الجامعة الوطنية
National University
Science & Technology للعلوم والتكنولوجيا

ANNUAL RESEARCH REPORT

2024 - 2025

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Message

Dr. Salim Al Araimi

Deputy Vice-Chancellor & Provost

As we reflect on the academic year 2024–2025, it is with great pride and a strong sense of achievement that this Annual Research Report is presented. The year has been characterized by notable progress and significant accomplishments, underscoring the resilience, commitment, and scholarly excellence of the University's research community.

Throughout the reporting period, our researchers continued to advance the frontiers of knowledge by addressing critical scientific, technological, and societal challenges. Their work spans a wide range of disciplines, including sustainable technologies, health sciences, environmental research, and engineering, demonstrating both the breadth and depth of the University's research portfolio and its relevance to contemporary global priorities.

The academic year also saw a marked growth in collaborative research activities, both internally across colleges and externally with national and international partners. These collaborations have strengthened the research ecosystem, enhanced interdisciplinary engagement, and created new pathways for innovation and real-world impact. In parallel, the University has continued to strengthen an inclusive and supportive research culture. A sustained commitment to diversity, equity, and inclusion remains central to our research strategy, ensuring a collaborative environment in which all members of the academic community are empowered to contribute meaningfully.

The accomplishments documented in this report reflect the collective dedication and perseverance of our faculty, students, and professional staff. Their sustained efforts in advancing knowledge, fostering innovation, and addressing societal needs have reinforced the University's position as a growing center of research excellence. Looking ahead, we remain confident and optimistic about the opportunities before us. Through continued collaboration and strategic investment in research, the University is well positioned to expand its impact and contribute to a more innovative, equitable, and sustainable future.

Preface

Prof. K P Ramachandran

Dean of Deanship of Graduate Studies and Research

As a leading institution of higher education in the region, the National University (NU) remains firmly committed to advancing its mission of transforming lives through education, generating new knowledge, and engaging meaningfully with society. This commitment has been strongly reflected throughout the academic year, as the University continued to expand its impact through excellence in research, innovation, and community engagement. NU has further strengthened its role as a hub for innovative solutions, particularly in the fields of science and technology. Our faculty members and researchers have demonstrated exceptional creativity, resilience, and scholarly rigor, consistently advancing knowledge and delivering impactful outcomes across their respective disciplines. Their efforts underscore the University's growing capacity to address complex challenges and contribute to national and global development priorities.

Collaboration continues to be a cornerstone of NU's research success. Strategic partnerships with industry, government agencies, local communities, and international institutions have enriched the research environment and enabled interdisciplinary and applied research initiatives. These collaborations play a vital role in translating research into practical solutions that support sustainable development and long-term societal benefit. A strong emphasis on applied research and innovation has led to meaningful advancements with tangible outcomes. By deepening engagement with corporations, healthcare systems, small and medium enterprises, startups, and community organizations, NU ensures that its research not only advances academic knowledge but also delivers measurable benefits to society at large.

This Annual Research Report highlights the achievements and scholarly contributions of faculty, staff, and students across the University's four constituent colleges: the College of Engineering, the College of Pharmacy, the College of Medicine and Health Sciences, and the International Maritime College Oman. These accomplishments reflect both individual excellence and a collective institutional commitment to strengthening research capacity and academic scholarship at NU.

As the University moves forward, it remains dedicated to enhancing research performance through targeted strategic investments, infrastructure development, and supportive initiatives. With a clear vision and sustained commitment, NU is well positioned to achieve continued growth in research excellence. The coming years promise further innovation, discovery, and impact, made possible by the dedication and collaborative spirit of the entire NU community.

Preamble:

University research plays a pivotal role in advancing innovation, generating new knowledge and technologies, strengthening research and development activities, and creating long-term value through sustained investment in research infrastructure. At the National University (NU), there is a strong and enduring commitment to enhancing the quality of education and research in order to deliver meaningful contributions to society.

Despite an increasingly competitive research funding landscape, NU faculty members continue to pursue high-impact, interdisciplinary research that bridges both traditional and emerging fields. These sustained efforts have not only expanded collaborative networks but have also led to increased external research funding from industry partners and government agencies. Such achievements reflect the growing maturity and relevance of the University's research ecosystem.

The Deanship of Graduate Studies and Research, in close collaboration with research centers across the constituent colleges, remains dedicated to positioning NU as a regional center of excellence and a strategic partner in discovery-driven and applied research, as well as innovation. Through coordinated initiatives and strategic oversight, the University continues to strengthen its research capacity and societal impact.

Over recent years, NU has experienced consistent growth in research outputs, underscoring the effectiveness of its research strategies and institutional support mechanisms. This Annual Research Report is presented with great pride and enthusiasm, highlighting the innovative research, scholarly endeavors, and creative activities undertaken by NU's faculty, students, and staff. The report provides a comprehensive overview of the University's research achievements during the academic year 2024–2025, including publications, patents, sponsored research projects, scholarly and creative works, and research-related awards and recognitions.

1-Journal Publications & Patents

During the academic year 2024–2025, the university recorded a total of 176 peer-reviewed journal publications, reflecting a strong and sustained research output across its constituent colleges. The College of Engineering (CoE) emerged as the leading contributor with 94 published papers, accounting for more than half of the university's total publications. This was followed by the College of Pharmacy (CoP), which produced 35 publications, and the College of Medicine (CoM) with 30 scholarly articles, underscoring their active engagement in research and knowledge dissemination. The International Maritime College Oman (IMCO) contributed 16 journal papers, while the College of Advanced Technology (CAT) reported one publication during the same period. Collectively, these figures demonstrate a broad-based research culture across the university, with particularly strong performance from the College of Engineering and continued contributions from all academic units. (please see **Appendix-A** for the *Abstracts* of the Journal publications).

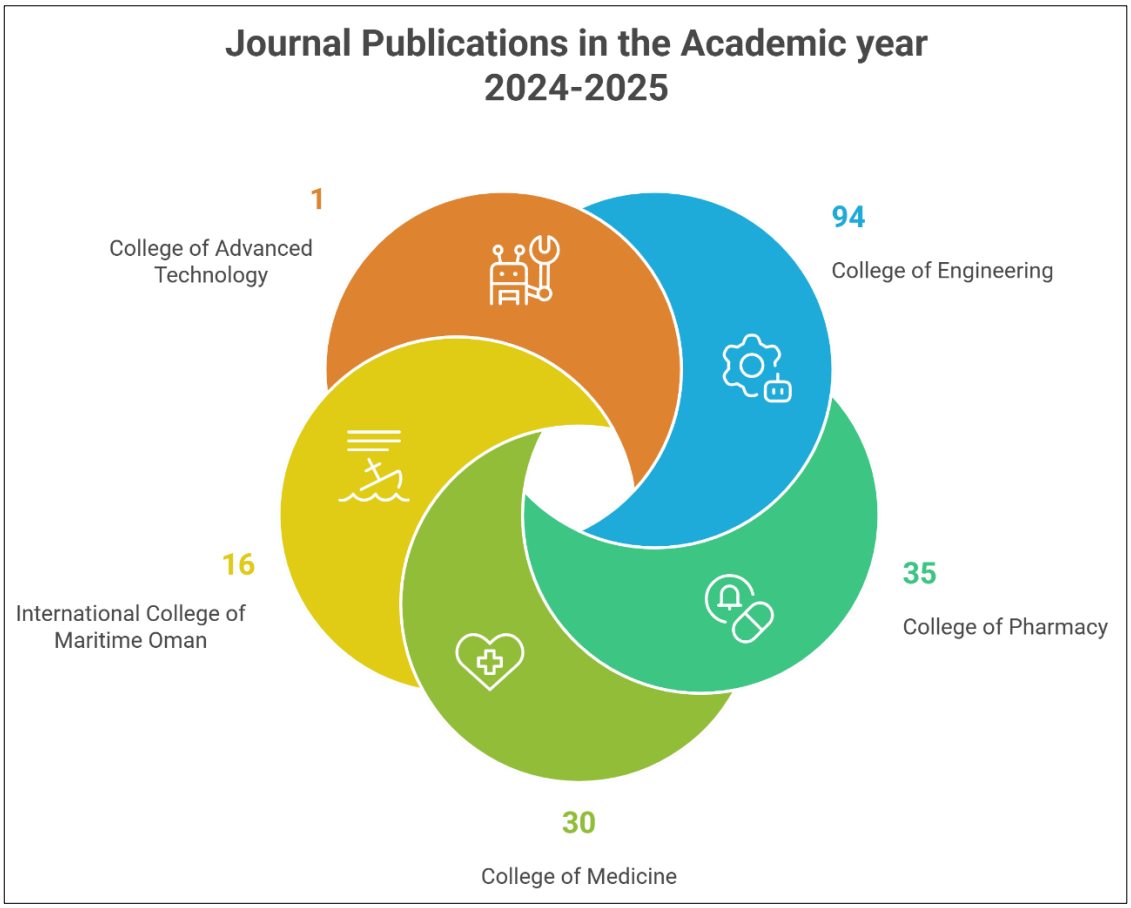

Figure. 1: NU Journal publications in the academic year 2024-2025

In addition to producing high-impact scholarly publications, NU researchers have demonstrated strong innovation capacity through the successful development and protection of intellectual property. During the academic year 2024–2025, NU inventors were awarded six patents by intellectual property offices in Germany and the Sultanate of Oman, reflecting both national and international recognition of their scientific and technological inventions. All granted patents have been duly registered with the relevant legal authorities to ensure intellectual property protection. A detailed list of patents secured during the academic year 2024–2025 is provided in Table 1.

List of Patents (2024-2025)						
Sl. No	**Inventors**	**College**	**Patent Title**	**Country of issued patent**	**Patent No**	**Date of Grant**
1	Dr. Mullaicharam, Dr.Yaman	CoP	A system for producing buccal strips of cineole	German	202024107652	28th Jan 2025
2	Dr. Shabib Sulaiman Al Rashdi Reem Al Qassabi (Student) Alyaqeen Al Suti (Student)	CoE	Biodegradable Lignin-Based Coatings for Sustainable Aluminum Packaging	Oman	OM/P/2025/190	13th Mar 2025
3	Dr. Shabib Sulaiman Al Rashdi	CoE	Detoxification of Methane from Biochar	Oman	PT000000000006484590	6th Nov 2024
4	Dr. Shabib Sulaiman Al Rashdi, Hiba Mohammed Al Qanaii (Student) Abrar Al Hashmi (Student) Al-Muntasir Al-Maamari (Student)	CoE	Innovative System for Industrial Wastewater Treatment and Green Hydrogen Production Using Heterogeneous Solar Fenton Process and Artificial Intelligence	Oman	OM/P/2025/189	13th Mar 2025
5	Dr. Shabib Sulaiman Al Rashdi	CoE	New Application of Biochar in Oman	Oman	OM/P/2024/719	6th Nov 2024
6	Dr. Geetha Devi Reem Hilal al Mamaari (Student)	CoE	Sustainable Production of Bioplastics from Waste Milk as an eco-friendly and Renewable Resource for Circular Economy	Oman	OM/P/2024/00478	13th Mar 2025

Table. 1: List of Patents (2024-2025)

2-Conference Publications

During the academic year 2024–2025, a total of 63 conference papers were published across the University. The College of Engineering accounted for the highest contribution with 31 papers, followed by the International Maritime College Oman with 17 publications. The College of Medicine and Health Sciences produced nine conference papers, while the College of Pharmacy contributed three publications. In addition, one conference paper was published by the College of Advanced Studies. The distribution of conference paper publications by college is illustrated in Figure 2.

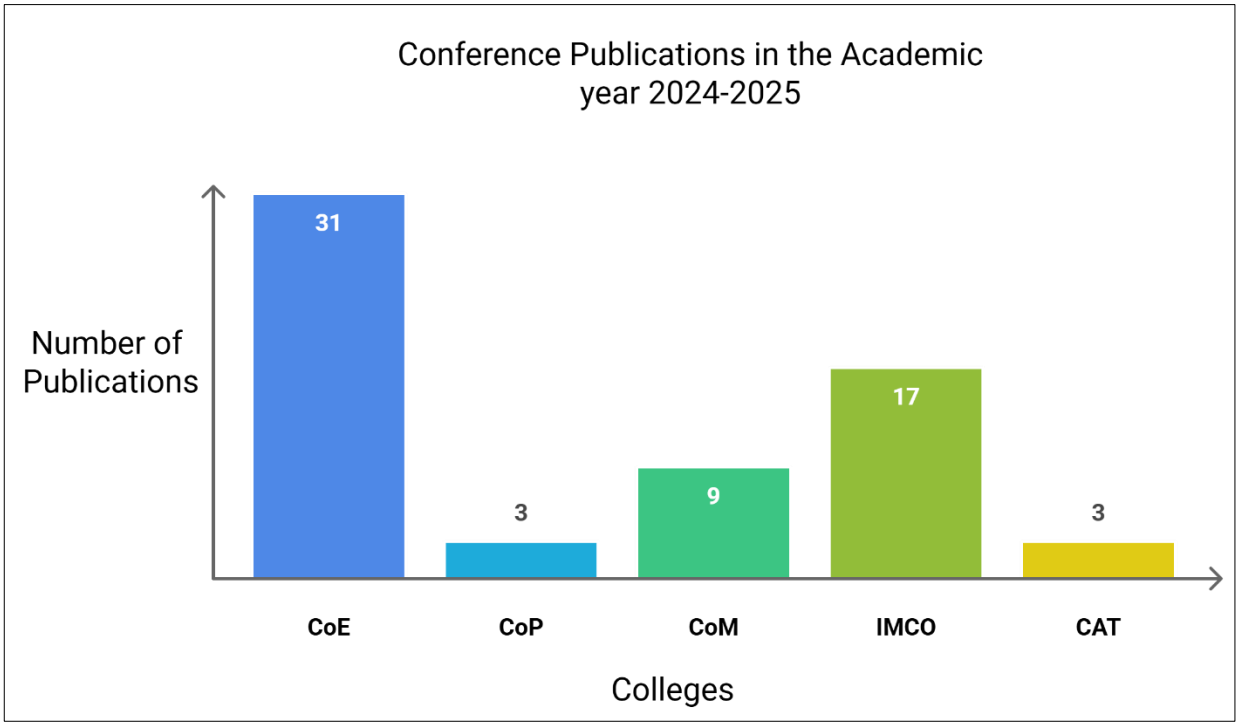

Figure. 2: NU Conference publications in the academic year 2024-2025

3- Books/Chapters Authored

During the academic year 2024–2025, NU researchers published a total of 48 books and book chapters. Of these scholarly outputs, 17 were contributed by the College of Engineering, 15 by the College of Pharmacy, eight by the International Maritime College Oman, five by the College of Medicine and Health Sciences, two by the School of Foundation Studies, and one by the College of Advanced Technology. A comprehensive list of books and book chapters authored by NU faculty members is presented in Table 2, while the distribution of contributions across constituent colleges is illustrated in Figure 3.1.

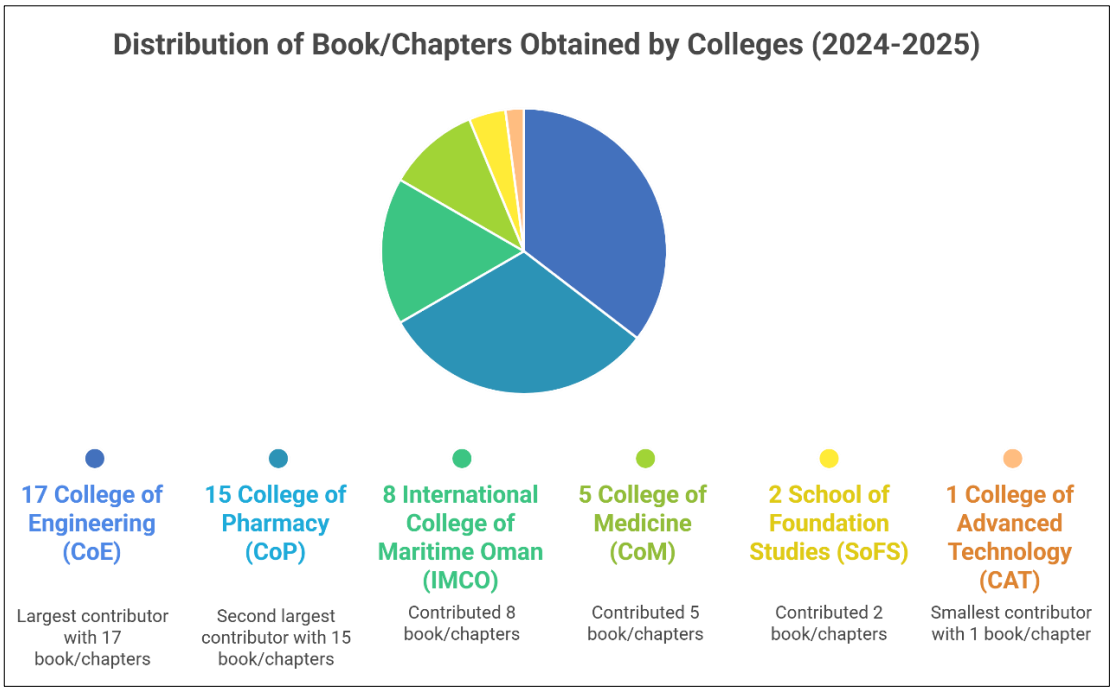

Figure. 3.1: Contributions of Colleges in Books and Chapters During the Academic Year 2024-2025

Figure.3.2: Books/Chapters authored in the academic year 2024-2025

List of Book/Chapters Authored (2024-2025)						
Sl. No	**College**	**Authors**	**Year of Publication**	**Book/ chapter**	**Book/chapter title**	**ISBN/link**
1	CoE	Dr. Sitesh Kumar Singh	2024	Book	A Handbook of Transportation Engineering	ISBN: 9385358456
2	CoM	El Shallaly GEHA	2024	Book	Checklists for clinical examinations in general surgery	ISBN: 9781398490833 (Paperback)
3	IMCO	Dr Jaffar Sadhik Basha	2024	Book	Heat & Mass Transfer	https://doi.org/10.5281/zenodo.13746486
4	CoE	Dr. Sitesh Kumar Singh	2024	Book	Sustainable Transport Systems Engineering	ISBN: 9384984590
5	CoP	Dhanalekshmi Unnikrishnan Meenakshi, Poovi Ganesan, Pushpa Sweety Joseph, Saranya Thekkila-Veedu, Dhilin Pathayappurakkal Mohanan, Ashly Merin George, Ruckmani Kandasamy, Nandakumar Selvasudha	2024	Book Chapter	Chapter 19; Fucoidan-Based Hydrogels in Pharmaceutical and Biomedical Applications In book: Biopolymers in Pharmaceutical and Food Applications	https://doi.org/10.1002/9783527848133.ch19
6	CoM	Rashmi T. D'souza, Vijaya Marakala, Rhea K. D'souza, Mamatha Jayandran, Pankaj Prabhakar, Princy L. Palatty, Manjeshwar Shrinath Baliga	2024	Book Chapter	The Role of Dietary Agents in Preventing the Pathogenesis by Helicobacter pylori , Metabolites of Medicinal Plants: Insightful Approaches	http://dx.doi.org/10.2174/9789815274103124010015
7	CoP	Dhilin Pathayappurakkal Mohanan, Saranya Thekkila-Veedu, Ashly Merin George, Nandakumar Selvasudha, Pushpa Sweety Joseph, Dhanalekshmi Unnikrishnan Meenakshi, Poovi Ganesan, Ruckmani Kandasamy	2024	Book Chapter	Chapter 26; Carrageenan Hydrogel for Pharmaceutical and Biomedical Applications.In book: Biopolymers in Pharmaceutical and Food Applications	https://doi.org/10.1002/9783527848133.ch26

9	CoP	Pushpa Sweety Joseph, Nandakumar Selvasudha, Dhanalekshmi Unnikrishnan Meenakshi, Poovi Ganesan, Saranya Thekkila-Veedu, Dhilin Pathayappurakkal Mohanan, Ashly Merin George, Ruckmani Kandasamy	2024	Book Chapter	Chapter 28; Pharmaceutical, Therapeutic, and Cosmetic Applications of Sericin; In book: Biopolymers in Pharmaceutical and Food Applications	https://doi.org/10.1002/9783527848133.ch28
9	CoE	NA Al Balushi (Student), S Al Rashdi, SM Rizwan, SM Al Saadi	2024	Book Chapter	Characterization of Oilfield Wastewater and Treatment Feasibility using Membrane Biofilm Reactor Technology - Innovation and Technological Advances for Sustainability, pp. 560–566	ISBN: 978-981-19-1234-5
10	IMCO	Dr. Jaffar Sadhik Basha	2024	Book Chapter	Desalination and Emission Reduction Techniques in a Diesel Engine Powered with MWCNT Blended Emulsions	https://doi.org/10.1201/9781003496724
11	CoE	M. Geetha Devi, R. Senthilkumar, Hebatallah Al Jabri	2024	Book Chapter	Development and Characterization of Nanostructured Thin Films for Corrosion Control Applications	ISBN: 9781394234288 (e Book)
12	CoE	S Walke, P Bhambare, S Rizwan, S Al Rashdi	2024	Book Chapter	Electrode Selection and Catalyst Evaluation in Hydrogen Production from Alkaline Water Electrolysis: A Review - Chemical and Process Engineering: New Frontiers, vol. 45, pp. 1–24	ISBN: 978-1-003-26224-1
13	CoM	Pankaj Prabhakar, Vijaya Marakala, Dhanya Sacheendran, Rhea Katherine D'souza, Rashmi Theresa D'souza, Mamatha Jayandran, Giriyapura S. Pavankumar, Princy L. Palatty, Manjeshwar Shrinath Baliga	2024	Book Chapter	Emblica officinalis in Preventing Metabolic Syndrome: A First Review Addressing the Benefits and the Mechanism of Action, Metabolites of Medicinal Plants: Insightful Approaches	http://dx.doi.org/10.2174/9789815274103124010012

14	IMCO	Dr Jaffar Sadhik Basha	2024	Book Chapter	Future Directions for IoT and AI-Based Zero Liquid Discharge (ZLD) Systems in Industrial Applications	https://link.springer.com/book/9783031849084
15	CoP	Suraj Kumar, Rishabha Malviya, Dhanalekshmi Unnikrishnan Meenakshi	2024	Book Chapter	Overview of Women's Health, Women's Health: A Comprehensive Guide to Common Health Issues in Women (2024)	https://doi.org/10.2174/9789815256291124010004
16	CoM	Raksha Nayak, Karkala Maya Sreedhara Pai, Vijaya Marakala, Harish Kumar Bastimal, Pankaj Prabhakar, Rhea Katherine D'souza, Sham Prasad Sajankila, Karkala Sreedhara Ranganath Pai, Manjeshwar Shrinath Baliga	2024	Book Chapter	Pharmacological Effects of Lesser-known Fruiting Plants Growing in India, Metabolites of Medicinal Plants: Insightful Approaches	http://dx.doi.org/10.2174/9789815274103124010014
17	CoP	Rishav Sharma, Rishabha Malviya, Swati Verma, Arvind Kumar, Dhanalekshmi U. Meenakshi	2024	Book Chapter	Role of Patents in Economic Development and Integration. In book: Pharma Marketing and Pharmacoeconomics	ISBN: 9781003506362
18	IMCO	Dr Jaffar Sadhik Basha	2024	Book Chapter	The Evolution of Energy Storage Devices	https://doi.org/10.1201/9781003495437
19	CoP	Garima Varshney, Rishabha Malviya, Sonali Sundram, Dhanalekshmi Unnikrishnan Meenakshi	2024	Book Chapter	Utilization of Microbial Genes as a Vaccine Against Cancer, Chapter in Book: Cancer Vaccination and Challenges	ISBN: 9781003501718
19	CoP	M. J. Akhtar, Dhanalekshmi UM, Tanveer Alam*, Mohammad Sohail Akhtar, Shah Alam Khan	2024	Book Chapter	Phytochemistry and Neuroprotective Spectrum of a Medicinal Food Product: Crocus sativus Linn. In Plants as Medicine and Aromatics	ISBN: 9781003403968 https://www.taylorfrancis.com/books/edit/10.1201/9781003403968/plants-medicine-aromatics-mohd-kafeel-ahmad-ansari-mushtaq-ahmad-gary-owens?refId=66f97de5-e7bb-4325-b5dd-21c6f9da5183&context=ubx

