of GALT gene of galactosemia inherited disease in Azerbaijan Republic and identification of GALT gene position c-119-116del. For the first time, a heterozygous mutation of the **GALT gene c-119-116del** was identified using a complex of molecular genetic methods of the GALT gene in a couple about to become parents in Baku.

REFERENCES

1. Bennett MJ. (2010) Galactosemia diagnosis gets an upgrade. Clin Chem;56:690
2. Beutler E. (1994), G6PD deficiency. Blood, vol. 84, p. 3613-3636.
3. Bosh AM. Classic galactosemia: dietary dilemmas. J Inherit Metab Dis 2011;34:257-60.
4. Galactosemia I type. Classic galactosemia. Diagnosis of galactosemia. Clinics of galactosemia. Medician house.
5. Gathof B.S., Sommer M., Padskarbi T. et al. (1995). Characteristics of two mutations with stop codons of galactose -1-phosphaturadiltranspherase at three men with galaktosemia with hard clinic appearances. Hum.Genet. №6, P. 721- 725.
6. Gu.W., Zhang F., Lupski J.R. (2008) Mechanisms for human genomic rearrangements, Eur.J.Hum.Genet., vol.1, p.4-12.
7. Herman R, Kunisaki S, Molitor M, et al. (2011); The use of peritoneal venous shunting for intractable neonatal ascites: a short case series. J Pediatr Surg 46:1651- 4.
8. Report of scientific group of World Health Organization. (1997) «Fight with hereditary diseases».

Jeneva, .P 133.

9. Shield JP, Wadsworth EJ, MacDonald A, et al. ((2000); The relationship of genotype to cognitive outcome in galactosaemia. ArchDisChild 83:248-50

4. Mutations at the galactose-1- phosphate uridyl transferase (GALT) gene.

Galactosemia is an alteration that alters the way the body processes galactose.. Galactosemia type 1 (classical), galactosemia type 2 (deficiency of galactokinase) and type 3 (galactose epimerase deficiency) The mutations most frequently cited are Q188R, K 285N, S135L,AND N314D.