21	CAT	Dr. Mahalingam Palaniandi, Dr. S. Mahalakshmi	2025	Book	Data Structures for AI and DS	ISBN: 978-93-48498-42-7 https://www.vr1publications.com/product/data-structures-for-ai-and-ds-a-y-2023-2024/
22	CoP	Shah A Khan & Md. Jawaid Akhtar	2025	Book	Drug repurposing: Novel Therapeutic Avenues and Innovations in Health Care	ISBN: 979-8-89530-422-8
23	CoE	Dr. Sunil K. Sansaniwal, Dr. Preeti Singh Bahadur, Dr. Sitesh Kumar Singh	2025	Book	Enhancing Energy and Environmental Sustainability Using Intelligent Technologies	https://www.appleacademicpress.com/enhancing-energy-and-environmental-sustainability-using-intelligent-technologies-/2059
24	IMCO	Sadhik Basha , Taofeek Olanrewaju Alade, Mitha Obaid Amur Al Khazimi, Ranjit Vasudevan and Jahanzeb Bahadur Khan	2025	Book	Optimizing Research Techniques and Learning Strategies With Digital Technologies	https://novapublishers.com/shop/phytoconstituents-of-the-neem-plant-pharmacological-activities-and-applications/
25	CoE	Balamuralikrishnan R. Ibrahim Shabbir Mohammedali	2025	Book Chapter	A Comparative Study on the Design of a Two-Story Car Showroom Using Pre-Engineered Buildings (PEBs) in Accordance with British Standards and Euro Codes	https://doi.org/10.9734/bpi/erpra/v5/4521 ISBN-13 (15): 978-93-49473-44-7 (Print) 978-93-49473-43-0 (eBook)
26	IMCO	Dr Jaffar Sadhik Basha	2025	Book Chapter	Advanced Fluid Dynamics in Microfluidic Systems for Environmental, Chemical, and Biomedical Engineering Applications Simulated using Computational Tools	https://doi.org/10.1201/9781003651772
27	CoE	Sitesh Kumar Singh, Jaishri Gothania and Rituraj Jain	2025	Book Chapter	Advanced Transportation Technologies for Next-Generation Logistics" as Chapter 15 in the book titled "Emerging Trends in Smart Logistics Technologies	ISBN: 9798337324340 https://www.igi-global.com/gateway/book/368231
28	CoP	Verma S, Malviya R, Meenakshi DU	2025	Book Chapter	Advances in soft robotics for limb design. In: Soft robotics in biomedical science	ISBN: 9781003610380
29	CoE	M. Geetha Devi & R. Senthil Kumar	2025	Book Chapter	Alginate-Based (Nano) Materials for Dyes and Metals Uptake" Reference Collection in Materials Science and Materials Engineering	ISBN: 9780128035818 https://www.sciencedirect.com/science/article/pii/B9780323954860001356

30	CoE	Venkata Krishna Reddy, C., Kandavalli, S. R., Sundar Raj, M., Amuthakkannan, R., Baskaran, J., Selvaraju, M., & Jose Anand, A	2025	Book Chapter	Architecture of digital twins and applications. In Handbook of Industrial and Business Applications with Digital	-
31	CoM	Divecha CA, Ramesh R, Tullu MS.	2025	Book Chapter	Common pediatric medical conditions: Anesthetic considerations. In: Dhayagude SH, Dave N, Bhardwaj N (editors). Principles and Practice of Pediatric Anesthesia.	-
32	CoP	Rishabha Malviya, Sonali Sundram, Dhanalekshmi Unnikrishnan Meenakshi	2025	Book Chapter	Drug Delivery Systems Using Quantum Computing,	ISBN: 9781394159338 (Online)
33	CoP	Md. Jawaid Akhtar & Shah A Khan	2025	Book Chapter	Drug repurposing for effective Alzheimer's and Parkinson's medicines: Potential approaches for drug discovery" In: Drug repurposing: Novel Therapeutic Avenues and Innovations in Health Car	ISBN: 979-8-89530-422-8
34	CoE	Sitesh Kumar Singh, Rituraj Jain	2025	Book Chapter	Future of Mobility: Potential Challenges and Ethical Considerations" as Chapter 12 in the book titled "AIoT for Smart Transportation: Transforming the Future of Mobility	ISBN: 978-1-83724-096-8
35	IMCO	Dr Jaffar Sadhik Basha	2025	Book Chapter	Hybrid Nanocomposites for High-Performance Applications in Aerospace, Mechanical, and Biomedical Engineering Enhanced by Computational Modeling and AI	https://doi.org/10.1201/9781003651772
36	IMCO	norhanghoneim	2025	Book Chapter	Innovative Nanomaterial Solutions for Shipboard Wastewater Management", in the Book Titled "Water and Food Security in the Face of Climate Change: Challenges and Opportunities for Resilience	DOI: 10.1007/978-3-032-00098-9_65

37	CoE	Alasali, B. E., & Alfach, M.	2025	Book Chapter	Innovative Pavement Materials and Sustainable Engineering Practices for Next-Generation Infrastructure in book: Engineering Solutions for Modern Challenges in Advanced Materials Science	-
38	CoE	Rituraj Jain, Sitesh Kumar Singh, Damodharan Palaniappan, Kumar Parmar, Premavathi T	2025	Book Chapter	Integrating Smart Cyber-Physical Systems into Urban Planning: The Future of Smart Cities" as Chapter 5 in the book titled "Smart Cyber Physical Systems: Innovations and Real-World Implications	ISBN: 9781032892931 https://www.routledge.com/Smart-Cyber-Physical-Systems-Innovations-and-Real-World-Implications/Poonia-Upreti-Khan/p/book/9781032892931
39	SoFS	Jasawala, S., and Dwivedi, P. B	2025	Book Chapter	Investigating EFL Teachers; Engagement in Action Research: Barriers and Opportunities in the Omani Context. Knowledge Exchange Workshop - Proceedings Book 2025: Innovative pedagogies & educational strategies: reshaping the future of GFP	ISBN: 978-93-48719-94-2 (E-copy)
40	SoFS	Jasawala, S., Kashouli, S. M. and Ghaffari, M.	2025	Book Chapter	Investigating the Impact of Utilizing Mobile Assisted Language Learning (MALL) on At-risk Learners' Vocabulary Learning in Foundation Studies at National University of Science and Technology. Knowledge Exchange Workshop - Proceedings Book 2025: Innovative pedagogies & educational strategies: reshaping the future of GFP	ISBN: 978-93-48719-94-2 (E-copy)
41	CoP	Pranjal Sachan, Meenakshi Goswami, Prachi Shrivastava, Akansha Kushwaha, Md Jawaid Akhtar,	2025	Book Chapter	Neem-Based Formulations and Therapeutics Applications, In book: Phytoconstituents of the Neem Plant: Pharmacological Activities and Applications	DOI: 10.52305/YLTF2512,
42	CoE	Saif Al Busaidi, Geetha Devi*, Qais Mohammed Mahmood Al Balushi	2025	Book Chapter	Physicochemical Preparation for Fabrication and Characterization of Gold Nanoparticles for Antibacterial Activity Study	ISBN 978 -3-301-94805-3 https://doi.org/10.1007/978-3-031-94805-3_5

43	CoP	Dhanalekshmi UM, Ahuja A, Nandakumar S, Lekshmi S, Chilaka Bo, and Shah Alam Khan	2025	Book Chapter	Prospects of Biodegradable Material: Sustainable and Patient-Centric Approach in the Realm of Biomedical Engineering". In: Biomaterials, Bioengineering and Sustainability. Volume 1: Sustainable Green Biomaterials as Drug Delivery Systems	https://doi.org/10.1007/978-3-031-79062-1_2
44	CoP	M J Akhtar, S A Khan,	2025	Book Chapter	Repurposing for effective Alzheimer's and Parkinson's Medicines: Potential approaches for drug discovery; Chapter 2, Drug repurposing – Novel Therapeutic Avenues and Innovations in Healthcare	-
45	CoE	Sitesh Kumar Singh, Bader Eddin Alasali, Khuloud Nasser Al Balushi,	2025	Book Chapter	Smart Transportation and Autonomous System Integration" as Chapter 7 in the book titled "Smart Cyber Physical Systems: Innovations and Real-World Implications	ISBN:9781032892931 https://www.routledge.com/Smart-Cyber-Physical-Systems-Innovations-and-Real-World-Implications/Poonia-Upreti-Khan/p/book/9781032892931
46	CoE	Sitesh Kumar Singh, Bader Eddin Alasali, Yuvraj Belbase,	2025	Book Chapter	Urban Transportation Planning: Artificial Neural Network Applications" as Chapter 18 in the book titled "Expert Artificial Neural Network Applications for Science and Engineering	ISBN:9798369372500 https://www.igi-global.com/book/expert-artificial-neural-network-applications/347395
47	CoE	Sitesh Kumar Singh, Michael Toryila Tiza, Bader Eddin Alasali	2025	Book Chapter	Utilization of Sustainable Resources for Energy Efficiency using Smart Technologies" as Chapter 7 in the book titled "Artificial Intelligence for Environmental Sustainability"	ISBN:978-1-77964-404-6 https://appleacademicpress.com/the-intersection-of-environmental-sustainability-and-artificial-intelligence-in-the-digital-age-/1675
48	CoP	Dhanalekshmi UM, Nandakumar S, Ganesan P, Lekshmi S, Sweety JP, Shah Al. Khan	2025	Book Chapter	Zinc Oxide Nanoformulations for Cancer Therapy". In: Metals in Medicine. Volume 2: Metallic Nanoparticles for Biomedical Applications	-

Table 2: List of Book/Chapters Authored

4-Funded Research projects

During the academic year 2024–2025, the National University successfully secured external research funding from the Ministry of Higher Education, Research and Innovation (MoHERI), including three Research Grant (RG) projects, six Graduate Research Grant (GRG) projects, and twenty-two Undergraduate Research Grant (URG) projects. The details of these funded projects are presented in Table 3. The total research funding awarded by MoHERI during this period amounted to **OMR 111,000**. In line with the University's Research Strategic Plan and its commitment to fostering high-quality research, the National University also provided internal research funding to support faculty-led initiatives. During AY 2024–2025, internal grants were awarded to five research projects in the College of Engineering, two projects in the International Maritime College Oman, one project in the College of Medicine and Health Sciences, and one project in the College of Pharmacy. The total internal research funding allocated during the reporting period amounted to **OMR 26,000**.

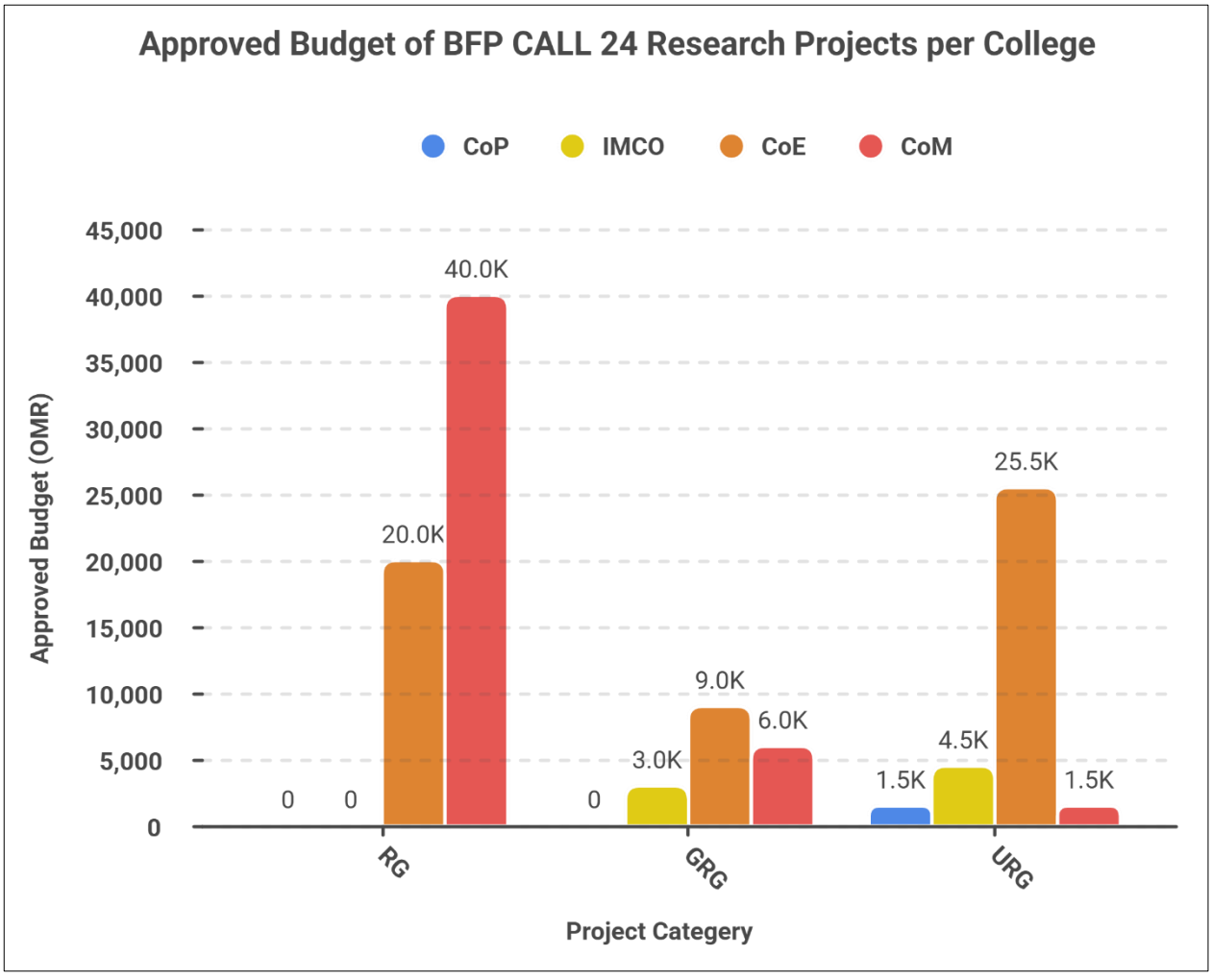

Figure. 4: (MOHERI) Research Fund in OMR – College wise for CALL 24

List of CALL 24 Funded Research Projects						
Sl. No	**Research Project Title**	**Project Code**	**College**	**Year**	**Funding (OMR)**	**Research Team/Mentor/PI**
1	Optimizing Diabetes Services through Digital Health and Artificial Intelligence: Identifying Risk Factors and Improving Patient Outcomes	BFP/RGP/HSS/24/398	CoM	2024	20,000	Dr. Mohammed Al Shafaee- PI Alokla, Souad- Co-PI K, Vijayalakshmi- Co-IN Al-Nazwani, Nasser- Co-IN
2	Development and Application of Novel Nano Materials for the Corrosion Control of RC Beam Steel Reinforcements	BFP/RGP/EI/24/403	CoE	2024	20,000	Dr. Geetha Devi - PI Namasivayam, Aravind- Co-PI Alaufi, Almoatasem- Co-IN Joy, Varghese- Co-IN Muhye Adeen, Eman- Co-IN Other Team Al Subhi, Maryam
3	Development of a Web-based Caregiver Toolkit for Down Syndrome	BFP/RGP/HSS/24/324	CoM	2024	20,000	Dr. Miriam Simon- PI Divecha, Chhaya- Co-PI Al Shirawi, Maryam- Co-IN Other Team Al Ghailani, Amal Al Shibli, Wajud
4	Analyzing the Pathways and Kinetics of Anaerobic Degradation of Labile Biochar Carbon Derived from Phoenix dactylifera Lignin under Various Thermo-Chemical Conditions	BFP/GRG/EI/24/182	CoE	2024	3,000	Al Shukaili, Arwa -PI Al Mazroui, Moosa- CO-PI Alaythee, Dr. Mutlag-Co-IN Patil, Ganesh- Co-IN Ibarra Buscano, Sonia-Co-IN Al Rashdi, Shabib - Supervisor
5	Assessing the thyroid dysfunction patterns among medical students	BFP/GRG/HSS/24/155	CoM	2024	3,000	Al Balushi, Maryam- PI Al Rushdi, Fatma- Co-PI Begum, Gulam Saidunnisa- Supervisor
6	Innovative Strategies for managing ecologically benign biofilms on carbonized surfaces derived from chicken and agricultural waste	BFP/GRG/EBR/24/075	CoE	2024	3,000	ALMAQBALI, AZZA -PI Al Balushi , Khuloud- Co-PI Alaythee, Dr. Mutlag- Co-IN Al Rashdi, Shabib - Supervisor
7	Antimicrobial Potential of Calotropis gigantea: Synergistic Interactions with Conventional Antibiotics Against Multidrug-Resistant Bacteria	BFP/GRG/HSS/24/190	COM	2024	3,000	Al Badi, Ahmed -PI Al Balushi, Hanan- Co-PI Alokla, Souad-Co-IN Al-Nazwani, Nasser- Supervisor
8	Exploring the use of AI based personalized learning in Higher education in Oman	BFP/GRG/EHR/24/143	IMCO	2024	3,000	Al Balushi , Ahlam- PI Al Ajmi, Khaloud- Co-PI Al Maskari, Sanad- Supervisor

9	Characterization of Functionally Graded Metal Matrix Composites (FGMMC's) Manufactured by Centrifugal Casting for Automotive Application	BFP/GRG/EI/24/154	CoE	2024	3,000	Al Abri, Abdulshafi Mohammed -PI Al Oraimi, Said- Co-PI Krishnan, Pradeep Kumar- Supervisor
10	Ecofriendly Selenium-Silver Nanoparticles: Synthesis Using Phyllanthus Niruri Extract, Characterization, And Investigation of Anticancer Activity	BFP/URG/HSS/24/035	CoP	2024	1,500	Al Siyabi, Bushra-PI Um, Dhanalekshmi- Supervisor Other Team: Al Zadjali, Rawan AL-Shibli, Noof Sultan Abdullah
11	Enhancing Barrier Characteristics and Corrosion Resistance of Bio-composite Coating Developed from Date Palm Waste	BFP/URG/EBR/24/061	CoE	2024	1,500	Al Habsi, Raiyan- PI Jahan, Shah- Supervisor
12	Manufacturing and Characterization of an eco-friendly bio-pesticide from custard apple seed kernels for soil treatment	BFP/URG/EBR/24/032	CoE	2024	1,500	Ms. Houriya Waleed Ali Al Shihhi- PI Dr. Shabib Al Rashdi- Supervisor Other Team Ms. Al Shima Ahmed Al-Mujaini Ms. Fatma Waheed Albalushi
13	AI-Powered Intervention for Enhancing Social and Communication Skills in Children with Autism Spectrum Disorder	BFP/URG/HSS/24/058	CoE	2024	1,500	Ali Said Ali Al-Hajri, Balaqis- PI K, Vijayalakshmi- Supervisor Other Team: Al Lawati, Noor AuladThani, Aseel
14	Harnessing Nanomaterials for Onboard Ship Wastewater Treatment	BFP/URG/EBR/24/012	IMCO	2024	1,500	AL JARADI, ABHA- PI Ghoneim, Nourhan- Supervisor Other Team: Al-Sawai, Rashid Alhasani, Maathir Al Shondoudi, Abdulaziz Alhashmi , Salim Al-Hakmani, Naser Al Bulushi, Al Zulfa
15	Synthesis of virgin biodegradable and bio-composite plastics from waste wood dust recycling	BFP/URG/EBR/24/056	CoE	2024	1,500	AL-GHAFRI , RANIA-PI Al Rashdi, Shabib- Supervisor
16	Green Hydrogen Production from Waste Car Batteries and its potential application in Cleaning Paraffin Deposits from Oil Pipelines	BFP/URG/EBR/24/032	CoE	2024	1,500	Al Mahrooqi, Wadhha- PI Devi, Dr. Geetha- Supervisor Other Team AL-Nabhani, Aya AL-Mahrooqi, Sundos Al-Abri , Ebtihal

17	Mechanical properties of Autoclaved Aerated Concrete (AAC) lightweight cellular concrete blocks with Omani Sarooj and bauxite ore	BFP/URG/EI/24/015	CoE	2024	1,500	Hadil Obaid Said Al Maqbali- PI Dr. N. Aravind- Supervisor Other Team Al Thuraiya Mohammed Salim Al Kharusi Maitha Nasser Hamdoon Al Mamari Ulla Mohammed Abdulrahim
18	Mathematical modeling in a comprehensive method system in Oman to produce green energy from solid waste	BFP/URG/EI/24/083	CoE	2024	1,500	Al Ghailani, Alaa-PI Al Rashdi, Shabib- Supervisor
19	Traffic Accidents Challenges and Solutions in Al-Seeb/Muscat	BFP/URG/EI/24/006	CoE	2024	1,500	Aljabri, Ulla-PI Alasali, Bader Eddin- Supervisor Other Team: Al Sabei, Noor
20	Developing Catalytic Process for Polymer Degradation and Environmental Sustainability.	BFP/URG/EBR/24/071	CoE	2024	1,500	Al Hinai, Alla Hamed Sulaiman-PI Syed, Murtuza Ali - Supervisor
21	Investigation of the Bubble Column Method for CO2 Conversion to Solid Carbon in Liquid Metal	BFP/URG/EBR/24/082	CoE	2024	1,500	Al Suti , Al Yaqeen-PI Al Rashdi, Shabib- Supervisor
22	Fabrication of ZnO/polyethylenimine nanocomposites and its application as an oligodynamic additive for paints in Oman	BFP/URG/EBR/24/063	CoE	2024	1,500	AlFarsi, Kauthar- PI B.M, Sangeetha- Supervisor Other Team: Al Busaidi, Zainab
23	Development of Polymer with Additives to Protect Metal Surfaces from Corrosion	BFP/URG/EBR/24/074	CoE	2024	1,500	Alrashdi, Shabib- Supervisor
24	Development of Vacuum Assisted Stir Casting Technique for the Production of Aluminium Metal Matrix Composites with Enhanced Properties	BFP/URG/EI/24/067	CoE	2024	1,500	Mohammed Al-Kindi, Bashair- PI KRISHNAN, PRADEEP KUMAR- Supervisor
25	Photovoltaic-Thermal (PV-T) collector unit for Drying of Food/agricultural Products in Oman	BFP/URG/EI/24/008	CoE	2024	1,500	Al Shukaili , Abdulaziz Ali- PI Bhambare, Parimal- Supervisor Other Team: Al Brashdi , Mohammed
26	Experimental Investigation on Spent Catalyst Based Self-Consolidating Concrete (SCC) RC Beams with Conventional and GFRP Rebars	BFP/URG/EI/24/045	CoE	2024	1,500	Sulaiman , Hanin-PI Ramadoss, Balamuralikrishnan- Supervisor
27	Atipathogenic bacterial activity of crystal proteins extracted from Bacillus subtilis isolated from the sheepfold in Oman	BFP/URG/HSS/24/007	CoM	2024	1,500	Al-Numani, Hussein- PI Al Balushi, Hanan- Supervisor

28	A study on innovative cementitious materials (ECC) for sustainable building construction: Bendable Concrete	BFP/URG/EI/24/015	CoE	2024	1,500	Dr Soleen Jaber Ahmad Al Hasan- Supervisor
29	Hybrid MDC-RO Technology for Sustainable Desalination in Oman	BFP/URG/EBR/24/017	IMCO	2024	1,500	Alajmi , Alhusain-PI Jafari, Tahereh-Supervisor Other Team: Nasser, Ramla Alwahibi, Qasim
30	Designing a "circular economy" model in treating and recovering energy for the organic portion of municipal solid waste in municipal engineering landfills via anaerobic digestion in the sultanate of Oman	BFP/URG/EI/24/033	CoE	2024	1,500	Al Habshi, Aaya- PI Al Rashdi, Shabib- Supervisor
31	Membrane Separation Technology for Sustainable Mining of Valuable Minerals from Seawater in Oman	BFP/URG/EI/24/003	IMCO	2024	1,500	Al Esry, Amra- PI Adewole, Jimoh- Supervisor
32	Iron Oxide-Driven Dark Fermentation for Sustainable Hydrogen Generation from Food Waste	NUFRG/24/CE/0037	CoE	2024	4800	Dr. Shah Jahan
33	Sustainable Biofilm Management Using Biochar from Poultry and Agricultural Waste: Applications in Agriculture, Water Treatment, and Industrial Sectors in Oman	NUFRG/24/CE/0035	CoE	2024	3000	Dr. Dinesh Keloth
34	Human-Machine Interaction: Analyzing the Evolving Roles and Prerequisites for Maritime Professionals within the Context of Remotely Controlled Autonomous Ships	NUFRG/24/IM/0039	IMCO	2024	4000	Capt. Dr. Arife Tugsan Colak
35	Innovative Nanofluid-Based Filtration Technique for Impurity Removal in some of Industrial Fluids within Porous Media	NUFRG/24/IM/0040	IMCO	2024	4000	Dr. Nourhan Ibrahim Ghoneim
36	The Role of Airborne Pollutants in Asthma and COPD: A Comprehensive Study of Environmental Factors in Sohar	NUFRG/24/CM/0043	CoM	2024	3200	Dr. Muhsin Muhammed
37	Association Between Glycemic Control and Root Caries Lesions in Omani Dental Patients: A Retrospective and Cross-Sectional Study	NUFRG/24/CP/0038	CoP	2024	4000	Dr. Majed M Abukhader

38	Optimizing Anaerobic Digestion Processes for Efficient Biogas Production from Fruit and Vegetable Waste in Waste Management Engineering	NUSRG/24/CE/0044	CoE	2024	1000	Safiya Salim Nasser Al Ghammari - NU200147 - Dr. Shabib
39	Biochar from Lignin and Agricultural Waste in Anaerobic Digesters: A Kinetic Model for Renewable Energy Production	NUSRG/24/CE/0041	CoE	2024	1000	Sharifa Mohammed Saleh Al Hinai - NU200177 - Dr. Shabib
40	Development of Biodegradable Bioplastics from Omani Palm Tree Agricultural Waste: A Sustainable Solution to Plastic Pollution and Economic Advancement for Oman Vision 2040	NUSRG/24/CE/0043	CoE	2024	1000	Arwa Hamed Hamdan Al Rubaie - NU200583 - Dr. Shabib
41	Development of Intranasal drug delivery of Spermidine loaded liposome for the mitigation of neurogenerative disorder	NUIJP/24/CP/01	CoP	2024	1000	Dr. Dhanalekshmi UM
42	IoT and Hydroponics enabled smart green house in Controlled Environment Agriculture (CEA) for Fruits, Vegetables and Herbs	NUIJP/24/IM/02	IMCO	2024	1000	Dr Abdul Hameed Kalifullah
43	Development and Implementation of an AI-Powered Decision Support System for Multimodal Data Integration in Oral Cancer Treatment	NUIJP/24/CE/03	CoE	2024	1000	Dr. Suresh Monic

Table 3. CALL 24 Funded Research Projects 2024-2025

5-Awards and Recognition

1. Dr. Mahalingam Palaniandi received an award of the Best Inspirational Teacher Awarded by the Global Gyaan Academy, Bangalore in September 2024.
2. Dr. Mahalingam has published a book titled IoT and Its Applications. His book was Prescribed as the official textbook for the course IoT and its Applications (Course Code: 23UCAE1A) in the BCA Programme at H.H. The Rajah's College (Autonomous), Tamil Nadu, India, offered by the PG and Research Department of Computer Science, Academic Year 2025–2026.
3. Prof. Sadhik Basha, Dr. Mohammadhifz, Dr. Mohammed Jawaid Akhtar and Dr. Shah Alam, are one of the top 2% scientist of the world, a list prepared by the authors from Stanford university.
4. Dr. Mullaicharam from CoP has been recognized as a Judge for the QS Reimagine Education Awards, an international competition for innovative research and educational projects, 2025 – United States.
5. Dr. J. Sadhik Basha from IMCO is listed as an Academic Editor of Journal of Emerging Engineering Technologies.

6. Dr. Chhaya Divecha from CoM won the GHEDEX Award for Innovation in Education 2025. She also was shortlisted as finalist for THE ARAB awards 2025 for Most Innovative Teacher of the Year 2025. She completed a fellowship in Health Professions Education and Leadership offered by FAIMER®, a division of IntealthTM through the International FAIMER Institute Philadelphia, Pennsylvania, USA (June 2023 through May 2025).
7. Dr. Jimoh Adewole earned an Aspen Plus Certification awarded by "AspenTech University 2025.
8. Maira al Qaidi and Al Hanoof students from IMCO have won the upgrade competition Sep 2024 under the supervision of Dr Tahereh Jafary.
9. Maira Al Qaidi a student in IMCO won the First Place in the field of environment in the individual category in the Omani Youth Day 2024, under the supervision of Dr Tahereh Jafary.
10. Manar Al Attar and Anfal Al Shizawei student's at IMCO are Winner in Upgrade, Sep 2024 competition under the supervision of Dr Tahereh Jafary.
11. Manar Al Attar and Anfal Al Shizawei student's at IMCO won the first Place in Environmental Excellence Hackathon organized by MoHERI, May 2025, under the supervision of Dr Tahereh Jafary. They have slod won the Second place in the 3rd Gulf Petrochemicals and Chemicals Association Innovation Competition conducted in Sep 2024 in Saudi Arabia and in the Engineering day event organized in UTAS Sohar in April 2025.
12. Under the supervision of Dr. Tahereh Jafary, Al Hussain Al Ajmi, Fatema Al Maqbali, and Ramala Al Ashkhari students at IMCO have secured the FIRST PLACE in the competition 'REWAA DHOFAR: SUSTAINABLE DEVELOPMENT IN OMAN' conducted in Dhofar University in March 2025.
13. Under the supervision of Dr. Tahereh Jafary, Majid Al Ghaithi a student at IMCO has secured the Second place in the Omani Young water Research Award in MEDREC conducted in Dec 2024.
14. Under the supervision of Dr. Tahereh Jafary, Ahmed Khalid Salim Al Saadi, Noor Hamad Saif Al Ghafri and Rudaina Abdullah Nasser Al Sinawi, secured the First Place in the 3 minutes thesis competition conducted in IMCO.
15. Dr. Geetha Devi & student research team won First prize and 2nd prize in the 3rd Engineering Exhibition for Innovative Graduation projects (3rd EEIGP) on 15th April 2025 at College of Engineering - University of Buraimi.
16. Dr. Geetha Devi & Student research team won First place in the Process Engineering Day competition held on 26th May 2025 at IMCO Suhar.
17. Dr. Geetha Devi & student research team 3rd place in the Process Engineering Day competition held on 26th May 2025 at IMCO Suhar.
18. Dr. Geetha Devi & student research team won Devi won second Grand prize among all engineering disciplines in the 15th Engineering gathering at SQU in March 2025.
19. Dr. Geetha Devi was felicitated by Dr. Saleh Al Zadjali, DG of Research Programs and capacity building MoHERI for scoring the maximum number of Scopus publications in the staff category and also received the maximum number of SCOPUS publications along with students during the CoE Research Day on 28th April 2025. The team received a certificate of appreciation and memento.
20. Dr. Geetha Devi has been appointed as Program Committee Chair in "IV International Conference on Improving Energy Efficiency, Environmental Safety and Sustainable Development in Agriculture (EESTE2024) held from 28 to 30 October 2024.

21. Dr. Geetha Devi (Associate Professor -MIE Department), has received a Certificate of Appreciation from MEDRC on 17th December 2024 for the excellent contribution as the Jury of the Omani Yung Water Researchers award 2024.

22. Dr. Geetha Devi & student research team won Devi won second Grand prize among all engineering disciplines in the 15th Engineering gathering at SQU in March 2025.
23. Dr. Geetha Devi has received certificate of merit from Middle East Desalination research Center (MEDRC) for supervising the 2nd prize winner of the research paper presented in Omani Young water Researchers Award 2024 in the undergraduate category on 17th November 2024.

24. Best Paper Award: Dr. Geetha Devi has received Best paper award in the First International Conference on Civil, Environmental and Applied Sciences (ICCEAS 2025) organized by Humanities, Gandhi Institute for Education and Technology, Baniatangi, India during 18 - 19 July, 2025.
25. Dr. Suresh Manic from CoE was selected as the best international author paper award at the ICMLDE 2024 conference for his pioneering research titled (Autimated Trss climber robot MANIC tree trekker for date palm harvesting).
26. Under the supervision of Dr. Prashanth Gouda, students research team consists of Amna Al-Farsi, Mithaa Al-Ghafri, Yaqeen Al-Torshi, and Mariya Al-Zakwani have achieved 2nd place in the Best Poster Award at the 4th Undergraduate Research Competition at Dhofar University. Their research, titled "Intersectionality and Breastfeeding: A Novel Approach to Support Exclusive Breastfeeding among Employed Omani Women".
27. On July 8, 2025, the Department of Logistics and Transport Management (LTM) proudly hosted its 13th Research Colloquium, spotlighting global maritime developments. The keynote speaker, Professor Ching-Chiao Yang from the National Kaohsiung University of Science and Technology (NKUST), Taiwan, led an insightful session attended by faculty and students alike.
28. Dr. Shabib Al Rashdi from CoE and his team has achieved notable national and international recognition in the field of research innovation as follows:
    a. Multiple Awards – Youth Initiative Honored by H.H. Sayyid Theyazin bin Haitham Al Said 26th Oct 2024 National Recognition for contributions to youth-led innovation.
    b. Top 13 – Research Excellence 11th Annual Researchers' Forum, MoHERI 2024 National Selected among top innovative research projects.
    c. Semi-Finalist – Stars of Science Global Qatar Foundation, Doha 2024 International Recognized for innovative environmental research solutions.
    d. Winner – South Al Sharqiyah Hackathon Oman LNG & Office of the Governor 2025 Regional / National Awarded for sustainable waste-to-energy innovation.
    e. Best Research Project Oman Investment Authority & Council of Ministers – Idea Makers Competition 2025 National Project selected as top national innovation.
    f. Special Honor H.H. Sayyid Theyazin bin Haitham Al Said – Idea Makers Feb 2025 National Distinguished recognition for innovation leadership.
    g. 3rd Place in We Are Oman Competition held in 2025, Recognition for impactful national project.
    h. 2nd Place as a Climate Leader Award in the Oman Climate Week in 2025, Recognized for climate-focused biochar innovation.
    i. Awarded the Grand Prize for Best Project at the Oman Science Exhibition held during the 15th Engineering Gathering in celebration of SQU's Silver Jubilee on March 25, 2025—a national recognition for the top project among universities.
    j. First Place in the Climate Tech Category at the Qatar International Innovation Hackathon 2025 — awarded first prize in the international climate innovation track.
    k. Selected to Represent Oman London International Youth Science Forum (LIYSF), UK 1st Aug 2025 International Selected as Oman's representative at LIYSF 2025.
    l. First Place – Engineering Category Dhofar University Research Competition 2025 National Top prize for engineering research project.

m. Global Recognition – Top 13 Projects at LIYSF 2025, London, UK (August 2025). Out of 100 global participants, two student projects from NU supervised by Dr. Shabib Al Rashdi were selected among the Top 13 worldwide.
    i. Hala Al-Zaabi: Treatment of landfill leachate using date-pit tannins & advanced oxidation.
    ii. Al-Muntasir Al-Maamari: Green hydrogen production from mesquite & industrial waste using AI.
    iii. Supervisor: Dr. Shabib Al Rashdi. Demonstrates lab's global leadership in environmental innovation and support for Oman Vision 2040.

6- Publications and Citations

Over the years, the university has had great success with its research performance. In terms of funded research projects, high impact & high-quality publications, consultancy projects, international patents, and supporting start-ups and spin-offs from our students and staff, NU has had significant success to date. Further, our faculty profile covers a range of cutting-edge research capabilities in engineering, medicine, health sciences, pharmacy, logistics, and maritime, with more than 30% of active researchers in the university.

- More than 4500 research publications
- More than 1700 Scopus publications
- More than 12 signed MoUs for research collaborations
- More than 70 students are directly involved in the funded research projects
- 39 International Patents
- More than 115 national and international research awards

The Deanship of Graduate Studies & Research at NU values innovation and research and provides administrative support in creating the ideal academic environment for postgraduate students. The Deanship also monitors and supports research to increase the effectiveness and efficiency of the University's scholarly activities.

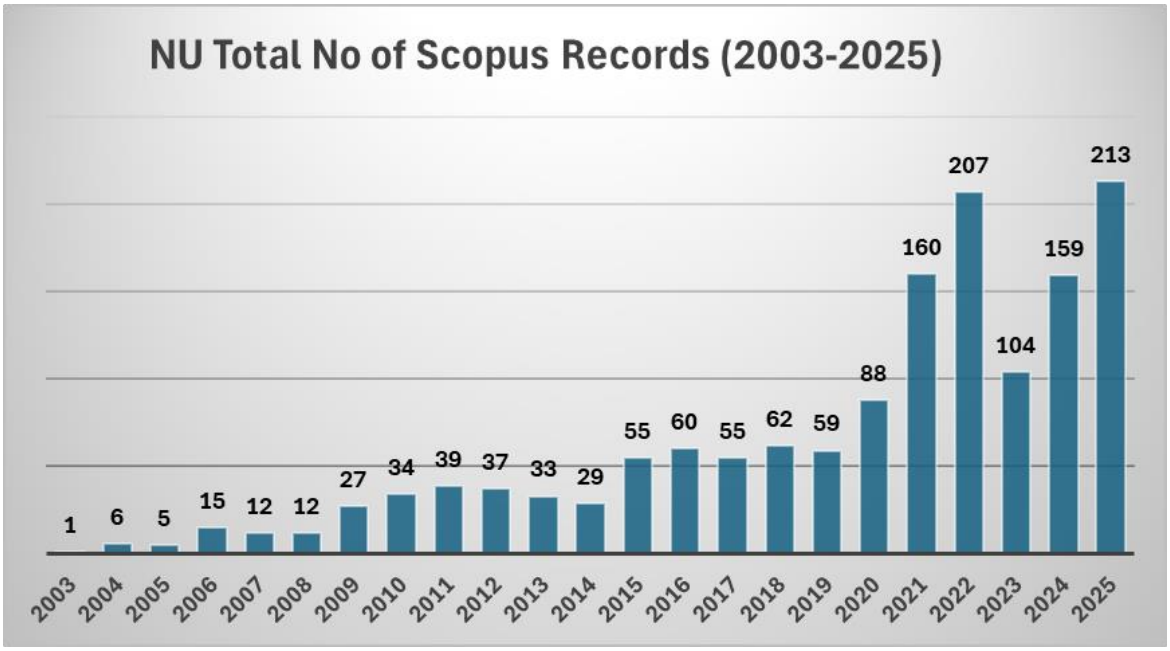

Figure. 5: Total number of Scopus publications (2003-2025)

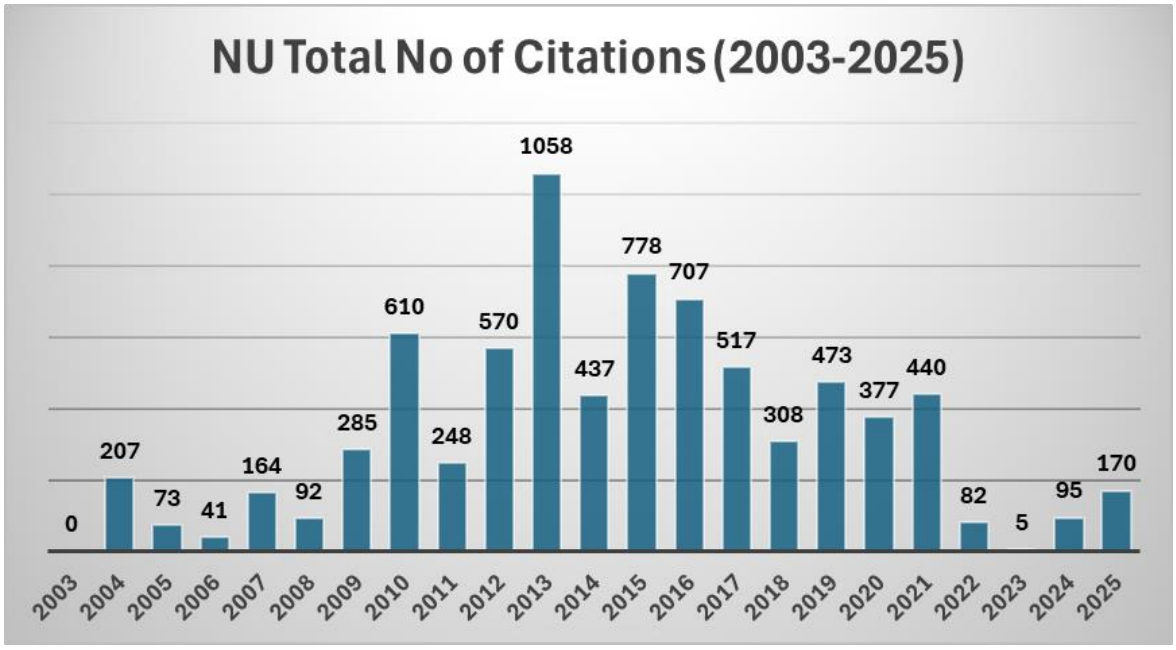

Figure. 6: Total number of Scopus Citations (2003-2025)

7- NU Research Collaboration and Links

1	University of Alba Iulia, Romania	32	Mansoura University, Egypt
2	Chiang Mai University, Thailand	33	Beni-Suef University, Egypt
3	Curtin University, Australia	34	Benha University, Egypt
4	Ghent University, Belgium	35	West Virginia University, USA
5	Applied Science Private University, Jordan	36	Pacific Northwest University of Health Sciences, USA
6	Aachen University, Germany	37	Glasgow Caledonian University, UK
7	National University of Singapore, Singapore	38	University of Cambridge, UK
8	University of Vaasa, Finland	39	Birmingham City University, UK
9	Ozyegin University, Turkey	40	University of Chakwal, Pakistan
10	Lille University Hospital, France	41	COMSATS University Islamabad, Pakistan
11	Esa Unggul University, Indonesia	42	Abdul Wali Khan University, Pakistan
12	University of Science and Technology of China, China	43	Khwaja Fareed University of Engineering and Information Technology, Pakistan
13	Chifeng University, China	44	Asia Metropolitan University, Malaysia
14	Central South University, China	45	INTI International University, Malaysia
15	Khartoum University, Khartoum, Sudan	46	University of Cyberjaya, Malaysia
16	Damascus university, Damascus, Syria	47	University Geomatika, Malaysia
17	Lebanese American University, Lebanon	48	University of Malaya, Malaysia
18	Ramaiah University of Applied Sciences, India	49	American University of the Middle East, Kuwait
19	PCET's Pimpri Chinchwad University, India	50	Kuwait University, Kuwait
20	Pondicherry University, India	51	United Arab Emirates University, UAE
21	Sandip University, India	52	Zayed University, UAE
22	Cochin University of Science and Technology, India	53	RAK Medical & Health Sciences University, UAE
23	Marwadi University, India	54	International University, UAE
24	Galgotias University, India	55	American University of Ras Al Khaimah, UAE
25	Amity University, India	56	King Saud University, Saudi Arabia
26	Oak University, Ahmedabad, India	57	Qassim University, Saudi Arabia
27	University of Technology and Applied Sciences, Oman	58	Imam Mohammad Ibn Saud Islamic University (IMSIU), Saudi Arabia
28	Sultan Qaboos University, Muscat, Oman	59	King Khalid University, Saudi Arabia
29	University of Nizwa, Oman	60	Princess Nourah bint Abdulrahman University, Saudi Arabia
30	Al-Bayan University, Iraq	61	Taif University, Saudi Arabia
31	Knowledge University, Iraq	62	Open University of Kenya, Kenya

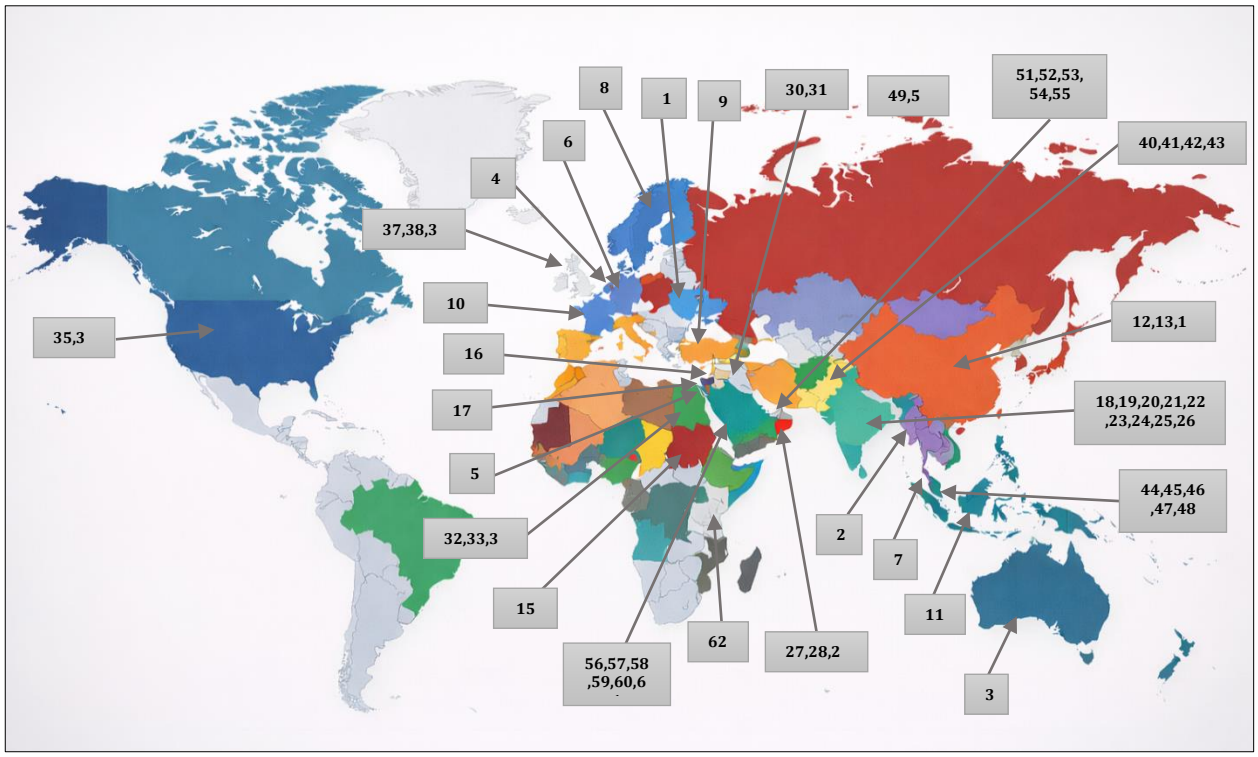

Figure.7: NU Research Collaboration Worldwide

الجامعة الوطنية
National University
Science & Technology للعلوم والتكنولوجيا

Abstracts
of
Journal Publications

2024/ 2025

TITLE OF JOURNAL PAPERS

College of Engineering

A comprehensive class of starlike functions involving Mittag-Leffler function

Kadhavoor R. Karthikeyan, Dharmaraj Mohankumar & Daniel Breaz

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2025− Applied Mathematics in Science and Engineering

https://doi.org/10.1080/27690911.2025.2487531

ABSTRACT

A new class of Bazilevič functions of the type κ+iμ is defined involving differential characterizations inspired by the study of multiplicative calculus. The defined function class unifies the studies of well-known subclasses like convex, starlike and alpha-convex functions. To further make our study more versatile, we have studied the new function class involving a differential operator defined using the Mittag-Leffler function. Estimates of Taylor–Maclaurin coefficients $a2$ and $a3$ of the functions which belong to the defined function class are obtained. Further, the Fekete–Szeg˝o inequality of this new class which was computationally cumbersome is part of our main results in this paper.

KEYWORDS: Multiplicative calculus, analytic function, univalent function, Schwarz function, Bazilevič functions, subordination, coefficient inequalities, Fekete–Szeg˝o inequality

A comprehensive study of performance metrices and potato dehydration at various slice thickness using an IoT-based indirect solar dryer: An experimental approach

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2025 – Solar Energy

https://doi.org/10.1016/j.solener.2025.113269

ABSTRACT

The utilization of solar energy for the drying of agricultural produce is a sustainable and cost-effective solution that addresses the increasing demand for energy-efficient food processing methods. In this study, an IoT-integrated indirect solar dryer is developed for dehydration of agricultural produce. Experimental tests were conducted on potato slices with thicknesses of 3 mm, 5 mm, and 7 mm. Each test was conducted from 9 am to 6 pm, under average ambient temperature of 32.25 ± 0.20 °C and average solar radiation of 565 ± 10 W/m^2. For the given drying period, thinner slices experienced higher moisture loss. For a 7 mm slice thickness, the moisture content of potato reduced to 13.6 % with an average drying rate of 0.54 kg/hr and drying efficiency of 31.71 %. On the other hand, thinner slices (3 mm) showed higher moisture loss up to 5.6 % moisture content with enhanced average drying rate of 0.67 kg/hr and average efficiency of 39.06 %. Furthermore, the mean specific energy consumption decreased by 11.5 % and 18.5 % respectively for 5 mm and 3 mm thick slice, compared to 7 mm. The drying curves of all tests were tested with different thin layer drying models. For all tests, the Modified Page model accurately predicted the moisture ratio of product with higher correlation coefficient (R^2 = 0.9970 to 0.9974), lower root mean squared error (RMSE = 0.0156 to 0.0167) and lower chi-square value ($\chi^2 = 7.97 \times 10^{-03}$ to 1.40×10^{-02}).

KEYWORDS: indirect solar dryer, Potato dryer, slice thickness, moisture ratio, drying rate, Mathematical modeling

A Delay Mathematical Model for Cholera Transmission: Stability, Chaos and Bifurcation

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2025 - Chaos, Solitons & Fractals

https://doi.org/10.1016/j.chaos.2025.116464

ABSTRACT

In this study, a mathematical model was developed and analyzed to describe the dynamics of cholera transmission in the presence of a time delay. The model incorporated both direct (human-to-human) and indirect (environmental) transmission pathways, with houseflies assumed to facilitate the transfer of Vibrio cholerae from contaminated to uncontaminated environments. The existence of disease-free and endemic equilibria was established, and stability conditions were examined. Analytical results demonstrated that, in the absence of time delay and under certain conditions, both equilibria remained stable. To account for the effects of time delay, the Lyapunov–Krasovskii approach was employed to establish global stability conditions. Numerical simulations were conducted to analyze the time-series behavior and the oscillatory dynamics induced by the time delay, also three-dimensional bifurcation and chaos patterns were presented. The occurrence of periodic cholera outbreaks was investigated, and a criterion for Hopf bifurcation was established by treating time delay as a bifurcation parameter. Finally, Hopf bifurcation analysis was conducted to identify the critical conditions under which the system transitions from a stable state to sustained oscillations, providing insights into the long-term dynamics of cholera epidemics.

KEYWORDS: Cholera, Time delay, Stability, Chaos, Bifurcation.

A Family Of Holomorphic Functions Associated With Mutually Adjoint Functions

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2024 – Journal of Applied Mathematics and Informatics

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ABSTRACT

Abstract. In this paper, making use of symmetric differential operator, we introduce a new class of ℓ-symmetric - mutually adjoint functions. To make this study more comprehensive and versatile, we have used a differential operator involving three-parameter extension of the well-known Mittag-Leffler functions. Mainly we investigated the inclusion relation and subordination conditions which are the main results of the paper. To establish connections or relations with earlier studies, we have presented applications of main results as corollaries. AMS Mathematics Subject Classification : 30C45

KEYWORDS: Analytic function, convex function, starlike function, Mutually-adjoint function, symmetric functions, Mittag-Leffler function, differential subordination.

A high sensitivity terahertz biosensor with hybrid metasurfaces for tuberculosis detection leveraging the integration of machine learning and multi-material resonators

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ABSTRACT

This study presents a terahertz-based biosensor for tuberculosis detection, incorporating a unique metasurfaces configuration. The sensor's architecture features multiple resonating elements: a silver-based circular ring resonator, a black phosphorus square ring structure, a graphene platform, and symmetrically positioned gold rectangular resonators. Finite element method analysis through COMSOL Multiphysics was employed for modelling and optimization. The sensor demonstrates an exceptional sensitivity of 1000 GHzRIU−1 and a detection limit of 0.310 RIU. In addition, the designed sensor maintains a high-quality factor of 8.176 and exhibits stable performance across its operational frequency range (0.1–1.4 THz). Moreover, the performance analysis under varying conditions showed consistent transmission patterns and frequency-dependent characteristics, with the graphene chemical potential that could be significantly influencing the sensor's response. Furthermore, the integration of polynomial regression-based machine learning optimization yielded remarkably accurate predictions ($R2 > 0.97$) across various operational parameters. Therefore, the investigated numerical findings and machine learning optimization prove that this sensor represents a significant advancement in tuberculosis detection technology, offering improved sensitivity and reliability compared to conventional methods, whilst maintaining fabrication feasibility through standard cleanroom processes.

KEYWORDS: Bionanoelectronics, Biosensors, Metamaterials, Nanosensors, Sensors and biosensors, Terahertz Optics

A high-sensitivity terahertz metasurface biosensor with graphene-MXene-black phosphorus integration for early pregnancy detection

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2025 – Chemistry Europe

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ABSTRACT

In this study,a biosensor for early pregnancy detection was developed, integrating a ternary nanomaterial composite of graphene, MXene, and black phosphorus. The device architecture comprises a dual circular ring resonator configuration with copper and MXene functionalization, deposited on a graphene-modified square substrate with silicon dioxide base. Computational simulations via COMSOL Multiphysics demonstrated exceptional sensing metrics, including sensitivity of 2000 GHzRIU⁻1, figure of merit of 18.868 RIU⁻1, and detection limit of 0.095 at the optimal resonant frequency of 0.813 THz. Performance optimization was conducted through parametric analysis of graphene's chemical potential and electromagnetic wave incident angles. Additionally, implementation of polynomial regression algorithms yielded predictive modelling with accuracy rates approaching 100%, significantly reducing computational complexity and resource utilization. The biosensor demonstrates robust analytical performance in detecting pregnancy-associated refractive index variations, establishing a promising platform for rapid, non-invasive gestational diagnostics.

KEYWORDS: Terahertz biosensor, Pregnancy detection, Metasurface, Graphene, Refractive index sensing

A new model to correlate solubility of drug compounds in supercritical carbon dioxide, Chemical Thermodynamics and Thermal Analysis

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2025 – Chemical Thermodynamics and Thermal Analysis,

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ABSTRACT

A new solubility model based on enhancement factor concept is proposed to correlate solubility of drug compounds in supercritical carbon dioxide ($SCCO_2$). The correlating ability of the new model is compared with existing solubility model. The proposed model and existing models were tested with twenty nine drug-supercritical carbon dioxide systems reported in the literature. The proposed model correlating performance is indicated in terms of absolute relative deviation percentage. Additionally, Akaike's Information Criterion (AIC) was used to assess the model's performance compared with existing solubility model. The results show the compared to existing solubility model, the proposed model accurately correlates the solubility. The global absolute average relative deviation percentage for the existing model and proposed new model are 22.17 % and 16.11 % respectively.

KEYWORDS: Akaike's information criterion Enhancement factor Solubility Supercritical carbon dioxide

A trimodal 2D metasurface biosensor with Bayesian regression for ultra-sensitive cancer biomarker detection

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ABSTRACT

In this study, we present the design, simulation, and characterization of a biosensor architecture leveraging a trimodal integration of MXene, black phosphorus, and graphene for the enhanced detection of neoplastic biomarkers. The sensor configuration consists of MXene-functionalized rectangular resonators coupled with black phosphorus-augmented circular ring structures, all integrated atop a graphene-modified substrate. The entire device was simulated on a silicon dioxide platform using standard photolithographic techniques. Electromagnetic performance, evaluated through finite element method (FEM) simulations (COMSOL Multiphysics), demonstrates outstanding sensing capabilities, with the sensor achieving an exceptional sensitivity of 2000 GHzRIU−1 within the clinically relevant refractive index range of 1.36–1.401.A series of parametric studies were conducted to investigate the effects of key factors, including graphene chemical potential (GCP), incident electromagnetic wave angle, rectangular resonator dimensions, and circular ring radius on the transmission spectra. The sensor exhibits a strong linear relationship between resonance frequency shift and refractive index variation (R2 = 98.918%). Moreover, Bayesian regression modelling applied to variations in GCP and incident angle yielded high predictive accuracy, with coefficients of determination of approximately 90% and 91%, respectively.

KEYWORDS: MXene, Black phosphorus, Surface plasmon resonance, Bayesian regression, Liquid biopsy, 2D materia

Advanced brain tumour detection using a hybrid 2D material metasurface sensor with machine learning-enhanced performance

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2025 – materials technology journal

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ABSTRACT

This study reports a metasurface sensor architecture for brain tumour detection, leveraging the synergistic integration of multiple two-dimensional materials. In this regard, the numerical simulations have been investigated based on the finite element method via COMSOL Multiphysics. The proposed design demonstrates an exceptional sensitivity of 1538 GHz/RIU within the 0.1–0.3 THz spectral window, exhibiting robust response across refractive indices ranging from 1.3333 to 1.4833 RIU. Additionally, further enhancement was achieved through machine learning-driven optimisation utilising one-dimensional convolutional neural networks, attaining an ideal coefficient of determination (R2 = 1.0) for critical parameters including graphene chemical potential, incident angle and resonator dimensions.

KEYWORDS: 2D materials, metasur face sensors, machine learning, Germanene, Terahertz sensing

Advanced terahertz-range dopamine detection using a 2D material-based metasurface biosensor

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2025 – OPTICA Publishing Group

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ABSTRACT

This study presents an innovative terahertz-range dopamine detection sensor utilizing a metasurface architecture incorporating graphene, borophene, and phosphorene. The sensor design features a 2 μm square resonator coated with phosphorene, surrounded by four 1 μm borophene-coated circular resonators on a 16μm×16μm graphene platform. The numerical findings in the present study are essentially investigated based on the fundamentals of the finite element method through COMSOL Multiphysics software. The sensor demonstrates consistent operation across two frequency bands (0.1-0.3 THz and 1.2-1.6 THz), with tuning ranges of 16 and 70 GHz, respectively. Meanwhile, the performance analysis reveals an exceptional sensitivity of 500 GHz/RIU, with a figure of merit of 8.333 and a detection limit of 0.223. Additionally, we have conducted a machine learning optimization using polynomial regression, achieving R2 values exceeding 0.92, to validate the design's reliability. Therefore, we believe that the proposed sensor offers a practical solution for dopamine detection, combining high sensitivity with fabrication feasibility for potential commercial applications.

KEYWORDS:

Advanced THz metasurface biosensor for label-free amino acid detection optimized with stacking ensemble algorithm

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ABSTRACT

This paper presents an advanced terahertz metasurface biosensor platform for real-time, label-free detection of amino acids. The biosensor incorporates F-shaped resonator design utilizing a hybrid material composition of graphene, gold, and silver on a silicon dioxide substrate. Computational modelling via COMSOL Multiphysics demonstrates exceptional sensitivity metrics of up to 1000 GHz/RIU and a figure of merit (FOM) of 33.333 RIU−1 within the 0.1THz–0.6 THz frequency range. Systematic parametric optimization, including variations in graphene chemical potential (0.1eV–0.9 eV), incident angle (0°–80°), and resonator dimensions, ensures robust detection performance across diverse operational conditions. The biosensing capabilities are further enhanced through implementation of a stacking ensemble machine learning model, which achieves optimal prediction accuracy with an R2 score of 100 % across multiple parameters. The proposed biosensor operates on physical transduction principles, detecting amino acids through resonance frequency shifts corresponding to local refractive index variations, eliminating the need for biochemical tags, enzymes, or antibody-based recognition elements. With its exceptional sensitivity, tunable design parameters, and compatibility with scalable fabrication techniques, the proposed biosensor design represents a significant advancement with potential applications spanning biomedical diagnostics, environmental monitoring, and food safety assessment. The integration of advanced machine learning frameworks further positions this technology as a promising platform for next-generation biomolecular sensing.

KEYWORDS:

AI-augmented terahertz biosensor with MXene–graphene architecture for sensitive sperm concentration detection

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ABSTRACT

This study presents surface plasmon resonance (SPR) biosensor operating in the terahertz (THz) regime for sensitive detection of sperm cells. The sensor demonstrates exceptional performance metrics with a maximum sensitivity of 5000 GHz/RIU and figure of merit reaching 67.568 $RIU^{-}1$. Comprehensive COMSOL Multiphysics simulations reveal that the sensor exhibits tunable electromagnetic response through modulation of graphene chemical potential, with transmittance values ranging from 97.841% to 56.810% across varying GCP levels. The device shows moderate angular tolerance and demonstrates a resonance frequency shift of 50 GHz (from 0.800 THz to 0.775 THz) upon analyte detection. Electric field distribution analysis confirms strong electromagnetic field localization at the resonance frequency of 0.785 THz, indicating optimal energy confinement for enhanced sensing performance. The proposed sensor outperforms several existing designs in terms of sensitivity while offering label-free, real-time detection capabilities specifically optimized for reproductive health diagnostics. Machine learning optimization techniques were employed to predict and enhance the sensor's behavioral characteristics, making it a promising candidate for advanced biomedical sensing applications.

KEYWORDS: Reproductive health, COMSOL simulation, Machine learning optimization, Plasmonic enhancement, THz spectroscopy

AI-driven non-invasive glucose sensing using a graphene–metal hybrid terahertz metasurface SPR biosensor

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ABSTRACT

The development of non-invasive, continuous glucose monitoring systems remains a critical challenge in diabetes management, affecting millions of people worldwide. This paper presents a biosensor utilizing a hybrid metasurface architecture enhanced with multiple two-dimensional (2D) materials for high-sensitivity glucose detection. The proposed sensor design features an arrangement of resonators coated with graphene, borophene, molybdenum disulfide and germanene, mounted on a silicon dioxide substrate. Through numerical simulations using COMSOL Multiphysics, we demonstrate exceptional sensing performance with a sensitivity of 1000 GHz/RIU, a quality factor of 9.859, and a figure of merit (FOM) of 15.625 RIU. The sensor exhibits excellent tunability through graphene chemical potential modulation, with transmittance varying from 97.917% to 52.699% across the investigated range. Angular dependency analysis reveals robust performance with transmittance decreasing from 52.699% to 16.314% as the incidence angle increases from 0° to 80°. Frequency range analysis shows optimal performance at 0.631 THz with a detection range spanning from 0.626 to 0.631 THz. Machine learning validation using Random Forest methodology achieves 90% R2 accuracy for angle predictions and 100% accuracy for polynomial complexity analysis. These results establish the sensor's potential for practical implementation in next-generation diabetes management systems.

KEYWORDS: Terahertz biosensor, 2D materials, Metasurface, Glucose detection, Graphene, Borophene

An Initial-Boundary Problem for a Mixed Fractional Wave Equation

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ABSTRACT

We aim to prove a unique solvability of an initial-boundary value problem (IBVP) for a time-fractional wave equation in a rectangular domain. We exploit the spectral expansion method as the main tool and used the solution to Cauchy problems for fractional-order differential equations. Moreover, we apply certain properties of the Mittag-Leffler-type functions of single and two variables to prove the uniform convergence of the solution to the considered problem, represented in the form of infinite series.

KEYWORDS: Wave equation, Fractional Differential Equations, Mittag-Leffler type functions, Cauchy problem, mixed type equation

Analysis of the Factors Affecting Women's Security in Urban Parks: Case Study of Shiraz Azadi Park

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ABSTRACT

Women, as half of the urban population, have more specific sensitivities than men about perceptions of crime areas. Therefore, by examining their perspectives on identifying crime potentials at the level of urban spaces, it is possible to achieve the characteristics of a safe urban space from the perspective of the totality of an urban society. Accordingly, addressing the issue of what characteristics of urban open spaces from the perspective of women make them safe or prone to crime, is the main purpose of this study. Also, among the various urban spaces, parks are of special importance as a public place for the daily presence of women, and this factor led to the selection of Shiraz Freedom Park as a case study. The research strategy in this study includes a combination of quantitative and qualitative methods and information was collected through questionnaires, interviews, observation and mental imaging. The results showed that the set of factors affecting the feeling of insecurity in women in urban parks can be classified under four physical, functional, social and perceptual-visual indicators. In these cases, following factors are very important in creating a safe space in urban parks from the perspective of women: vegetation density, the presence of sub-spaces and outcrops, territorial segregation, the presence of signs and symbols, the circadian nature of land uses, proper location of entrances and exits, the possibility of proper navigation in space, artificial care, reputation or a notoriety) a space, gender dominance in parts of the park, visual communication with different parts of the park, proper lighting at night and the brightness and clarity of the space.

KEYWORDS: Women Crime Security Space Features Freedom Park

Analysis of the Inherent Frequencies to Mitigate the Liquid Sloshing in an Overhead Double Baffle Damper

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ABSTRACT

A disco-rectangular volume-fraction-of-fluid (VOF) model tank of a prismatic size is considered here for investigating the severe effect of overhead baffles made of three different materials, nylon, polyamide, and polylactic acid. In this work, the overdamped, undamped, and nominal damped motion of baffles and their effect are studied. In this research, the behaviour of different material baffles based on the sloshing effect and natural frequency of each baffle excited in damped, undamped, and overdamped cases is studied. VOF modelling is carried out in moving Yeoh model mesh with fluid–structure interaction between the water models for various baffle plates. The results of the water volume distribution and baffle displacement operating between a sloshing time of 0 and 1 s are recorded. Also, a strong investigation is carried out for the water volume suspended on overhead baffles by three different material selections.

KEYWORDS: VOF—volume-fraction-of-fluid model; disco-rectangular tank; Yeoh model; ALE formulation; natural frequency of baffle

Application of artificial intelligence in prediction of mechanical properties of sustainable plastic pavement blocks and validation through experimental analysis

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2025 - Discover Concrete and Cement, (Springer

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ABSTRACT

The present study aims to develop a mathematical model based on previous research work for the prediction of the compressive strength of plastic pavement blocks. The present study consists of the development of a mathematical model using Machine Learning (ML) and experimental validation. The background of the present study provides a brief overview of the existing research, along with the data collected and utilized for developing the ML model. The literature review indicated a lack of prior research on the use of machine learning models to predict the physical and mechanical properties of paving blocks incorporating LDPE and HDPE. The novelty of this study lies in utilizing machine learning to predict the properties of paving blocks made with recycled HDPE pellets obtained from Plasbin, a recycling facility based in Oman. According to the developed model, the mix proportions of plastic and fine aggregate is 1:3 corresponding to the required compressive strength of 20 MPa since C20 grade concrete is commonly used for the pavement construction. For the experimental study, plastic paving blocks are prepared using melted high/ low-density polyethylene and fine aggregate. The experimental study involved measuring the internal temperature, thermal conductivity, and compressive strength of LDPE and HDPE paving blocks. The results show that both materials have similar internal temperature characteristics. A comparison of the thermal conductivity of LDPE and HDPE paving blocks reveals that LDPE has 29.41% higher thermal conductivity than HDPE. However, the comparison of average compressive strengths between HDPE and LDPE pavement blocks indicates that the compressive strength of the HDPE block is 33.05% greater than that of the LDPE block. The Gaussian Process Regression (GPR) model with a Matern 5/2 kernel and constant basis function achieved the best performance, with the lowest RMSE, MSE, and MAE, though 1393 s for training. The percentage difference between the expected compressive strength predicted by the ML model and the experimental results ranges from 13 to 16%, indicating that the developed ML model performs effectively. One limitation of the present study is the release of harmful or toxic gases during the plastic melting process. For future research, the use of acetone is recommended as a potential solvent for melting plastics, as it may help reduce the emission of these gases.

KEYWORDS: LDPE, HDPE, Paving block, ML model, Plastic waste, Compressive strength, Water absorption

Application of the fourth-order differential subordination and superordination results for analytic functions associated with an operator

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2025 - International Journal of Analysis and Applications

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ABSTRACT

This study focuses on differential subordination using arithmetic and geometric approaches when the dominant function is linear. In addition to the results of differential subordination of arithmetic and geometric means in which a convex function was dominant, one can study such differential subordination for a selected convex function. We investigate several results of the differential subordinations of analytic functions are associated with an operator built using arithmetic and geometric means.

KEYWORDS: biopesticide, custard apple seeds, gas chromatography, hexane, soxhlet extraction

Applications Of Mittag-Leffler Functions On A Subclass Of Meromorphic Functions Influenced By The Definition Of A Non-Newtonian Derivative

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2024 - Fractal and Fractional

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ABSTRACT

In this paper, we defined a new family of meromorphic functions whose analytic characterization was motivated by the definition of the multiplicative derivative. Replacing the ordinary derivative with a multiplicative derivative in the subclass of starlike meromorphic functions made the class redundant; thus, major deviation or adaptation was required in defining a class of meromorphic functions influenced by the multiplicative derivative. In addition, we redefined the subclass of meromorphic functions analogous to the class of the functions with respect to symmetric points. Initial coefficient estimates and Fekete–Szegö inequalities were obtained for the defined function classes. Some examples along with graphs have been used to establish the inclusion and closure properties.

KEYWORDS: multiplicative calculus; Mittag–Leffler functions; analytic function; univalent function; Schwarz function; starlike and convex functions; subordination; coefficient inequalities; Fekete–Szegö inequality

Artificial intelligence-enhanced terahertz metasurface biosensor for breast cancer biomarker detection

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ABSTRACT

This study reports a biosensor engineered for the label-free detection of breast cancer biomarkers, leveraging surface plasmon polaritons in a metal–insulator–metal configuration. The sensor architecture integrates gold-coated rectangular resonators and silver-coated square resonators atop a graphene-functionalized circular base further enhanced by a surrounding array of MXene-coated hemispherical ring resonators on a SiO_2 substrate. Finite element simulations using COMSOL Multiphysics demonstrates a resonant frequency window between 0.738 and 0.742 THz, delivering a sensitivity of 500 GHzRIU−1a figure of merit (FOM) of 5.208 $RIU^{-}1$, a quality factor (Q) of 7.729, and a detection limit of 0.401 RIU. The sensor exhibits a strong linear dependence of resonance frequency on refractive index (R2 = 0.988), and design optimization guided by machine learning—specifically polynomial regression—achieves predictive accuracies approaching 100%. These findings position the proposed device among the most sensitive THz biosensors and underscore its promise for non-invasive, real-time breast cancer diagnostics.

KEYWORDS: Terahertz metasurface sensor, Breast cancer detection, Surface plasmon polaritons, Metal–insulator-metal waveguide, Graphene-MXene hybrid structure

Assessing the Impact of Architectural Quality on Enhancing Quality of Life in Residential Complexes, with Consideration to Residents' Health Status (A Case Study of Shiraz's Residential Complexes)

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2025 - Journal of Posthumanism

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ABSTRACT

The rapid growth of urbanization has caused designers and architects to neglect the quality of residential complexes, and the residents of these complexes have faced many problems, including decreased quality of life (QOL) and even threatened health status. This paper aims to evaluate architectural quality, QOL, and health quality as independent, dependent, and mediating variables, respectively, as well as the relationship between them. Health quality evaluated with three indices, including physical, mental, and social health; architectural quality considered while embodying three criteria, including environmental, structural, and functional quality; and, finally, QOL defined as a constant multilateral concept. In the analysis of data, both quantitative and qualitative techniques are used. Surveys, interviews, and field observations were used to collect data. The researcher-made questionnaire was used to collect data on architectural and health quality, while the standard questionnaire was used to collect data on quality of life. Participants were residents in ASATID, DERAK, and CHOWGAN residential complexes (Shiraz, Iran), all with the same social contexts and geographical locations but different environmental and architectural indices. The results confirmed that enhancing architectural quality can dramatically improve residents' QOL, mainly through promoting their health status. In other words, environmental, structural, and functional quality promotes physical, mental, and social health, respectively; and all of them improves QOL in residential complexes.

KEYWORDS: Architectural Quality, Quality of Life, Health Dimensions, Residential Complexes, Shiraz

Automated Workflow for Processing and Classifying Dental Radiographs: A Hands-On Approach

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ABSTRACT

Background Classifying large dental radiographic datasets enables efficient data management and retrieval, facilitating quick access to specific types of radiographs for clinical or research purposes. It also supports advanced analytics, research, and the development of Artificial Intelligence (AI) tools. This study aimed to develop an automated workflow to improve the efficiency of dental radiograph classification. The workflow covers the entire process, from retrieving Digital Imaging and Communication in Medicine (DICOM) files to converting them into Joint Photographic Experts Group (JPEG) format and classifying them using Convolutional Neural Networks (CNNs) on a large dataset. Materials and methods This cross-sectional machine learning study was conducted using 48,329 dental radiographs to develop an automated classification workflow using CNNs. The workflow involved retrieving 48,329 DICOM files, standardizing them to a uniform size, and converting them to JPEG using the Pydicom library. Image preprocessing, including normalization, prepared the images for machine learning analysis. Various models, such as ResNet-50, AlexNet, and custom CNN models, were trained, validated, and tested on distinct datasets. Results These models were then deployed to classify a dataset of 48329 images. AlexNet demonstrated the highest performance, with a 95.98% detection rate and no errors, while ResNet-50 achieved 92.3% accuracy with 194 errors, and the custom CNN model showed a 77.25% detection rate with 1,623 errors. Conclusion The study established an effective automated workflow for dental radiograph classification, demonstrating that CNN models significantly improve classification accuracy and efficiency.

KEYWORDS: computer-assisted; convolutional neural networks; machine learning; radiographic image interpretation; radiography dental.

Bi-univalent functions subordinated to a three leaf function induced by multiplicative calculus

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ABSTRACT

Our aim was to develop a new class of bi starlike functions by utilizing the concept of subordination, driven by the idea of multiplicative calculus, specifically multiplicative derivatives. Several restrictions were imposed, which were indeed strict constraints, because we have tried to work within the current framework or the design of analytic functions. To make the study more versatile, we redefined our new class of function with Miller-Ross Poisson distribution (MRPD), in order to increase the study's adaptability. We derived the first coefficient estimates and Fekete-Szegő inequalities for functions in this new class. To demonstrate the characteristics, we have provided a few examples.

KEYWORDS: analytic function, bi-univalent function, convolution, Miller-Ross function, multiplicative calculus, subordination, Poisson distribution

Bond and Flexural Behaviour of Locally Available Spent Catalyst-based Normal and High Strength Concrete, Civil Engineering and Architecture

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ABSTRACT

Environmental regulators put pressure on refineries to handle wasted catalyst in a safe manner. Spent catalyst, which is produced when petroleum is split to reduce its sulphur level and enhance its burning properties, is one of the petroleum refineries in Oman's industrial byproducts. Spent catalysts include cementitious material, which can be utilised in place of cement to some extent. The relationship between steel bond strength and the flexural behaviour of regular (C30) and high-strength (C60) spent catalyst-based concrete is the main topic of this study. Concrete cubes of the C30 and C60 grades, each measuring 150 mm × 150 mm × 150 mm, were made for optimisation after different amounts of leftover catalyst were added to the concrete, such as 3%, 6%, 9%, and 12% by weight of cement. Twenty-four cubes were cast for the bond research and forty-eight cubes for the compressive strength test as part of the optimisation procedure. For a bond study with a helical spring H8 diameter to avoid local shear an embedded vertical bar H12 at a length of 500 mm was inserted while casting of the cubes. Finally, for flexural strength test prism was cast of size 500 ×100 × 100 mm - 12 nos. for 0% and 9% for C30 and C60 grade concrete. The test was run on regular concrete more precisely, on leftover catalyzed-based concrete cubes after the concrete had been cured for 28 days. For the bond investigation, a 1000 kN capacity Universal Testing Machine (UTM) was used to perform a pull-out test. The optimum dosage of spent catalyst-based concrete cubes replacing cement is 9% under the compressive strength test. The bond study using a pull-out test of 9% replacement of concrete by spent catalyst gives better performance compared to other dosages of spent catalyst (3%, 6%, & 12%). It concludes that a 9% replacement of cement using spent catalyst gives an 11% increase in terms of pull-out strength with respect to conventional concrete.

KEYWORDS: Spent Catalysts, Bond Strength, C30 Grade Concrete, C60 Grade Concrete, Pull-out Test

Certain Results on Analytic Functions Associated with Respect to Symmetric Point

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ABSTRACT

The purpose of this paper is to introduce and study a new subclass of analytic functions with respect to symmetric points associated to a conic region impacted by Janowski functions. Also, the study has been extended to quantum calculus by replacing the ordinary derivative with a q - derivative in the defined function class. Interesting results such as initial coefficients of inverse functions and Fekete-Szegö inequalities are obtained for the defined function classes. Several applications, known or new of the main results are also presented.

KEYWORDS: analytic functions, Bazilevič functions, starlike and convex functions, subordination, Fekete-Szegö problem, coefficient inequalities, q-calculus, Jackson's q-derivative operator

Characterization of oilfield wastewater and treatment feasibility using membrane biofilm reactor technology

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ABSTRACT

The water crisis increased over the last decades. Many researchers work in treating domestic wastewater through several technologies. Biological treatment by fabrication of biological cells shows great results in treating domestic wastewater. Microbial fuel cells or bio-electrochemical systems are newly developedtechnologies with high efficiency, low cost, and environmental sustainability. Current research has novelty in terms of treating the wastewater produced in the oilfield. A simple design had been fabricated to observe the possibility of biological growth on the outer surface of the membrane. The membrane biofilm reactor (MBfR) is composed of a hollow fiber membrane, feed tank, air compressor, and feed pump. Three samples of produced wastewater that were fed into membrane flow cells were examined at varying flow rates and retention times while at room temperature. To measure the thickness of bacterial adhesion to the membrane, scanning electron microscopy (SEM) is performed. By means of spectrophotometry, the Multiparameter Bench Photometer for Laboratories isused to measure the levels of COD, TP, TN, and oil content in the water. It is advised to use the produced oilfield wastewater in microbial fuel cells for treating wastewater and generating energy as a result of the observation of biological growth on the external surfaceof membranes with various thicknesses.

KEYWORDS: hollow fiber membrane, MABR, produced oilfield & water technology

Coefficient Bounds For Certain Subclasses Of Quasi-Convex Functions Associated With Carlson-Shaffer Operator

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ABSTRACT

Let Y denote the class of functions χ(ξ) of the form χ(ξ)=ξ+∑_(n=2)^∞▒a_n ξ^n which are analytic in the open unit disc Δ=\{ ξ∈C: |ξ|<1 }. In recent times investigating the properties of several existing and new subclasses of quasi-convex functions have gained importance and attracted researchers working in the theory of univalent functions. Using the Carlson-Shaffer operator, we introduce new subclasses of quasi-convex functions. The coefficient bounds for functions belonging to the defined function classes are our main results. Further, we establish various well-known results as corollaries to our main results.

KEYWORDS: Analytic function, quasi-convex, close to convex, close to star, Janowski function, coefficient estimates, Carlson-Shaffer operator,

Condition monitoring of CNC drill bit for the manufacturing sector using wavelet analysis and artificial neural network based on feedforward multilayer perceptron (MLP)

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ABSTRACT

Real-time condition monitoring and precision health assessment systems are necessary for effective maintenance programs in the industrial sector. Rapid advancements in information technology and other engineering technologies have invited more proactive attention from research and development in industrial sectors, particularly in condition monitoring of machines and related Industrial processes. In this work, drill bit condition monitoring techniques have been developed based on wavelet analysis and Artificial Neural Networks (ANN) for automatic drill bit fault detection and classification. An experimental work has been conducted to capture the vibration signals for analysis. The CNC drill machine uses a high-carbon steel drill bit and mild steel material as work pieces in this experiment. The cutting condition parameters are kept constant, and the wear level varies from 0.2 to 0.6 mm. Using an accelerometer, the Data Acquisition system (DAQ) with Lab VIEW software captures the vibration signals for drill bits with different wear conditions. The captured vibration data are analyzed using Continuous Wavelet Transform (CWT) with Morlet and Daubechies wavelet as prime functions. The CWT coefficient is generally used to generate the input features to ANN for automatic tool condition classification, with two outputs (0, 1) for healthy and (1, 0) for faulty. The outcome of ANN showed 98% accuracy in the wear prediction, and these results show the effectiveness of the combed WT and ANN for the automatic classification of tool wear conditions with a high success rate.

KEYWORDS: Artificial Neural Network, Condition monitoring, Lab VIEW software, Wavelets transform analysis

Data-Driven Civil Engineering: Applications of Artificial Intelligence, Machine Learning, and Deep Learning

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ABSTRACT

Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) are a great advantage that is coming to civil engineering in ways that detail accuracy can be enhanced, many tasks automated, and predictive modeling improved. Across some of the significant subdomains, these technologies allow for eminent progress in structural health monitoring, geotechnical engineering, hydraulic systems, construction management. Currently, AI-powered models such as Artificial Neural Networks (ANNs), fuzzy logic, and evolution-based algorithms allow engineers to predict failure, optimize design, and better resource management of infrastructures. Yet, despite the potential, the adoption of AI, ML, and DL into civil engineering faces a host of challenges including data availability, computational complexity, model interpretability, integration with traditional systems, etc. High-quality, real-time data collection remains expensive and the resource-intensive nature of DL models limits their application to a large scale. In addition, the "black-box" nature of these models raises ethical and regulatory issues especially in decisions related to safety. Against this backdrop, this paper reviews current and potential applications of AI, ML, and DL in civil engineering within the framework of benefits and limitations of AI, ML, and DL, focusing on comparisons. Besides that, the paper outlines future directions regarding cloud computing, explainable AI, and regulatory frameworks. With all these changes within the scope of the discipline, AI-driven technologies will be major in safe, efficient, and sustainable infrastructure systems, provided that success is specifically dependent on addressing these key challenges.

KEYWORDS: Skin cancer, Dermoscopy, Augmentation, Deep learning, Optimization, Fusion

Dehydration of Onion Slices for Food Processing Application Using Internet of Things-Based Smart Solar Drying System

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ABSTRACT

Indian onion producers experience significant economic losses as a result of the unpredictable fluctuations in onion prices during the harvesting and post-harvest stages. In order to address these difficulties and increase farmers' earnings, the transformation of onions into value-added goods such as onion paste, onion powder, onion sauce, and onion oil has emerged as a possible option. The objective of this project is to create a smart solar drying system based on IoT technique specifically designed for the dehydration of recently harvested red onions. In April 2023, a series of five experimental tests were carried out, examining the effects of different onion slice thicknesses ranging from 2mm to 4mm, with intervals of 0.5mm. Each trial consisted of running the dryer for a duration of 9 hours, specifically from 9:00 am to 6:00 pm, throughout the daylight hours for three consecutive days. The experiment involved evaluating different drying characteristics, such as moisture content on dry and wet bases, shrinkage ratio, and thermal efficiency. The drying time required to achieve a 10% moisture level (w.b.) was reduced by 30.19%, 16.98%, 11.32%, and 3.77% when comparing a 4mm slice thickness to thinner alternatives of 2mm, 2.5mm, 3mm, and 3.5mm, respectively. The dryer had a superior thermal efficiency of 27.89% when the thickness was 2mm, in contrast to 19.50% when the thickness was 4mm. Significantly, onions that were dehydrated from slices measuring 2mm and 2.5mm in thickness shown exceptional suitability for the production of powdered onion.

KEYWORDS:

Design and development of a low-cost parabolic type solar dryer and its performance evaluation in drying of kingfish: A case study in Oman

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ABSTRACT

Dry fish is a rich source of proteins and nutrients and can be eaten in many forms. Oman is one of the important fish producers in the world, and there is a high demand for Oman fish in neighboring countries. The Fishery sector is considered an important economic development sector in the Sultanate of Oman. In the fishery sector, the use of technology is not up to the mark because of less awareness of technology applications among Omani fishermen. Also, there is a demand for more cold storage in different regions to store fresh fish, which has not materialized yet. Similarly, there is a demand for perfect and cheap technology in Oman for dry fish to improve the profit of the fishermen. Solar energy is abundantly available in Oman, and there are many possibilities for its use in domestic and industrial applications. Since sunlight is available throughout the year, converting it into thermal or electrical energy is possible. Electricity can be produced by photovoltaic principle (PV) or indirectly with concentrated solar power. Similarly, it is possible to use solar concentrators for many thermal applications. The solar dryer is used to dry fruits, vegetables, leaves, clothes, etc. If any of the items are dried with the help of solar energy, then we can save a lot of non-renewable energy sources and help improve the country's economy. The sun can, at least seasonally at Oman's latitudes, provide a substantial part of the energy needed for various applications. In this work, a solar dryer is proposed to be used to make high-quality dry fish. Using a parabolic concentrator to dry the fish is an effective solution, an innovative idea for the fishermen. The temperature variation in the dryer is directly proportional to the solar

intensity. The tracking mechanism combines electronic and mechanical design to track the sun automatically. In this work, a parabolic concentrator with an automatic tracking mechanism was designed, and a performance analysis was done. In the design, copper tubes are used for heat transfer, and then the hot fluid is circulated in the box, which is used to dry the kingfish. As per the experiment, solar collector efficiency obtained from the solar dryer is 77.9%, and the overall efficiency obtained is 33.1 %, and it took three days to dry kingfish of 20kg. There are many advantages in parabolic type solar concentrators related to the quality of dryness in the fish and the time taken to dry the fish, which are elaborately discussed in this paper. This solar dryer technology will improve the green environment, reduce carbon footprint, and save non-renewable sources for the Sultanate of Oman for extended periods.

KEYWORDS: Evacuated copper tube absorber, Parabolic solar, Solar energy, Solar dryer, Specific heat.

Design and performance prediction of a multilayer metamaterial absorber for broadband solar-thermal energy conversion using random forest regression. Case Studies in Thermal Engineering

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ABSTRACT

This study introduces a streamlined, multi-layered metasurface design for broadband solar-thermal energy conversion, effectively covering the ultraviolet (UV) to mid-infrared (mid-IR) spectral range. The proposed metamaterial absorber integrates tungsten-coated rectangular resonators, indium antimonide (InSb) square ring resonators, and graphene-enhanced circular substrates layered over SiO2/Ti films. Electromagnetic simulations conducted via COMSOL reveal outstanding absorption characteristics, with an average absorptance of 96.88 % across the UV to IR spectrum, including 98.19 % in the visible range and 97.90 % in the near-IR region. The structure exhibits robust performance across a range of graphene chemical potentials (0.1–0.9 eV) and maintains high efficiency at incident angles up to 60° for both transverse electric (TE) and transverse magnetic (TM) polarizations. Performance prediction using Random Forest machine learning models yielded high coefficients of determination—91 % for angular dependence and 87 % for chemical potential variations—while heat map validations achieved perfect (100 %) accuracy. This work represents the first demonstration of a tunable, graphene-based metasurface absorber combining tungsten rectangular and InSb ring resonators for efficient, broadband solar-thermal energy harvesting, marking a significant advancement in metamaterial-based energy conversion technologies.

KEYWORDS: Angular dependenceTunable optical propertiesRenewable energyThermal energy conversion

Development of an adaptive AI-enhanced prosthetic arm for physically impaired children

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ABSTRACT

This research addresses the critical gap in pediatric prosthetics for children by developing an adaptive prosthetic arm tailored to children aged 7 to 14, a demographic often overlooked in prosthetic innovation. Rapid physical growth during this age requires frequent adjustment and more medical care. Because of the requirement for frequent adjustment, pediatric prosthetics are more complex than adult models. Existing solutions have disadvantages, such as difficulty adapting adult designs and lack of the ergonomic, functional, and psychological considerations required for children. This work introduces a novel prosthetic arm that integrates Artificial Intelligence (AI) and Deep Learning (DL) to enhance adaptability, control, and user experience. In the initial phase of the work, the existing models and their disadvantages were considered. Then, the new design is developed, which leverages biosensors and electromyographic (EMG) signals for intuitive gesture recognition, enabling tasks such as gripping, pinching, and twisting. After developing the design, a 3D printer was used to create the arm. The arm was tested in real-time, and the AI developed with the prosthetic arm showed a promising overall accuracy of 91%. This shows the design and other components' accuracy and that the proposed arm design can be implemented for pediatric prosthetics.

KEYWORDS: Prosthetics, Artificial Intelligence, Machine Learning, Pediatric healthcare, AI algorithms, Oman vision 2040

Eco-Friendly Optimization of Landfill Leachate Treatment via Agricultural Waste-Derived Coagulants and Advanced Oxidation

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2025 – Engineering, Technology & Applied Science Research,

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ABSTRACT

Landfill Leachate (LL) presents a significant environmental concern, particularly in rapidly developing nations such as Oman, due to its high concentrations of persistent pollutants including ammonia (NH3), color-causing compounds, and organic matter. These contaminants are often resistant to removal by conventional treatment methods. This study aimed to develop an effective and eco-friendly treatment strategy for stabilized LL by integrating two processes: Persulfate Advanced Oxidation Processes (P-AOP) and Coagulation-Flocculation (C-F). The specific objectives were to: i) extract natural coagulants from date pits using the Soxhlet method, ii) enhance pollutant removal through the combined P-AOP and C–F approach, and iii) optimize the process using Response Surface Methodology (RSM). The hybrid treatment method achieved high removal efficiencies: 96% for color, 60% for NH3, and 74% for Chemical Oxygen Demand (COD). Additionally, a 12.433×103% increase in Total Suspended Solids (TSS) was observed, attributed to floc formation, which signifies effective coagulation. These findings confirm the potential of the integrated approach and highlight the feasibility of using date pits as a sustainable alternative to chemical coagulants.

KEYWORDS: landfill leachate, catechin tannins, coagulation-flocculation, persulfate advanced oxidation, optimization

Effect of Alumina microparticles infused polymer matrix on mechanical performance of Carbon Fiber Reinforced Polymer (CFRP) composite

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ABSTRACT

In recent times, fiber reinforced polymer composite materials have become more popular due to their remarkable features such as high specific strength, high stiffness and durability. Particularly, Carbon Fiber Reinforced Polymer (CFRP) composites are one of the most prominent materials used in the field of transportation and building engineering, replacing conventional materials due to their attractive properties as mentioned. In this work, a CFRP laminate is fabricated with carbon fiber mats and epoxy by a hand layup technique. Alumina (Al2O3) micro particles are used as a filler material, mixed with epoxy at different weight fractions of 0% to 4% during the fabrication of CFRP laminates. The important objective of the study is to investigate the influence of alumina micro particles on the mechanical performance of the laminates through characterization for various physical and mechanical properties. It is revealed from the results of study that the mass density of the laminates steadily increased with the quantity of alumina micro particles added and subsequently, the porosity of the laminates is reduced significantly. The SEM micrograph confirmed the constituents of the laminate and uniform distribution of Al2O3 micro particles with no significant agglomeration. The hardness of the CFRP laminates increased significantly for about 60% with an increase in weight % of Al2O3 from 0% to 4%, whereas the water gain % gradually drops from 0 to 2%, after which a substantial rise is observed for 3 to 4%. The improved interlocking due to the addition of filler material reduced the voids in the interfaces and thereby resist the absorption of water and in turn reduced the plasticity of the resin too.

Tensile, flexural and inter-laminar shear strengths of the CFRP laminate were improved appreciably with the addition of alumina particles through extended grain boundary and enhanced interfacial bonding between the fibers, epoxy and alumina particles, except at 1 and 3 wt.% of Al2O3, which may be due to the pooling of alumina particles within the matrix. Inclusion of hard alumina particles resulted in a significant drop in impact strength due to appreciable reduction in softness of the core region of the laminates.

KEYWORDS: carbon fiber; alumina; micro fillers; laminate strength; fiber rupture

Effect of Rice Husk Ash on the Properties and Performance of Geopolymer Concrete

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ABSTRACT

This study examines the influence of Rice Husk Ash (RHA) as an additional substance in geopolymer concrete (GPC), specifically analyzing its impact on workability, setting times, compressive strength, and splitting tensile strength. The experimental findings demonstrate that an increase in RHA concentration results in a decrease in workability and a speeding up of setting times while yielding significant enhancements in both compressive and tensile strengths. More precisely, the compressive strength experiences an increase from 16 MPa to 35 MPa, while the splitting tensile strength rises from 1.3 MPa to 2.6 MPa as the amount of RHA increases. The changes are caused by the large surface area and water absorption qualities of RHA, which affect the consistency and curing characteristics of the mixture. Although there have been significant improvements in the mechanical qualities, the reduced workability and shorter setting periods pose issues that require more investigation. The study highlights the potential of RHA as an environmentally friendly addition, providing a sustainable option to traditional materials and aiding in reducing building waste. Suggestions for future research encompass enhancing the RHA composition to achieve a harmonious blend of mechanical performance and workability, examining the long-term durability and environmental resistance, establishing standardized production procedures, exploring other industrial by-products, and conducting thorough assessments of the life cycle and economic aspects. By focusing on these specific areas, the development of RHA-enhanced GPC will be promoted, facilitating its incorporation into sustainable building methods and improving its overall effectiveness and environmental footprint.

KEYWORDS: Geopolymer Concrete, Rice Husk Ash, Compressive Strength, Split Tensile Test, Setting Value

Electrode Selection and Catalyst Evaluation in Hydrogen Production from Alkaline Water Electrolysis: A Review

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ABSTRACT

Generating hydrogen, through alkaline water electrolysis shows promise as an energy source. This review delves into the significance of choosing the electrodes and evaluating catalysts to enhance the efficiency and performance of hydrogen production. It summarizes the activation energy and losses linked to reactions in alkaline electrolysis emphasizing the necessity for electrode materials and catalysts. The review also touches upon challenges such as electricity consumption and platinum group metal based electro catalysts proposing various electrode materials and catalysts with superior activity and selectivity for hydrogen production. Additionally, it discusses electrolysis cell designs that facilitate separating by-products from hydrogen gas. The study reveals that with low over potentials of 70, 318, and 361 mV at 10, 500, and 1000 mA·cm−2 , respectively, NiOx/NF exhibits strong alkaline hydrogen evolution activity, resulting in great performance in alkaline HER. Moreover, it outlines advancements in alkaline water electrolysis technology focusing on enhanced efficiency and reduced operating costs associated with electricity consumption. Overall this review underscores the role of selecting electrodes and evaluating catalysts in optimizing hydrogen production from alkaline water electrolysis.

KEYWORDS: hydrogen production, electrolysis, electrode selection, catalyst evaluation, electrochemical performance

Empirical Review of Urban traffic Challenges and Sustainable Solutions: A case study of Muscat, Oman

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2025 – Journal of Applied Science and Technology Trends

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ABSTRACT

This paper presents an empirical and bibliometric analysis of the issue of traffic in Muscat, Oman, combining statistics and world research trends. According to the empirical results, 15,195 traffic accidents and 1,086 deaths were recorded in Muscat between 2012 and 2022, with the root cause of road fatalities being overspeeding (54%). This has an impact of over 38 hours of congestion delay per driver annually, and its air pollution level of PM 2.5 is 48 μg/m³, far exceeds the WHO levels, which highlights severe environmental and health aspects. The study is methodologically descriptive and a trend analysis using secondary data from government and international sources. An analogous bibliometric was based on 3,799 articles indexed in Scopus and mapped via co-occurring keywords, thematic grouping, and author collaborations in VOSviewer. The factors used as inclusion criteria were peer-reviewed journal articles in the field of engineering that were written in English. The analysis compounds one of the gaps in the research spheres of the Gulf region that supports the novice nature of this muscat-focused paper. The conclusions also underline the necessity of infrastructure improvement, intelligent transport systems (ITS), transportation improvements, and behavioral changes. This review provides actionable policy recommendations and other research directions that should be undertaken, such as stakeholder views and long-term intervention evaluations. In the current study, I will lead researchers and policymakers to the specifics of data-driven, long-term urban mobility policies in Muscat.

KEYWORDS: traffic congestion, urbanization, public transportation, intelligent transportation systems, road infrastructure

Estimation of reliability parameters for power transformers

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2024 – Journal of mechanics of continua and mathematical sciences

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ABSTRACT

Power transformers play an important role in the efficient delivery of power to consumers. Their failure leads to significantly higher losses and maintenance costs. Therefore, it is essential to have an optimal maintenance strategy in place for the transformers. However, to design an effective maintenance strategy, real failure data of the transformers need to be collected and studied to identify the failure patterns. To facilitate the analysis presented in this paper, five years of real failure data of a transformer system is collected from a power distribution company. The best-fit distribution for the failure times data of the system is found using AIC, BIC, and LKV values. Useful reliability parameters of the system are evaluated using the Maximum Likelihood Estimation and Rank Regression Method. Life data analysis is performed to estimate the reliable life, mean time to failure, and remaining lifetime of the entire system and its subsystems.

KEYWORDS: Best-fit distribution, Maximum likelihood estimation, Rank regression,reliability, Transformer,

Extraction & Characterization of Bio-Pesticide from Custard Apple Leaves

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2024 - African Journal of Biological Science

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ABSTRACT

Bio-pesticides, derived from natural sources that target pest's nervous systems directly, represent a sustainable alternative to chemical pesticides. The widespread use of chemical pesticides has led to profound ecological and health concerns, including biodiversity decline, genetic variability in plant populations, water pollution, and human health risks like cancer. This study focuses on extracting an environmentally friendly bio-pesticide from custard apple seed kernels, emphasizing high yield and efficacy. The extraction process employed advanced batch processing using Soxhlet extractor and rota-evaporator, ensuring efficient separation and purity of the bio-active compounds. Gas Chromatography (GC) was employed to meticulously characterize the chemical composition of the extracted samples. The effect of solvent, particle size and time of contact were determined. Furthermore, the biopesticide's effectiveness against pests infesting soil and leaf surfaces was rigorously evaluated. The results of GC analysis revealed that Oleic acid and Palmitic acid are prominent bio-active components responsible for insect mortality. Furthermore, it is noteworthy that hexane extraction yielded the highest percentage (70%) of bio-pesticide. This research advances sustainable pest management strategies by developing natural biopesticides from agricultural by-products. Emphasizing eco-friendly solutions, the study aims to mitigate the environmental impact of conventional pesticides while promoting agricultural sustainability and ecosystem health.

KEYWORDS: biopesticide, custard apple seeds, gas chromatography, hexane, soxhlet extraction

Fabrication and characterization of carbon nanotubes for oily wastewater treatment applications

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2025 - Journal of the Indian Chemical Society

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ABSTRACT

The oil processing industry creates severe environmental pollution by generating considerable volume of contaminated water. Realization of a sustainable and cost-effective water treatment technique has become a top priority. Nanotechnology is an emerging field and has great potential in bioremediation and environmental pollution control. Therefore, this study aimed to fabricate carbon nanotubes (CNT's) for the treatment of oily wastewater. The CNT's were analyzed using Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Zeta potential measurement and Energy Dispersive X-ray (EDX). The CNTs were successfully employed in the batch treatment of oily wastewater by varying the processing parameters (i.e. effluent pH, speed of agitation, agitation time and quantity of CNTs) and the optimal treatment parameters were established. The wastewater treatment efficiency was assessed by recording the turbidity, chemical oxygen demand (COD), dissolved oxygen (DO), total suspended solids (TSS), and total dissolved solids (TDS) values of the wastewater before and after treatment. The optimized parameters are pH = 6.0, contact time = 60 min, agitation speed = 75 rpm and amount of CNT's = 0.2 g/L. The results of the study validate the successful preparation of CNTs, as evidenced by the significant characteristic peaks observed through the FTIR spectrum and XRD analysis. The microstructural features of the CNT's using SEM demonstrate the successful synthesis. The EDX spectra confirmed the excellent purity and elemental composition of CNT's. The experimental outcomes suggest that the synthesized CNT's could effectively remove pollutants from oily wastewater. Due to the exceptional surface area and tunable physical and chemical properties of carbon nanotubes have demonstrated its potential to eliminate toxic pollutants from oily wastewater.

KEYWORDS:

Federated learning-based futuristic fault diagnosis and standardization in rotating machinery

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2024 – International Journal of Electrical and Electronics Engineering

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ABSTRACT

In the industrial sector, intelligent sensors in fault diagnosis are becoming more critical in recent technological improvements. The prediction accuracy can be enhanced in fault diagnosis using 3-dimensional, sequential, real-time, and image data. Sensors that capture the vibration, sound, and image data are more critical in predicting unbalancing, tool wear, crack, misalignment, etc, in the rotating machinery to increase productivity and to provide an effective maintenance management system. Due to the fast development of industry 4.0 techniques, monitoring of mechanical machinery is experiencing explosive growth and getting more attention in the area of fault diagnosis (FD). Machine learning and Deep learning methods give promising results and accuracy in predicting faults in rotating machinery on shop floors. The success of AI-based models is due to the availability of comprehensive labeled data. Federated Learning (FL) is the machine learning subfield aiming to train an algorithm with a heterogeneous dataset. Data transmission from local facilities to a central server in AI models creates data privacy and security issues. Heterogeneous data analysis is a complicated process in predicting the machine fault in the central server because of millions of data during real-time condition monitoring. Decentralized data handling and analysis is mandatory in condition monitoring because of heterogeneity in data processing, data privacy, and security advantages. The application of federated learning in fault diagnosis has been getting more attention in recent days, and this study is a review of FL applications that address fault diagnosis in rotating machinery in the first phase. A comparison between the types of FL approaches in FD and the use of aggregation algorithms and their applications will also be discussed in Phase 1. In phase 2, a novel methodology has been proposed using Federated learning to diagnose rotating machinery faults. The proposed method, FLOACOS, addresses how prediction challenges are solved using federated learning approaches by optimizing and standardizing the data at local facilities. This work will be helpful for future condition monitoring researchers and gives an overview of a novel method of the FL technique used in predicting faults and the progress made in the maintenance management of rotating machinery.

KEYWORDS: Fault diagnosis; Federated Learning; Internet of Things; Machine learning; Rotating machinery and condition monitoring

Flexural Performance of Rubberised Concrete with Flyash, Silica Fume and Plaster of Paris: An Experimental and Numerical Analysis

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2025 – International Journal of Civil Engineering

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ABSTRACT

The global demand for concrete, the most widely used construction material, continues to rise due to rapid expansion in residential, commercial, and infrastructure projects. Simultaneously, the increasing cost of cement and aggregates, coupled with the growing volume of solid waste such as discarded automobile tires, poses significant environmental challenges. Addressing both economic and ecological concerns necessitates the adoption of alternative materials to partially replace conventional concrete constituents, such as cement and coarse aggregates. This study explores the partial replacement of cement with mineral admixtures, including Plaster of Paris (POP), Silica Fume (SF), Fly Ash (FA), and the use of Reclaimed Rubber (RR) as a substitute for coarse aggregate. Both experimental and computational methods were employed, focusing on an M20 grade concrete mix. The study determined the most effective replacement level, with optimal results observed at a 9% substitution rate for both FA and POP. A predictive model for compressive strength was implemented in C++ using a Genetic Algorithm (GA), incorporating various mixtures of RR, SF, FA, and POP as input parameters. The simulation results led to the identification of five optimal mix design configurations. Twelve concrete cubes were cast and tested to validate the simulation results, demonstrating strong agreement between experimental and predicted compressive strength values. Furthermore, twelve beams incorporating the selected combinations were prepared and subjected to flexural testing, with load-deflection curves generated for each of them. The findings demonstrated that incorporating these alternative materials led to an improvement in the concrete's bending (flexural) strength.

KEYWORDS: Alternative building materials, Strength forecasting, Compressive performance, Flexural performance; Recycled rubber, Genetic Algorithm (GA).

Friction stir additive manufacturing of $AA7075/Al_2O_3$ and Al/MgB_2 composites for improved wear and radiation resistance in aerospace applications

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2025 – Journal of Environmental Nanotechnology

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ABSTRACT

The research focuses on a class of materials called multifunctional metal matrix composites (MMCs) that combine with structural and functional characteristics. These materials can offer better protection from space environmental dangers without sacrificing scalability, weight, or mass. An MMC is a metal matrix composite made using a scalable friction stir additive manufacturing (FSAM) technique. It contains more than 30% volume of evenly distributed metallic/ceramic particles. In aluminum MMCs, the FSAM approach and the significant amount of nanoparticles significantly improve the microstructures of the metal matrices, leading to interparticle gaps smaller than 1 μm. So, the FSAM process refines the MMC matrix while combining a high concentration of metallic and ceramic particles. This improves hardness and coefficient of friction, and it also integrates the functionalities of adding nanoparticles into the MMCs, which is crucial for justifying threats in the aviation environment. This allows for effective radiation shielding, increased durability in high temperatures, and increased friction at contact surfaces.

KEYWORDS: Friction stir additive manufacturing; AA7075; Nanoparticles; Microstructure; Hardness.

Gradient boosting-assisted polarization independent SPR biosensor for multiplexed diagnostics and behavioural prediction

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2025 - Diamond and Related Materials Journal

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ABSTRACT

This work presents a graphene-based metamaterial terahertz (THz) sensor designed for the simultaneous detection of glucose and hemoglobin, two crucial biomarkers for diabetes and anemia monitoring. Meanwhile, the proposed sensor integrates a graphene-coated square resonator with copper-coated circular elements and bismuth-coated peripheral squares atop a SiO_2 substrate. Finite element method simulation demonstrates the dual-resonance absorption characteristics corresponding to the distinct molecular signatures of glucose and hemoglobin. Interestingly, this sensor achieves high sensitivities of 1000 GHz/RIU for glucose and 433 GHz/RIU for hemoglobin, with figures of merit up to 23.81 RIU−1 and a high-quality factor of 22.7. Moreover, the parametric studies show tunability via graphene chemical potential and incident angle as well. Additionally, a gradient boosting regressor model predicts sensor response with 93 % accuracy, demonstrating its reliability for real-time biosensing. The proposed dual-analyte platform offers a non-invasive, label-free, and compact diagnostic solution suitable for point-of-care applications in healthcare.

KEYWORDS: Terahertz spectroscopy, Metamaterial engineering, Graphene nanostructures, Simultaneous dual-analyte detection, Glucose biosensing, Hemoglobin quantification, Machine learning integration

Graphene terahertz metasurface sensor enabled by AI for rapid, high-precision sperm detection in fertility assessment

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2025- Plasmonics Journal

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ABSTRACT

The global decline in male fertility has underscored the urgent need for advanced diagnostic platforms capable of rapid, accurate, and non-invasive sperm analysis. Conventional assessment techniques are often constrained by limited sensitivity, lengthy processing times, and subjective interpretation. Here, we report the design and simulation of a graphene-based multilayered metasurface sensor operating in the terahertz (THz) regime, engineered for high-sensitivity sperm detection. The sensor features a concentric architecture comprising a silver-coated central circular resonator nested within a gold-coated U-shaped resonator, which is further enclosed by a copper-coated square ring, all embedded on a graphene-coated square substrate. Finite-element simulations performed in COMSOL Multiphysics reveal a peak sensitivity of 5000 GHz·RIU^{-}1, a figure of merit of 17.986 RIU^{-}1, and a quality factor of 2.151. The sensor exhibits distinct spectral shifts in the 0.589–0.598 THz range in response to sperm-related refractive index variations, with a minimum detectable index change of 1.51 × 10^{-}1 RIU. Moreover, tunability via graphene chemical potential enables 2-bit optical encoding. To further enhance performance, a one-dimensional convolutional neural network (1D-CNN) was implemented, achieving predictive R2 values of 0.93–1.00 across multiple design parameters.

KEYWORDS: Terahertz biosensor, Graphene metasurfaces, Sperm detection, Multilayer resonators, Machine learning optimization, Surface plasmon resonance

Implementation of quality function deployment to improve online learning and teaching in higher education institutes of engineering in Oman

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ABSTRACT

In this digital era, online learning and teaching is an essential platform for college and university students, and it requires many technical facilities and in-depth knowledge to have an effective learning process. During the COVID-19 pandemic, students and teachers in Higher Education Institutions (HEIs) were forced to grapple with the certainty of shifting to online classes due to large learning groups or the advantages of effective distance learning which is becoming an essential part in learning and teaching. In the case of Oman, there have been some efforts to integrate alternative learning mechanisms in the past, but they have not followed the scale in the post-pandemic world. This study sought to utilize the principles of Total Quality Management (TQM) by implementing Quality Function Deployment (QFD) to understand the experiences of Omani teachers and students from HEIs to enhance the quality of online learning and teaching. The perspectives of teachers and students were investigated and recorded. In this regard, 165 teaching staff and 355 students from HEIs of engineering participated in a survey. After the survey, a house of quality analysis was performed to analyze the requirements based on how strongly they relate to the standard learning outcomes expected from HEIs in Oman. The results of the house of quality show that “in-person attention is required as a technical requirement”, with a high score of 164, and that student knowledge and competence need to improve as a customer requirement, with a high score of 45. This shows that more attention is required in online education in the Sultanate of Oman before it is implemented as a significant part of learning and teaching.

KEYWORDS: higher education institutions; online learning and teaching; quality function deployment; total quality management; voice of the customer

Inclusion Results of Class Expressed as a Convex Combination of Meromorphic Starlike Functions

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2025 – Research in Mathematics

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ABSTRACT

In this paper, a new class of functions is defined by expressing combination of two known differential characterizations galvanized by the definition of multiplicative derivative. Estimates involving the initial coefficients of the functions, which belong to the defined function class are our main results. To establish some interesting properties such as inclusion and closure properties, we have provided examples along with some graphical illustration.

KEYWORDS: Multiplicative calculusmeromorphic function univalent function Schwarz functions tarlike and convex function subordination coefficient inequalities Fekete-Szegő inequality

Inequalities Of A Class of Analytic Functions Involving Multiplicative Derivative

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2025 – Mathematics

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ABSTRACT

Using the concepts of multiplicative calculus and subordination of analytic functions, we define a new class of starlike bi-univalent functions based on a symmetric operator, which involved the three parameter Mittag-Leffler function. Estimates for the initial coefficients and Fekete–Szegő inequalities of the defined function classes are determined. Moreover, special cases of the classes have been discussed and stated as corollaries, which have not been discussed previously.

KEYWORDS: generalized Mittag-Leffler function; multiplicative calculus; bi-univalent function; starlike; subordination

Intelligent fault diagnosis using deep learning algorithms: A comparative analysis of MLP, CNN, RNN and LSTM

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2024 – International Journal of Electrical and Electronics Engineering

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ABSTRACT

Health management in industrial systems is more critical in maintenance management and it plays an important role in productivity, fault diagnosis, safety, efficiency, and economy in manufacturing industries. Early detection of faults in machinery may increase the effectiveness of maintenance actions and will avoid unwanted consequences in process operations and maintenance. Existing fault diagnosis methods have limitations such as insufficient accuracy, slow detection rate, and handling large and complex data sets. In this digital age, Industry 4.0 techniques have been applied across all fields, including the condition monitoring of machines. This research addresses the gaps in traditional fault diagnosis by using deep learning, a modern AI technique effective for diagnosing faults in various machines. Deep learning algorithms Multilayer Perceptron (MLP), Coevolutionary Neural Network (CNN), and Recurrent Neural Network (RNN) with Long Short-Term Memory (LSTM) are tested for fault diagnosis using vibration datasets collected from Spectra Quest Machinery Fault Simulator (SQMFS). In this research work, NI-DAQ (National Instruments- Data Acquisition) system, accelerometer, and LabVIEW software are used to collect vibration signals. Preprocessing of the signals has been done using a sampling strategy, shuffling, standardization, and reshaping data augmentation. The result shows that MLP accuracy in the prediction of fault is 0.9, CNN reached 0.95, and RNN and LSTM with 0.57 and 0.45 respectively. The high performance of CNN is due to its ability to effectively capture spatial patterns in vibration data which is crucial for fault diagnosis in rotating machinery followed by MLP due to its faster convergence during training. However, when scaling the data, MLP outperformed CNN, demonstrating superior adaptability to increased data complexity and volume. Due to the need for larger datasets and temporal patterns in the vibration data, which RNN and LSTM are designed to handle, they resulted in a lower accuracy.

This study shows that CNN has given better results than other deep learning algorithms MLP, RNN, and LSTM in fault diagnosis of rotating machinery. Future research could explore the application of these techniques to different types of machinery and fault conditions. The utilization of the MCDM technique facilitates the customization of electronic commerce platforms, whereby affordable products can be identified and retrieved according to individual user preferences. The study investigates the impact of electronic gadgets and energy-efficient WSNs on inventory management, customer preferences, and online shopping sustainability, highlighting the intricate relationship between data privacy, energy efficiency, and governance. The proposed method is compared to other state-of-the-art methodologies and shown to be effective under various criteria.

KEYWORDS: Condition monitoring; Machine Fault Simulator; unbalancing; Multilayer Perceptron (MLP); Convolutionary Neural Network (CNN); Recurrent Neural Network (RNN) with Long Short-Term Memory (LSTM)

Investigation on the influence of process parameters on the mechanical performance of 3D printed specimens

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2025 – New Materials, Compounds and Applications

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ABSTRACT

3D printing using Fused Deposition Modeling (FDM) is a familiar technique in additive manufacturing employed in this work to fabricate specimens made of Polylactic Acid (PLA). The objective of the present study is to investigate the mechanical behavior of 3D printed PLA specimens for various testing parameters combination. The process parameters selected for investigation in this study were the infill pattern, filling speed and layer thickness, whereas parameters such as the infill density, raster angle, build orientation and nozzle temperature were maintained at a fixed value during fabrication. Analyzing the 3D printed specimens, higher order porosity was observed at layer thickness 0.28 mm and filling speed 50 mm/s. The tensile strength increased with increasing filling speed and decreasing filling layer thickness. A maximum tensile strength of approximately 15 MPa was observed for a filling speed of 50 mm/s and layer thickness 0.16 mm. The tensile performance of the specimens with gyroid filling patterns was inferior to that of the specimens with line and triangular filling patterns. Specimens fabricated with filling speed of 30 mm/s and filling layer thickness of 0.16 mm resulted in better compressive strength. The flexural performance of 3D printed specimens was better at higher filling speeds, which contradicted the tensile and compression performances. Overall, specimens printed under lesser filling speed of 30 mm/s and lesser layer thickness of 0.16 mm resulted in better mechanical performance due to enhanced bonding strength with higher degree of adhesion between the layers.

KEYWORDS: 3D printing Polylactic acid filling speed infill pattern layer thickness, tensile strength

Label-free graphene-based surface plasmon resonance sensor for advanced male fertility evaluation with behavior prediction via polynomial regression

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2025 – Sensing and Bio-Sensing Research

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ABSTRACT

Male infertility affects approximately 15 % of reproductive-age couples globally, with male factors contributing to roughly 50 % of infertility cases, creating an urgent need for advanced, accessible diagnostic technologies for semen analysis. Current sperm assessment protocols rely predominantly on conventional light microscopy and Computer-Assisted Sperm Analysis (CASA) systems, which suffer from subjective interpretation, high costs, and limited accessibility in resource-constrained settings. This study presents a simple graphene-based Surface Plasmon Resonance (SPR) biosensor featuring a simple resonator architecture optimized for ultrasensitive sperm detection through label-free, real-time analysis. The electromagnetic analysis using COMSOL Multiphysics 6.3 demonstrates exceptional sensitivity ranging from 118 GHzRIU−1 to 5000 GHzRIU−1 across refractive indices of 1.33–1.3461 RIU, with a maximum figure of merit of 68.493 RIU−1 and detection limits as low as 0.028 RIU. Machine learning optimization using polynomial regression achieved prediction accuracies of 87–91 % (R2 values of 94–100 %) across critical operational parameters including graphene chemical potential (0.1–0.9 eV), geometric variations, and angular dependencies (0–80°), validating the sensor's robust performance for clinical sperm analysis applications.

KEYWORDS: Machine learning optimizationLabel-free detectionRefractive index sensingCOMSOL simulationPolynomial regressionClinical diagnostics

Leveraging Ecological Systems Theory to Identify the Factors Shaping the Learning Experiences of Engineering Students in Higher Education Institutions in Oman

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2025 – International Journal of Learning, Teaching and Educational Research

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ABSTRACT

The research thoroughly investigates the multifaceted factors influencing students' learning experiences at a prominent Higher Education Institution in Oman. To explore these factors in depth, the study involved a diverse group of 22 students from Levels 3 and 4 of Engineering courses. This exploratory, descriptive study employed focus group interviews structured around 18 carefully crafted questions grounded in Urie Bronfenbrenner's ecological systems theory. This theoretical framework provides a comprehensive lens to examine the intricate interactions between individuals and their various environments. Interview data was analyzed quantitatively and qualitatively by measuring and analyzing the frequency of opinions and information. The findings revealed that while students recognized the significance of written goal-setting record, family motivation, and the increasingly important role of artificial intelligence in education, they exhibited a concerningly low awareness of valuable resources such as online library services, massive open online courses, and potential job prospects in their field. This gap in awareness suggests a need for improved communication and outreach regarding available academic resources and career opportunities. Responses among participants varied regarding the effectiveness of peer tutoring, the value of group assignments, and participation in student clubs, indicating a spectrum of experiences that could benefit from targeted interventions. Notably, there was a positive attitude toward utilizing platforms like YouTube for study purposes, highlighting the potential of digital resources in enhancing learning.

KEYWORDS: learning experience; Chabot; student awareness; ecological systems theory; higher education

Literature Review on Reliability, Optimization, And Performability Analysis of Industrial Systems

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2025 – Journal of Mechanics of Continua and Mathematical Sciences

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ABSTRACT

Over the past thirty years, reliability engineering has significantly evolved beyond its conventional focus on system reliability indices, profit evaluations, and cost-benefit analyses. With the advent of smart manufacturing, the field now integrates sophisticated stochastic modeling, multi-objective optimization, and AI-powered predictive maintenance. This review highlights key developments, including improvements in the reliability of single-unit, dual-unit, and multi-unit industrial systems, applications in various industries, the incorporation of renewable energy, and AI-driven monitoring and analysis. Furthermore, it identifies current research gaps and presents potential avenues for further innovation in reliability assessment.

KEYWORDS: AI-Based Predictions, Cost-benefit analysis, Industrial Systems, Markov Processes, Reliability Analysis, Semi-Markov Models,

Machine learning approach to the possible synergy between co-doped elements in the case of $LiFePO_4/C$

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ABSTRACT

This study investigates the synergistic effects produced by the co-doping of several components in the LFP/C structure. To execute this work, a dataset was initially created from the existing literature, encompassing information on doped LFP structures by a singular element. Numerous intrinsic and extrinsic characteristics, such as atomic number, valence, relative variations in atomic and ionic radii of Fe and Li, electronegativity, molar percentage of dopant, and C-rate, were evaluated. The optimal selection of features leading to satisfactory model training was achieved by analyzing the Pearson correlation coefficient factors. Subsequently, two machine learning algorithms (i.e., Random Forest and Gaussian Process Regression) were trained using the optimized feature set. The two models were evaluated, and the model with superior predictive power was chosen for further study. An analysis of the synergistic effect of two co-dopants was conducted by comparing the actual specific discharge capacities with the expected values derived from the superimposition of the machine learning predictions. Ultimately, experimental validation

was conducted by synthesizing several unique LiYxNdyFe1-x-yPO4/C (Nd = 0.06, 0.02 <Y<0.08) samples using solid-state methods. The synthesized powders underwent relevant testing, including SEM, TEM, CV, EIS, and GD. Finally, based on the best ML scheme developed and experimental results, another ML scheme was developed to analyze the possible synergic effects that co-dopants may exhibit regarding the specific discharge capacity of co-doped LFP structures.

KEYWORDS: Co-dopingLi-ion batteriesMachine LearningSynergic effectsLFP

Machine Learning-Based Optimization of Electrolysis Parameters in Green Hydrogen Production Using Renewable Energy Sources

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2025- IEEE

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ABSTRACT

An investigation of the functioning of machine literacy methods to optimize electrolysis settings for the production of green hydrogen is presented in this research. It is of the utmost importance to improve the efficiency of green hydrogen products as the globe moves toward more sustainable energy results. The process of electrolysis, which is an essential method for the production of hydrogen, involves several variables that can be altered, such as the viscosity of the current, the temperature, and the electrolyte attention. When it comes to successfully exploring the complicated, multidimensional parameter space, traditional optimization approaches typically fail to meet expectations. In this study, we make use of sophisticated machine-learning techniques to model and optimize these parameters. Our objective is to maximize the amount of hydrogen produced while simultaneously decreasing the amount of energy consumed and the costs associated with its operation. Through a series of trials and simulations, we demonstrate how machine literacy models, including retrogression and bracket algorithms, can prognosticate optimal settings and expose perceptivity into the electrolysis process. Our findings demonstrate considerable improvements in the efficiency of hydrogen products, demonstrating the possibility of incorporating machine literacy into electrochemical processes in the future.

KEYWORDS: Computational modeling, Sustainable Production, Energy Efficiency, Green Hydrogen, Machine Learning, Electrolysis Optimization, Hydrogen Yield

Machine learning-enhanced graphene-gold hybrid metasurface sensor for high-precision terahertz detection of isoquercitrin biomarkers

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2025 – Sensing and Bio-Sensing Research

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ABSTRACT

This study presents a sensor operating in the terahertz (THz) frequency range for the selective detection and quantification of isoquercitrin, a crucial flavonoid biomarker. Through optimization of graphene chemical potential (and geometric parameters, the sensor achieves exceptional sensitivity of 1000 GHz/RIU with a quality factor ranging from 7.849 to 8.000. The integration of machine learning algorithms, including an ensemble of Random Forest, Support Vector Machine, and Neural Network models, significantly enhances analytical capabilities with 98.7 % prediction accuracy and 2.3 μg/mL RMSE. The ML framework incorporates advanced spectral pre-processing with 95 % noise reduction, automated extraction of 127 spectral features, and real-time processing capabilities with sub-second response times (0.12 s). Electric field distribution analysis reveals optimal resonance at 0.68 THz with maximum field confinement, while the sensor demonstrates robust performance across varying incidence angles. The proposed system offers superior detection limits, high selectivity, and exceptional reliability with 95.3 % average prediction confidence, making it highly suitable for point-of-care diagnostics, nutraceutical quality control, and personalized health monitoring applications.

KEYWORDS: Surface plasmon resonance, Flavonoid quantification, Point-of-care diagnostics Ensemble learning Biomarker detection, Spectral analysis

Machine learning-enhanced terahertz plasmonic biosensor based on MXene-gold nanostructures for tuberculosis detection

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2025 – Sensing and Bio-Sensing Research

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ABSTRACT

This study presents a terahertz hybrid plasmonic biosensor utilizing MXene-gold nanocomposites for tuberculosis detection. COMSOL Multiphysics simulations were employed to optimize sensor performance across varying chemical potential, incident angle, and resonator dimensions. The optimized configuration achieved a sensitivity of 1000 GHzRIU−1 and figure of merit of 22.22 RIU−1, with a strong inverse linear relationship between resonance frequency and TB biomarker refractive indices (R2 = 0.981). A machine learning framework based on decision tree regression was developed to predict sensor behavior, achieving R2 values of 0.96, 0.92, and 0.88 for resonator dimensions, refractive index, and incident angle variations, respectively. The sensor platform offers significant potential for rapid, sensitive TB diagnostics in resource-limited settings.

KEYWORDS: Terahertz sensingPoint-of-care testingMachine learningNanophotonicEarly disease detection

Mathematical analysis and parameter estimation of the 2017–2018 cholera outbreak in Yemen

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2025 - The European Physical Journal Plus

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ABSTRACT

The cholera outbreak in Yemen, spanning from April 2017 to March 2018, represents one of the most severe and widespread epidemics in recent history. Understanding the dynamics of such outbreaks is critical for improving disease prediction, control measures, and resource allocation. This study focuses on the parameter estimation of a mathematical model designed to describe the cholera transmission dynamics during this period. Using a combination of compartmental models and available epidemiological data, we aim to estimate key parameters such as transmission rates, recovery rates, and case fatality rates, which are essential for assessing the effectiveness of intervention strategies. Our mathematical findings show that the disease-free equilibrium is globally asymptotically stable if $R_0 < 1$, and the endemic equilibrium is globally asymptotically stable if $R_0 > 1$, and hence, the system undergoes a transcritical bifurcation. The parameters' estimation results provide estimation for R_0 for almost all Yemen's governates based on data from 2017–2018 outbreak.

KEYWORDS:

Modeling & Optimization of Omani Date Seed Oil Extraction Using Acoustic Cavitation

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ABSTRACT

Palm seed dates usually end up as waste. They actually contain oil that can be extracted using a unique method called acoustic cavitation explored in this research study. Acoustic cavitation involves using waves to form bubbles in a liquid that implode quickly. This implosion breaks down the plant cell walls effectively extracting the oil without the need, for chemicals commonly used in extraction methods. Using field emission scanning electron microscopy (FESEM) researchers apply this method to observe how cavitation impacts the seed structure by revealing the formation of cracks and micro fractures that facilitate the oil release process. The research compares the efficacy of cavitation, with techniques such as Soxhlet extraction and indicates that acoustic cavitation may offer benefits in terms of speed and potentially reduced environmental footprint. The amount of oil extracted for 20 g of date seed powder using acoustic cavitation 2.91 g and by using Soxhlet extraction is 2.1 g. Furthermore, the study delves into the utilization of RSM (Response Surface Methodology) software, for modeling. The results of this study not only show how acoustic cavitation can be an effective approach, for extracting date seed oil but also add to the overall efforts in sustainable use of biomass resources. It provides an eco-friendly option compared to extraction techniques and sets the stage for potential advancements in the food industry, cosmetic sector and biofuel field, by turning waste materials into valuable assets.

KEYWORDS:

Navigating the impediments and challenges of integrating artificial intelligence technologies within the framework of Education 4.0: A systematic review

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ABSTRACT

Implementation of Fourth Industrial Revolution (4IR) techniques is needed for long-term sustainability and automation in the Industrial and education sector processes. Rapid advancement in information technology and other engineering technologies demands more proactive steps in education institutes. In the post-pandemic world, there is an increasing demand for changes in teaching and learning methodologies with the support of modern digital technologies. So, all teaching institutes need to make significant changes in learning and teaching. The impact of 4 IR is more critical on the education sector than the previous generation's industrial revolution. Keeping track of essential technologies can be challenging as they evolve quickly. The fourth Industrial Revolution is the current technological digital revolution in which the primary focus is on cyber-physical and biological systems such as Artificial Intelligence, Robotics, the Internet of Things, and Virtual Reality, etc. educators and institutions should establish pedagogies and teaching with the aid of Industry 4.0 techniques to evolve education 4.0. So, it is essential to understand the challenges and competencies required for implementing 4IR by the faculty members and students currently studying in Higher Education Institutes (HEIs). This paper aims to systematically review industry 4.0 techniques and their application to online learning and teaching, pedagogies change, data management enhancement in HEIs, digital and virtual laboratories, etc. This work explores various fields in education 4.0 and the challenges involved in the implementation and execution of HEIs. This study contributes a systematic overview of digital technology application in HEIs based on existing literature, current trends, and research gaps and accordingly gives the future direction of education 4.0.

KEYWORDS: Industry 4.0, Education 4.0, Artificial Intelligence, Robotics, Virtual reality, Blockchain technology, Gamification, Digital laboratories.

Optimal control and cost effectiveness analysis of a Zika–Malaria co-infection model

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2024 - Partial Differential Equations in Applied Mathematics

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ABSTRACT

Malaria and Zika, are two significant public health concerns, particularly in tropical and subtropical regions. The co-infection of Malaria and Zika can occur due to overlapping geographical distributions of their respective vectors, namely Anopheles mosquitoes for Malaria and Aedes mosquitoes for Zika. These mosquitoes serve as intermediate hosts for the parasites and viruses, respectively. The proposed mathematical models capture the complex interactions between the human population and the mosquito population to provide insights into the transmission dynamics. The primary transmission route to humans is through the bite of infected mosquitoes for both diseases. Moreover, Zika virus can be also transmitted sexually and vertically. The models provide a valuable tool for evaluating the impact of different interventions on the transmission dynamics of Malaria and Zika co-infection such as prevention schemes against co-infection with Malaria and Zika, prompt Malaria treatment, and effective mosquito control measures. Using Pontryagin's maximum principle, the model determines the most effective strategies for reducing Malaria and Zika co-infection over time. By combining modeling with cost-effectiveness analysis and targeted interventions, it is possible to develop evidence-based approaches that reduce disease transmission, protect vulnerable populations, and make efficient use of available resources.

KEYWORDS: Zika, Malaria, Optimal control, Cost effectiveness analysis, Sensitivity analysis

Optimization and multi-objective analysis of tensile, flexural and impact strength in nano-hybrid bio-composites reinforced with Helicteres isora, Holoptelea integrifolia fibers, and nanographene

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2025 - Matéria

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ABSTRACT

Industries worldwide seek sustainable, high-strength bio-composites to reduce carbon footprint and replace synthetic materials. This research enhances natural fiber-based composites, ensuring lightweight, cost-effective, and eco-friendly alternatives. It supports green manufacturing and sustainable engineering, promoting a shift away from fossil-based materials. This study aims to optimize the mechanical properties of nano-hybrid bio-composites reinforced with Holoptelea integrifolia fibers, Helicteres isora fibers, and graphene nanosheets within a polypropylene matrix. Using the Box-Behnken design and Response Surface Methodology (RSM), the effects of fiber and graphene composition on tensile, flexural and impact strength were analyzed. The Multi-Objective Particle Swarm Optimization (MOPSO) approach was employed to maximize strength while minimizing composite weight. The optimized composition (15.6721 wt% Holoptelea integrifolia, 15.7198 wt% Helicteres isora, and 0.9307 wt% graphene) achieved a tensile strength of 45.407, flexural strength of 62.0344 MPa and impact strength of 147.119 J/m, demonstrating a significant enhancement. FESEM analysis revealed improved fiber-matrix adhesion, reduced voids, crack path deviation, and fiber bridging mechanisms, which enhanced fracture resistance. These findings support the development of lightweight, high-performance bio-composites, making them ideal for automotive, aerospace, and structural applications where improved strength-to-weight ratios are crucial. Keywords: Holoptelea integrifolia fibers; Helicteres isora fibers; flexural strength; Impact strength; Response surface methodology (RSM)

KEYWORDS: Holoptelea integrifolia fibers, Helicteres isora fibers, flexural strength, Impact strength, Response surface methodology (RSM)

Optimized Extraction of Furfural from Omani Date Palm Seeds

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ABSTRACT

Amidst the substantial growth of date palm cultivation in Oman, this study presents a sustainable approach to utilizing the agricultural by-product of date palm seeds for furfural production. Furfural, a versatile organic compound with a characteristic almond fragrance, is conventionally used in various industrial applications. This research systematically explores two distinct extraction methodologies—Soxhlet extraction with subsequent rotary evaporation and simple distillation—to optimize furfural yield. Critical parameters were meticulously assessed, with optimal humidity at 7.71%, pH at 5.5, and water activity at 0.365 identified as crucial for obtaining high-quality furfural. The investigation further determined that fine particle size and precise humidity control during Soxhlet extraction significantly enhanced furfural yield. Comprehensive analyses through gas chromatography-mass spectrometry (GC-MS) and nuclear magnetic resonance (NMR) spectroscopy confirmed the presence and purity of furfural, indicating successful extraction. These key findings are instrumental for advancing the valorization of date palm residues in Oman and beyond.

KEYWORDS: furfural, date palm seeds, soxhlet extraction, distillation, GC-MS, NMR spectroscopy, agricultural waste valorization

Performance analysis of machine learning and deep learning techniques in diagnosing imbalance using machine fault simulator: A case study

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2025 - International Journal of Engineering Trends and Technology

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ABSTRACT

The growth of Machine and Deep Learning in the manufacturing sector has been tremendous in the past decade, and it is widely used in many fields. Conditional monitoring of machines is a challenging task in manufacturing and process industries. It requires real-time monitoring to reduce downtime of machines, reduce cost and scraps, and improve the productive ML and DL, which have given promising results in the core domains of feature extraction and fault classification in machine fault detection. This paper addresses applying ML and DL techniques to predict the unbalancing of machines accurately and finding the proper techniques for predicting the unbalancing of rotating machines. This research uses an accelerometer, data acquisition card, and lab view software to collect vibration signals due to unbalancing. The output of the vibration data is collected in terms of frequency domain and time domain data. The ML techniques KNN, Support vector machine, Decision Tree, Random Forest, Naïve Bayes, logistic regression, and linear discriminant analysis are applied and predict the accurate prediction of unbalancing of machines. Similarly, DL techniques, MLP, CNN, RNN, and LSTM are used to identify the unbalancing of machines. After predicting the accuracy, precision, recall, and FN score of ML and DL, an extensive comparative analysis is done to identify the proper AI techniques in real-time condition monitoring; this research is executed by collecting data from the Spectra quest machine fault simulator. The result shows that ML techniques DT and RF give better results than other ML techniques. Similarly, MLP provides better results than CNN, RNN, and LSTM.

KEYWORDS: Condition monitoring, Machine fault simulator, Machine Learning, Deep Learning, KNN.

Performance Evaluation and Enhancement of Geopolymer Concrete using Silica Fume

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ABSTRACT

This study investigates the effects of Silica Fume (SF) on Geopolymer Concrete (GPC) to evaluate its impact on key performance metrics, including workability, setting times, and mechanical properties. Geopolymer concrete mixes with varying SF/Fly Ash (FA) ratios were prepared and tested for the slump, initial and final setting times, compressive strength, and splitting tensile strength. Results indicate that increasing SF content decreases slump values, reflecting reduced workability due to the high surface area and water absorption of SF particles. Incorporating SF significantly accelerates setting times, which is advantageous for applications requiring rapid strength gain. Mechanical testing revealed a marked improvement in compressive and splitting tensile strengths with higher SF content, attributed to enhanced microstructural densification and reduced porosity. Despite these promising findings, the study identifies several knowledge gaps, including the need for research on long-term durability, optimization of mix proportions, standardization of production methods, exploration of additional industrial byproducts, and comprehensive environmental and economic assessments. Addressing these gaps will advance the understanding and application of SF-blended GPC, supporting its broader adoption in sustainable construction practices.

KEYWORDS: Geopolymer Concrete, Silica Fume, Workability, Compressive Strength, Splitting Tensile Strength, Sustainability

Performance monitoring of a double slope passive solar powered desalination system using Arduino programming

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2025 - MDPI

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ABSTRACT

Solar energy is one of the promising renewable energies; it is clean, green, and accepted worldwide for targeting sustainable development through applications such as power generation, desalination, food preservation, etc. Solar-powered desalination has received more attention in recent times to meet the demand of pure water in the rural places of many countries where solar energy is abundant. In the present work, a double-slope passive solar desalination system was fabricated with readily available materials that can be installed and used in rural places, either for domestic purposes or in small-scale industries. The capacity of the desalination system fabricated to be filled with saline water is ~15 L. The performance of the desalination system is continuously monitored by recording the temperatures at various locations around the system, such as the outer surface of the glass, the inner surface of the glass, inside the basin, and outside the basin, through DHT11 sensors controlled by Arduino programming fed in the Arduino UNO board. The influence of solar radiation intensity and temperatures at various locations on the solar still on the thermal performance and production of desalination unit is analyzed by the data recorded by the Arduino program. A cumulative yield of fresh water of around 0.7–0.9 L is recorded every day, and the lowest yield of around 0.55 L was obtained on the third day of experimentation.

KEYWORDS: monitoring; desalination; Arduino; temperature; performance; solar still; yiel

Properties Of A Class Of Analytic Functions Associated With Exponentially Convex Functions

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2025 - Journal of Mechanics of Continua and Mathematical Sciences

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ABSTRACT

Studies in univalent function theory comprising the exponential of differential characterizations are rarely considered. The prominent study in this direction is the study of so-called -exponentially convex functions. Here we study a class of analytic functions which satisfy an analytic characterization influenced by the definition of the multiplicative derivative and -exponentially convex functions. Integral representation and coefficient inequalities of the defined function class are the main results of the paper.

KEYWORDS: Analytic function, exponentially convex functions, multiplicative derivative, starlike functions,

Properties Of Bazilevič Functions Involving q-analogue of the generalized M-series, mathematics

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2025 - European Journal of Pure and Applied Mathematics

DOI: https://doi.org/10.29020/nybg.ejpam.v18i1.5841

ABSTRACT

With primary motive to unify and extend the various well-known studies, we define a new family of differential operator using the q-analogue of the generalized M-series. The generalized M-series unifies two well-known and extensively used special functions namely {\em generalized hypergeometric function} and {\em Mittag-Leffler function}. Making use of the defined operator, we define a new family of analytic functions expressed as a combination two differential characterizations. The combination of differential characterizations involving the operator not only unifies studies of starlike, convex, Bazilevi\v{c} and α-convex function classes, it extends to new classes. Estimates involving the initial coefficients of the functions, which belong to the defined function class are our main results. Some examples along with graphs have been used to establish the inclusion and closure properties.

KEYWORDS: Generalized M-series, Mittag-Leffler function, Generalized hypergeometric functions., quantum calculus, Analytic and univalent functions, starlike and convex functions, Bazilevi\v{c} function, Differential subordination

Pseudo starlike functions involving convex combination of two starlike functions

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2025 - International Journal of Engineering Trends and Technology

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ABSTRACT

In this paper, we introduce a new class of functions involving a familiar analytic characterization that was used to obtain sufficient conditions for starlikeness. We have discussed the impact of the convex combination of two starlike functions. The results obtained here extend or unify the various other well-known and new results

KEYWORDS: Analytic function, Convex function, Starlike function, Bazilevič function, Fekete-Szegö problem, Differential subordination.

Reliability analysis of a power distribution system with two transformers and six feeders

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2025 - Reliability Analysis of Power Distribution System

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ABSTRACT

The article explores the reliability and sensitivity of a power distribution substation. It includes an analysis based on real maintenance data collected from a 33/11kV electrical power distribution substation, which features a set of two 6 MVA power transformers supplying power through a total of six outgoing feeders (three feeders per transformer). The study documents faults observed in both transformers and all six outgoing feeders. The reliability of the substation is evaluated using various indices such as availability, repair durations, and expected repair frequencies for different failure types. The analysis employs Markov processes and regenerative point techniques. In addition to reliability, the study includes a profit analysis of the substation. It presents graphical representations of key parameters. Furthermore, a sensitivity analysis is conducted to assess how variations in parameters impact the availability and profitability of the substation components. Substation economics is also established to assess the operational viability.

KEYWORDS: failure, reliability, transformers, Markov process, regenerative processes.

Review study of e-waste management and resource recovery system for controlling environmental pollution

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2025 - International Journal of Environment and Waste Management
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ABSTRACT

This study investigates the escalating challenges of electronic waste (e-waste) disposal, highlighting its environmental and public health implications. It underscores the need for sustainable e-waste management by exploring diverse resource recovery methods and analyzing environmental risk assessment and pollution control strategies. Methodologically, the research reviews a decade of literature, revealing e-waste generation trends, regulations, and laws. Emphasizing issues with the informal recycling sector and limited environmental awareness among stakeholders, it offers a comprehensive overview of e-waste treatment technologies, advocating for resource-efficient practices. The article highlights challenges in organized e-waste management, considering unorganised recycling and environmental unawareness. An essential discovery underscores the immediate need for a strong recycling framework that adheres to ethics and laws. This framework would tackle the environmental and health risks associated with unregulated e-waste disposal. The study stresses the importance of accessible policies and collaborative efforts to combat e-waste proliferation, contributing to the discourse on sustainable resource management.

KEYWORDS: environmental pollution, e-waste management, recycling, waste treatment, resource recovery, risk assessment

Utilizing Rotary Friction Welding for Joining Aluminum Composite Materials by Omani Waste Marble Reinforcement

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2024 - Nanotechnology Perceptions

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ABSTRACT

luminum composite materials consist of a base material created from an aluminum alloy (ALSi12Fe) and reinforcement elements made from marble waste (MW). The stir-squeeze casting technique is employed to cast these components together. Composites consisting of an aluminum alloy and 5% MW were subjected to mechanical testing. The study demonstrated that the addition of MW reinforcements significantly improved the mechanical properties of the composite materials. The AL-Si12Fe +5%MW and AL-Si12Fe +5%MW-weld composites exhibited an ultimate tensile strength (UTS) that was 16% and 52% respectively higher than that of the ALSi12Fe aluminum alloy. Friction welding is a technique that can be used to improve and recrystallize crystals, in addition to being a technique for super-deformation.

KEYWORDS: AL-Si12Fe alloy, aluminum composites, rotary friction welding, marble wastes.

Some inequalities of a certain subclass of Bazilevič functions involving multiplicative calculus

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ABSTRACT

We define a new class of functions expressed as a convex combination of differential characterizations affected by the multiplicative derivative. Multiplicative derivative is defined in a domain, which excludes zero. Hence, in this case, the defined subclass does not involve replacing the ordinary derivative with a multiplicative derivative. However, we have used the motivation behind the purpose of this restrictive calculus given by the circumstances that we have a more versatile calculus of Newton and Euler. Estimates involving the initial coefficients of the functions, which have Maclaurin series and belong to the given function class are our main results. Some examples, along with the graphs, are used to establish the inclusion and the closure properties. Moreover, we obtain the logarithmic and inverse coefficients for the analyzed function class.

KEYWORDS:

Spatiotemporal Analysis and Machine Learning-Based Prediction of Air Quality in Indian Urban

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ABSTRACT

Air pollution, more specifically Particulate Matter (PM2.5 - particulate matter with diameter less than 2.5 micrometers), threatens the public health most critically in urban Indian cities, and Delhi, among them, presents the most acute challenge. This study predicts the concentrations of PM2.5 using machine learning models using data ranging from 2010 to 2023 and assessing model fit via R^2, RMSE, MAE, and MAPE metrics. Models tested: Random Forest, Gradient Boosting, AdaBoost, Histogram-Based Gradient Boosting, XGBoost. The Random Forest model is extremely effective for the training set ($R^2 = 0.99$) but shows the highest degree of overfitting, with R^2 of 0.35 for the test set. Gradient Boosting has a more balanced result, with R^2 0.54 and 0.48, respectively on the training and test set, as well as fewer errors (RMSE: 56.46, MAE: 39.60, MAPE: 0.50). Hence, it is a good predictor. AdaBoost performs the worst with an R^2 of 0.28 on the test set and the highest errors in terms of RMSE: 66.86, MAE: 52.34, MAPE: 0.94. Histogram Gradient Boosting and XGBoost: both models yield an average accuracy value, but the Gradient Boosting model is still a tad better than the former ones in terms of RMSE and MAE. Thus, Gradient Boosting happens to be the most accurate model considering generalization as well as accuracy for the prediction of the concentration of PM2.5. These results will be highly beneficial to policymakers to adopt machine learning-based air quality forecasting for better environmental management and the protection of public health.

KEYWORDS: Air Quality Prediction , Gradient Boosting , Machine Learning Models , Particulate Matter (PM2.5) , Random Forest , Spatiotemporal Analysis

Starlike Functions With Respect To (l,κ)Symmetric Points Associated With The Vertical Domain

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ABSTRACT

The study of various subclasses of univalent functions involving the solutions to various differential equations is not totally new, but studies of analytic functions with respect to (ℓ,κ) -symmetric points are rarely conducted. Here, using a differential operator which was defined using the Hadamard product of Mittag–Leffler function and general analytic function, we introduce a new class of starlike functions with respect to (ℓ,κ) -symmetric points associated with the vertical domain. To define the function class, we use a Carathéodory function which was recently introduced to study the impact of various conic regions on the vertical domain. We obtain several results concerned with integral representations and coefficient inequalities for functions belonging to this class. The results obtained by us here not only unify the recent studies associated with the vertical domain but also provide essential improvements of the corresponding results.

KEYWORDS: analytic function; univalent function; Schwarz function; vertical domain; subordination; coefficient inequalities

Supercritical CO_2 as a Green Technology for Carotenoids-Rich Virgin Palm Oil Production

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ABSTRACT

The experimental conditions of supercritical carbon dioxide (scCO2) extraction of virgin palm oil (VPO) from oil palm mesocarp fiber (OPMF) were optimized using the Response Surface Methodology (RSM). Results showed that a maximum of 28.68 % of VPO extraction was obtained at the optimal experimental conditions of scCO2 extraction: pressure of 31 MPa, temperature of 340 K, and extraction time of 80 min. The second-order rate equation, Arrhenius equation and Eyring theory were employed to assess the kinetics behaviour, activation energy and thermodynamics behaviour of scCO2 extraction of VPO from oil palm mesocarp fiber. The lower activation energy value (12.17 kJ/mol) of scCO2 for the extraction of VPO from OPMF indicates that the scCO2 extraction technology is less dependent on temperature during the extraction of VPO from OPMF. The physicochemical properties and fatty acids compositions analyses reveal that the scCO2 extracted VPO contains high carotenoids content (982 μg/g), low free fatty acids content (0.31 wt%), higher oxidative stability and higher unsaturated fatty acids content.

KEYWORDS:

Terahertz multi-resonator refractive index sensor with graphene and MXene integration for cancer biomarker analysis

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2025 - Physica E: Low-dimensional Systems and Nanostructures

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ABSTRACT

In this study, we propose an innovative biosensor design that incorporates multiple resonators specifically engineered for detecting carcinoembryonic antigen (CEA). The biosensor integrates a unique combination of materials, including MXene, black phosphorus, and graphene, arranged in a hybrid configuration. The design consists of a centrally positioned circular MXene resonator encircled by a square ring of black phosphorus, complemented by four gold circular resonators. These components are assembled on a silicon dioxide substrate. A comprehensive performance evaluation was conducted across the terahertz spectrum (0.1–1.0 THz) using finite element method modeling in COMSOL Multiphysics 6.2. The biosensor demonstrated impressive metrics, including a maximum sensitivity of 811 GHz RIU−1, a figure of merit of 14.479 RIU−1, and a quality factor of 6.946. When tested with varying CEA concentrations ranging from 0 to 5 ng/mL,

the device maintained stable and reliable operation. The transmission characteristics revealed systematic frequency variations from 0.389 THz to 0.382 THz. Additionally, a machine learning approach based on stacking ensemble regression was implemented to optimize sensor parameters. This computational strategy delivered outstanding predictive performance, achieving near-perfect accuracy across most operational variables. The biosensor's combination of high sensitivity, compact design, and reliable functionality positions it as a promising technology for early cancer screening and patient monitoring applications.

KEYWORDS:

Terahertz surface plasmon resonance sensor based on plasmonic heterostructures for dual-modal detection of cancer biomarkers and malaria antigens

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2025 - Surfaces and Interfaces

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ABSTRACT

Cancer and malaria represent significant global health burdens, requiring diagnostic platforms with enhanced sensitivity, specificity, and portability for effective disease management. Meanwhile, we have introduced in the present study a dual-modal terahertz surface plasmon resonance (THz-SPR) biosensor utilizing simple layered heterostructure incorporating gold, MXene, graphene, and black phosphorus nanomaterials for monitoring and detection of cancer and malaria. The numerical findings of the proposed sensor have been demonstrated based on the finite element method (FEM) and COMSOL Multiphysics software. In this regard, comprehensive electromagnetic simulations coupled with machine learning validation demonstrate exceptional sensitivity performance of 1000 GHzRIU-1 for precise detection of cancer biomarkers including carcinoembryonic antigen (CEA) and prostate-specific antigen (PSA), as well as malaria antigens histidine-rich protein 2 (HRP2) and parasite lactate

dehydrogenase (pLDH). In addition, the biosensor exhibits strong linear correlation between resonance frequency and refractive index variations ($R^2 > 0.91$), achieving low detection limits and demonstrating a superior analytical performance compared to conventional diagnostic platforms. Moreover, the integration of stacking ensemble machine learning algorithms significantly enhances predictive accuracy and maintains consistent performance across diverse operational parameters. Therefore, we believe that these findings establish the potential of two-dimensional material-based THz-SPR biosensors as high-performance diagnostic tools for simultaneous multi-target detection in resource-limited settings, addressing critical healthcare needs in global disease surveillance and point-of-care diagnostics.

KEYWORDS:

Ultra-high sensitivity terahertz detection using a 2D-material-based metasurface: Design, tuning, and machine learning validation

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ABSTRACT

The quantification of dopamine, a critical catecholamine neurotransmitter, remains a significant challenge in neurological research and clinical diagnostics due to its low physiological concentrations and interference from structurally similar compounds. This study presents a simple metasurface sensor employing graphene-enhanced surface plasmon resonance for ultra-sensitive dopamine detection. Finite element method simulations using COMSOL Multiphysics 6.2 demonstrate exceptional performance with a maximum sensitivity of 500 GHzRIU−1 at 0.805 THz, achieving a figure of merit of 2.110 and quality factor ranging from 3.376 to 3.435. The sensor exhibits tunable response through graphene chemical potential modulation (0.1–0.9 eV), with transmittance varying from 81.6% to 16.4%. Angular stability analysis reveals consistent performance across incidence angles from 0° to 80°. Machine learning integration using XGBoost regression achieves 92–100% prediction accuracy, enabling real-time performance optimization. The proposed sensor surpasses existing designs in sensitivity while maintaining broad refractive index detection range,positioning it as a promising platform for advanced neurochemical sensing applications in Parkinson's disease, schizophrenia, and substance abuse disorder diagnostics.

KEYWORDS: Machine learning optimization, XGBoost regression, Biomedical sensing, Photonic crystal fibre, Refractive index sensing, Plasmonic enhancement

VLSI-integrated CMOS-compatible high-performance terahertz metasurface biosensor for dual-mode detection of cancer and malaria with machine learning optimization

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2025 - Plasmonics

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ABSTRACT

The development of accessible diagnostic technologies for resource-limited settings remains a critical challenge in global health. This study presents a metasurface biosensor capable of simultaneous detection of cancer and malaria biomarkers. Operating at frequencies between 0.189–0.423 THz, the sensor demonstrates exceptional sensitivity of 1000 GHzRIU−1 for cancer detection and 143 GHzRIU−1 for malaria detection, with figure-of-merit values reaching 25.641 $RIU^{-}1$ and 5.102 $RIU^{-}1$, respectively. The device exhibits robust performance characteristics, including consistent quality factors (6.750–10.846), low detection limits (0.065–0.520 RIU), and excellent signal stability across varying experimental conditions. Machine learning optimization using Random Forest Regression achieved R2 scores of up to 94% for refractive index predictions and 89% for incident angle variations, validating the sensor's reliability and predictive accuracy. This dual-mode biosensor represents a significant advancement in point-of-care diagnostics, offering a unified platform for simultaneous cancer and malaria screening with potential for widespread implementation in resource-constrained healthcare environments.

KEYWORDS: Plasmonic resonance, Dual-mode sensing, Point-of-care diagnostics, Machine learning optimization, Global health technology

College of Medicine & Health Science

A constellation of anatomical variation: middle scalene, wrist extensor, and aortic arch variants share embryological origins in cervical somites

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ABSTRACT

During dissection of a 70-year-old male donor, several anatomical variations were observed, highlighted by a bilateral variant middle scalene muscle in the superolateral thoracic wall. The variant scalene muscle was traced from the transverse processes of cervical vertebrae to the fourth rib with a pronounced fascial slip. The elongated middle scalene muscle was thick in girth and abnormally wide at its insertion (56.0 mm), which is hypothesized to reflect compensatory hypertrophy secondary to lung carcinoma. A bilateral wrist extensor variant also was observed as well as an anomalous left vertebral artery from the aortic arch with an abnormal entrance into the vertebral canal. Collectively, these findings represent a constellation of anatomical variations that may be interrelated through altered cervical somite development, providing a fascinating example of how anatomical variations may cluster based on common embryological origin. Clinically, these observations have implications in thoracic outlet syndrome, tendon transfer, and vascular surgery.

KEYWORDS: Anatomic variation, Neck muscles, Vertebral artery, Somites, Thoracic outlet syndrome

Approaches to learning and study skills among medical students in Oman

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ABSTRACT

Effective learning habits have been identified as a significant factor influencing students' academic achievement. The present study was designed to investigate the learning approaches and study skills exhibited by the medical students from academic years MD1, MD2 and MD3 using a validated study skills inventory questionnaire, The Denis Congo Study Skills Inventory (DCSSI). The study of 255 students revealed that MD2 students generally scored lower in several skill areas compared to MD1 and MD3 students. Specifically, 70.54% of MD2 students scored below 30 in textbook reading, while 60.46% scored below 20 in note-taking skills. In memory skills, 26.35% of MD2 students scored below 30. For test preparation, 22.48% of MD2 students scored below 40, and 27.90% scored below 35 in concentration skills. Additionally, 44.18% of MD2 students scored below 20 in time management. These differences across the groups were statistically significant. The study identified note-taking, textbook reading, and time management as the areas where students needed the most support.

KEYWORDS: Study skills, Time management, Textbook reading, Note taking, Memory skills

Assessment of Professionalism in Undergraduate Medical Education: What Oncologists Need to Know: A Systematic Review

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2024 – Liaquat National Journal of Cancer Care

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ABSTRACT

Background: Cancer is the 3 most common non-communicable disease. Oncology is generally considered a super-subspecialty, and in several centers, postgraduate students rotate through the specialty. However, since undergraduates rotate in oncology wards and clinics and deal with cancer patients, they frequently come across the treating oncologists. Since oncologists are part of a teaching unit, they need to be aware of assessment tools in undergraduate medical education. Objective: The objective of this study was to provide oncologists with an overview of the current methods of assessment. Methods: Asystematic review of peer-reviewed literature using SCOPUS database was carried out to identify methods of assessment of professionalism in undergraduate medical education. The title and abstract of the selected documents were skimmed to include only relevant articles, defined as articles describing methods or tools of assessment of professionalism in undergraduate medical curricula. Results: Over the period 1973 to 2020, 125 relevant articles were identified. 54 articles described a method or tool of assessment, such as continuous assessment, or formal end-of-year/semester assessment. Most articles described assessing professionalism as part of continuous assessment, such as peer-assessment, self-assessment, a combination of the two, conscientiousness index, and portfolio. Conclusion: Assessment of professionalism in undergraduate medical education is complex, and several types of methods have been employed. While formal assessments play a role, integration of continuous assessment methods, such as peer and selfassessments and portfolios, suggests a shift towards formative evaluation strategies. Curriculum developers and examination committees should select method(s) appropriate to their program, contextually and culturally.

KEYWORDS: Professionalism, assessment, medical education, curriculum, systematic review, Oman

Asthma and Atopic Dermatitis in Asia, 1990-2021: The Global Burden of Disease Study 2021

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2025 - Clinical & Experimental Allergy

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ABSTRACT

Background: Given the diverse population and regional differences across Asia, a comprehensive analysis of allergic diseases is crucial for guiding healthcare planning, resource allocation, and prevention strategies. Therefore, utilising the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2021, we aimed to thoroughly investigate the burden of allergic conditions and their attributable risk factors in Asia. **Methods:** Asthma and atopic dermatitis (AD) prevalence and burden estimates were calculated across various regions within Asia (Central, South, Southeast, East Asia and high-income Asia Pacific) from 1990 to 2021, covering age groups segmented into five-year intervals and analysing data separately and combined for males and females. The Bayesian meta-regression tool was employed to estimate the prevalence, incidence, and cause-specific mortality of allergic disorders. Asthma-related deaths and disability-adjusted life years (DALYs) attributable to each risk factor were estimated using relative risks, risk exposure and the theoretical minimum risk exposure level input. **Results:** From 1990 to 2021, asthma in Asia showed significant declines in age-standardised prevalence, mortality, and DALYs, exceeding global trends. In 2021, an estimated 106 million (95% UI, 92–121) individuals in Asia had asthma, with age-standardised rates decreasing significantly. However, asthma-related deaths still accounted for 346,755 (278,046–464,848) cases in 2021. In contrast, the AD burden remained stable, with 68.1 million (65.4–71.0) cases in 2021, reflecting a 16.1% increase since 1990, though the age-standardised prevalence remained unchanged. AD exhibited the highest DALYs rates in high-income Asia Pacific and Central Asia, with significant gender disparities in prevalence. **Conclusion:** This study showed a declining age-standardised asthma burden, mortality, and impact, along with a stable burden of AD in Asia from 1990 to 2021. This comprehensive data analysis would provide invaluable insights for making targeted health interventions and policies aimed at mitigating the burden of allergic diseases in Asia.

KEYWORDS: Asia; Global Burden of Disease Injuries and Risk Factors Study; allergy; asthma; atopic dermatitis.

Awareness, preference, and utilisation of Ayush in India: Evidence from National Sample Survey, 2022–23

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2025 – Advances in Integrative Medicine

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ABSTRACT

Background: Integration of Ayurveda, Yoga and Naturopathy, Unani, Siddha, Sowa-Rigpa, and Homeopathy (Ayush) for universal healthcare coverage is a key policy agenda in India. Despite growing debate on its integration with mainstream healthcare, previous studies lack exclusive data on awareness, preference, and utilisation of Ayush. This study aims to analyse Ayush awareness, preference, and utilisation in rural and urban areas of India to inform policy recommendations.Materials and methods: The present study used the latest exclusive National Sample Survey (NSS) survey data on Ayush (2022–23). Descriptive, bivariate, and logistic regression analyses were applied to present the levels and patterns of awareness, preference, and utilisation of Ayush care in India. Results: Over 95 % of individuals in India are aware of Ayush, while about 60 % prefer to use Ayush for their treatment and 53 % utilise Ayush. There is an insignificant difference in awareness and preference between rural and urban areas, but there is considerable gap exists in the utilisation of Ayush. A higher utilisation is noted among older individuals, females, Scheduled Tribes (STs), and urban residents as compared to their counterparts. Self-medication with Ayush is very common among the users. Predominant treatments are rejuvenation (45.4 %) and therapeutic care (27 %). Key reasons for utilisation of Ayush care include effectiveness (72.1 %), faith (58.1 %), and low side effects (50.4 %). Conclusions: The preference and accessibility of Ayush services need to be enhanced particularly at the community level, to reduce reliance on self-medication and folk healers. Tailored strategies must address socio-demographic, religious, and caste-based variations to ensure equitable and broader acceptance of Ayush. Expanding rejuvenation and therapeutic care services can foster a preference for Ayush. Additionally, investment in research to understand factors influencing Ayush use and improve service infrastructure is essential for sustainable and effective integration of Ayush into the healthcare system.

Biallelic variants in SREK1 downregulating SNORD115 and SNORD116 cause a Prader-Willi-like syndrome

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ABSTRACT

Biallelic variations in SREK1 reduce SNORD115/116 expression, linking severe obesity and Prader-Willi-like traits, offering genetic and molecular insights into a new form of syndromic obesity.

KEYWORDS: Cell biology; Genetics; Molecular genetics; Monogenic diseases; Neuroscience; Obesity.

Calculating the Notional Learning Hours (NLH) for Final-year Medical Students in a Clinical Surgery Clerkship Course

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DOI 10.18502/sjms.v19i3.15081

ABSTRACT

Background: The main objective of this study is to design a method to calculate the notional learning hours (NLH) of final-year medical students doing a surgical clerkship course, as current methods are based only on assumptions. Secondary objectives include derivation of the Oman Qualification Framework (OQF) credits and setting a benchmark of NLH calculation in clinical courses. Methods: This is an observational cross-sectional study which uses quantitative methods to estimate students' NLH. A questionnaire was designed and filled in by final-year medical students at the end of their surgical rotation. Ethical clearance was obtained. Data were uploaded and analyzed using the SPSS 25. The NLH was thencalculated and mapped onto the OQF template. Results: Ninety-seven students participated in the study. Students spent an average of 1.20 hrs/day studying for their clinical sessions and 2.86/day studying for their theory sessions. The mean weekend hours of study on Friday and Saturday were 3.1 and 3.2 hrs, respectively. The average preparation for the end rotation and the final graduating (MD) exams were 9.7 and 10.4 hrs, respectively. We calculated the NLH of our students by adding the above data to the contact teaching hours from our course timetable. We compared our results with medical schools worldwide. Conclusion: The NLH of our surgical clerkship students was calculated and subsequently the OQF credits were derived. Our method is based on real-life students' study hours and not on unproven assumptions. It could be used as a guide by other clinical clerkship courses.

KEYWORDS: notional learning hours, credit hours, Oman Authority for Academic Accreditation and Quality Assurance of Education (OAAAQA), Oman Qualification Framework (OQF), students′ workload, self-study, medical students, surgical clerkship

Clinical and microbiological perspectives on multidrug-resistant gram-negative pathogens in bloodstream infections

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ABSTRACT

Introduction: Bloodstream infections (BSIs) caused by multidrug-resistant (MDR) Gram-negative bacilli pose a significant challenge in healthcare settings around the world. The main objective of this research was to determine the incidence, etiology, risk factors, and sources of BSIs among patients treated at Sohar Hospital in Oman. Methods: The study employed a retrospective methodology at Sohar Hospital, Oman, analyzing patients with BSIs from January 2018 to December 2019 utilizing electronic health data. Demographic data, bacterial etiology, antibiotic susceptibility, and patient outcomes were obtained from electronic health records. The statistical tools employed comprised t-tests, Mann–Whitney tests, Chi-square tests, and Fisher's exact tests for variable comparison, alongside univariate odds ratios computed for mortality correlations utilizing the R package GTSUMMARY. Bacterial identification and testing was performed in accordance with Clinical and Laboratory Standards Institute (CLSI) guidelines utilizing both traditional methods and automated technologies. Results: The majority of BSIs occur in elderly individuals with comorbidities. Surgical intervention was identified as a predominant risk factor for adverse consequences. MDR infections were linked with higher mortality rates. Klebsiella pneumoniae and Acinetobacter baumannii were prevalent, with K. pneumoniae exhibiting resistance to several antibiotics. Conclusions: The study highlights the urgent requirement for effective monitoring, management and infectious control measures to reduce the impact of BSIs and MDR pathogens on patient outcomes. It contributes valuable insights into the local epidemiology of BSIs in Oman. It emphasizes the significance of tailored interventions and precise medications to address the growing threat of antimicrobial resistance in healthcare settings.

KEYWORDS:

Does widowhood affect social capital in old age: the case of India

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ABSTRACT

Purpose: In India, widowhood, besides, being a personal status, presents itself as a social institution. Widows in India have long been deprived of normal living conditions and their hardships have been generally inconspicuous to policymakers as well as researchers. Therefore, this study is an attempt to understand the social dynamics of widowhood in India mainly through empirical means. It aims to examine the social capital of old widows through the lens of sociability, safety, and trust and solidarity. Methods: Ordered logistic regressions and Item Response Theory Partial Credit models with data drawn from the SAGE Study on Global Aging and Adult Health which was conducted across six populous states of India have been used for analysis. **Findings:** Results show that old widows experience significantly lesser sociability, trust and solidarity as compared to their married counterparts. Also, older widows from high income group are less vulnerable and have higher social capital compared to that of older widows from poorer income groups. **Discussion:** Policy implications drawn based on the findings can play a vital role in uplifting the life of old widows in India significantly. This study is perhaps the first study to capture how widowhood affects the social capital in old age in India. Besides, based on the findings, we also suggest some policy initiatives to address the concern of low social capital among old widows in India.

KEYWORDS: widowhood, women, old age, social capital, sociability, India

Early nourishment, better survival: association between breastfeeding initiation and infant mortality in Indian tribes

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ABSTRACT

Background: Timely breastfeeding initiation within one hour of birth is recommended to reduce neonatal and early infant mortality. However, rates of early breastfeeding remain suboptimal in India, especially among marginalized tribal communities, which continue to experience disproportionately high infant mortality. The study investigated the association between the late breastfeeding initiation and infant mortality among the tribal population in India. **Method:** The study utilized data from the fifth round if the National Family Health Survey, which provided a sample of 232,920 most recent live births in the past five years with data on breastfeeding initiation time and infant mortality. Associations between late initiation (> 1 hour) and mortality were analysed using Cox proportional hazards regression and Kaplan-Meier survival curves. **Results:** The results showed that infants breastfed after the first hour of life had a 30% higher risk of infant mortality compared to those breastfed within an hour of birth (aHR: 1.30, 95% CI: 1.06–1.60). The Kaplan-Meier curves further highlighted the lower chances of survival when breastfeeding was delayed. **Conclusion:** These findings underscore the need for promoting early breastfeeding initiation through culturally appropriate interventions in tribal areas as a strategy to reduce persistent child survival disparities in India.

KEYWORDS: Breastfeeding, Mortality, Child, India, Indigenous

Escape and Evolve: Simulation Escape Rooms as a Transformative Pedagogy in Health Professions Education

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ABSTRACT

Background: Simulation escape rooms (SERs) in health professions education are an innovative pedagogical strategy designed to actively develop crucial graduate competencies addressing limitations of traditional teaching. Despite reported benefits, there is a research gap regarding their efficacy, especially with control group studies. Thus, we designed, implemented and evaluated a SER module, recognizing the need for more innovative strategies in our curriculum. **Approach**: We employed a nonequivalent control group pre- and post-test design in final-year medical students during paediatric rotations. The control group (n = 55) had conventional student-led seminars, while the intervention group (n = 59) experienced the SER module, which incorporated six sequential challenges to be completed within 45 min. We assessed knowledge acquisition (Kirkpatrick Level 2) using pre- and post-test questionnaires and gathered data on student experiences (Kirkpatrick Level 1) through structured feedback. Facilitator evaluations also contributed to the assessment of competencies. **Evaluation:** While achieving similar knowledge gains, the SER intervention significantly enhanced student satisfaction and preference, with students reporting improved clinical competencies, including team communication, leadership and critical thinking. Positive qualitative feedback supported the learning environment and faculty support, and facilitators noted effective teamwork. Challenges included significant faculty time investment, with limitations of short-term knowledge evaluation and dependence on self-reported competency perceptions. **Implications:** An innovative paediatric-themed SER module was implemented, demonstrating its feasibility in enhancing learning, engagement and perceived collaborative problem-solving. This study's flexible design provides a useful framework for educators to develop context-specific escape rooms, while also highlighting the need for digital adaptations to improve delivery.

KEYWORDS:

Exploring Milestones": Harnessing active learning in the undergraduate paediatrics curriculum

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ABSTRACT

Introduction: Paediatric milestones provide a structured method for observing and monitoring a child's progress and should be part of core paediatric curriculum. However, a literature review reveals that primary care physicians and pediatricians feel inadequate about their knowledge and practice of developmental paediatrics, thus exposing the lacunae in training. Methods: An intervention was planned amongst final-year medical undergraduate students in Oman during their paediatric rotation. A 90-minute multimodal active learning module incorporating diverse learning orientations was planned and administered as a skill-lab session. Its effectiveness in learner motivation, engagement, and faculty participation was evaluated using a questionnaire based on the ICAP (Interactive, Constructive, Active, and Passive) framework, administered to students at the end of the session. Results: Responses of the 62 participants indicated a significant association between their overall experience and tasks related to the active, constructive, and interactive elements of the module (p=0.001). The faculty's role in facilitating the session significantly contributed to students' overall experience (p=0.000). On linear regression, active, constructive, and interactive components of the module were moderate to high predictors of the participants' overall learning experience. Conclusion: It was beneficial to base the teaching module on established learning theories. Active learning strategies proactively fostered student engagement and self-directed learning during the session. Faculty played an important role in planning and customising the content, flow, and delivery to maximise meaningful learning. Such interactive collaboration, especially for theoretical concepts in medicine, enables better student engagement, providing enhanced opportunities for learning, practice, and feedback.

KEYWORDS: Active Learning, Child Development, Undergraduate Medical Education, Student Engagement, ICAP Framework

Exploring the Role of Psychological Support and Social Factors in Resilience among Traumatic Amputees in North Batinah, Oman: Mixed Methodology

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ABSTRACT

Background: The absence of an obligatory psychological component in amputee rehabilitation services can delay postamputation adaptation and may amplify the influence of psychological variables on adjustment among Omani individuals. The integration of mental health practices into recovery could significantly enhance the overall integrity of the rehabilitation process. **Objectives:** This study explores the experiences of traumatic amputees in North Batinah, Oman, focusing on the impact of professional psychological support, social support factors, and self-esteem on their resilience. **Methods:** A mixed-methods design was employed, combining quantitative analysis of three psychological scales—the Rosenberg Self-esteem Scale, Connor-Davidson Resilience Scale-10 (CD-RISC-10), and the Protective Factors of Resilience Scale (PFRS)—with thematic analysis of narratives from nine participants. Quantitative data were analyzed using descriptive statistics, correlation analysis, and group comparisons. Qualitative data underwent thematic analysis, with themes generated from the participants' shared experiences. **Results:** The descriptive statistics indicated variability in protective factors, while self-esteem and resilience scores were more consistent. Correlation analysis revealed a strong positive relationship between self-esteem and resilience ($r = 0.76$). Thematic analysis identified four major themes: Self-perception as a determinant of resilience, perceived social support, impact of professional psychological support on resilience, and key contributors to resilience. Participants with positive self-perception and strong social and psychological support networks reported higher levels of resilience. Additionally, prosthetic acceptance and employment emerged as crucial factors in promoting recovery. **Conclusions:** This study highlights the pivotal role of professional psychological support in enhancing resilience and facilitating post-amputation adaptation among traumatic amputees. The findings underscore the importance of integrating tailored psychological interventions into rehabilitation programs. For clinical practice, these results suggest the need for customized rehabilitation programs and treatment plans that address the psychological well-being of amputees. Future research should address the limitations of this study, including sample size and demographic diversity, and explore additional factors influencing resilience in this population

KEYWORDS: Amputation, Resilience, Self-esteem, Social Support, Psychological Support, Prosthetic Acceptance, Rehabilitation

Global burden of vision impairment due to age-related macular degeneration, 1990-2021, with forecasts to 2050: a systematic analysis for the Global Burden of Disease Study 2021

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ABSTRACT

Background: Age-related macular degeneration (AMD) is a growing public health concern worldwide, as one of the leading causes of vision impairment. We aimed to estimate global, national, and region-specific prevalence and disability-adjusted life-years (DALYs) along with tobacco as a modifiable risk factor to aid public policy addressing AMD. **Methods:** Data on AMD were extracted from the Global Burden of Disease, Injuries, and Risk Factor Study 2021 database in 204 countries and territories, 1990-2021. Vision impairment was defined and categorised by severity as follows: moderate to severe vision loss (visual acuity from <6/18 to 3/60) and blindness (visual acuity <3/60 or a visual field <10 degrees around central fixation). The burden of vision impairment attributable to AMD was subsequently estimated. These estimates were further stratified by geographical region, age, year, sex, Healthcare Access and Quality (HAQ) Index, and Socio-demographic Index (SDI) levels. Additionally, the effect of tobacco use, a modifiable risk factor, on the burden of AMD was analysed, and projections of AMD burden were estimated through to 2050. These projections also included scenario modelling to assess the potential effects of tobacco elimination. **Findings:** Globally, the number of individuals with vision impairment due to AMD more than doubled, rising from 3·64 million (95% uncertainty inverval [UI] 3·04-4·35) in 1990 to 8·06 million (6·71-9·82) in 2021. Similarly, DALYs increased by 91% over the same period, from 0·30 million (95% UI 0·21-0·42) to 0·58 million (0·40-0·80). By contrast, age-standardised prevalence and DALY rates declined, with prevalence rates decreasing by 5·53% (99·50 per 100 000 of the population [95% UI 83·16-118·04] in 1990 to 94·00 [78·32-114·42] in 2021) and DALY rates dropping by 19·09% (8·38 [5·70-11·53] to 6·78 [4·70-9·32]). These rates showed a consistent decrease in higher SDI quintiles, reflecting the negative correlation between HAQ Index and AMD burden. A general downward trend was observed from 1990 to 2021, with the largest age-standardised reduction occurring in the low-middle SDI quintile. The global contribution of tobacco to age-standardised DALYs decreased by 20%, declining from 12·45% (95% UI 7·73-17·37) in 1990 to 9·96% (6·12-14·06) in 2021. By 2050, the number of

individuals affected by AMD is projected to increase from 3·40 million males (95% UI 2·81-4·17) in 2021 to 9·02 million (5·72-14·20) and from 4·66 million females (3·88-5·65) to 12·32 million (8·88-17·08). Eliminating tobacco use could reduce these numbers to 8·17 million males (5·59-11·92) and 11·15 million females (8·58-14·48) in 2050. **Interpretation:** While the total prevalence and DALYs due to AMD have steadily increased from 1990 to 2021, age-standardised prevalence and DALY rates have declined, probably reflecting the effect of population ageing and growth. The consistent decrease in age-standardised rates with higher SDI levels highlights the crucial role of health-care resources and public policies in mitigating AMD-related vision impairment. The downward trend observed from 1990 to 2021 might also be partially attributed to the reduced effect of tobacco as a modifiable risk factor, with declines in tobacco use seen globally and across all SDI quintiles. The burden of vision impairment due to AMD is projected to increase to about 21·34 million in 2050. However, effective tobacco regulation has the potential to substantially reduce AMD-related vision impairment, particularly in lower SDI quintiles where health-care resources are limited.

KEYWORDS: Alternative organisms, cell culture, refinement, replacement, vertebrate

Global, regional, and national burden of asthma and atopic dermatitis, 1990-2021, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021

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2025 – Lancet Respiratory Medicine

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ABSTRACT

Background: Asthma and atopic dermatitis are common allergic conditions that contribute to substantial health loss, economic burden, and pain across individuals of all ages worldwide. Therefore, as a component of the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2021, we present updated estimates of the prevalence, disability-adjusted life-years (DALYs), incidence, and deaths due to asthma and atopic dermatitis and the burden attributable to modifiable risk factors, with forecasted prevalence up to 2050. **Methods:** Asthma and atopic dermatitis prevalence, incidence, DALYs, and mortality, with corresponding 95% uncertainty intervals (UIs), were estimated for 204 countries and territories from 1990 to 2021. A systematic review identified data from 389 sources for asthma and 316 for atopic dermatitis, which were further pooled using the Bayesian meta-regression tool. We also described the age-standardised DALY rates of asthma attributable to four modifiable risk factors: high BMI, occupational asthmagens, smoking, and nitrogen dioxide pollution. Furthermore, as a secondary analysis, prevalence was forecasted to 2050 using the Socio-demographic Index (SDI), air pollution, and smoking as predictors for asthma and atopic dermatitis. To assess trends in the burden of asthma and atopic dermatitis before (2010-19) and during (2019-21) the COVID-19 pandemic, we compared their average annual percentage changes (AAPCs). **Findings:** In 2021, there were an estimated 260 million (95% UI 227-298) individuals with asthma and 129 million (124-134) individuals with atopic dermatitis worldwide. Asthma cases declined from 287 million (250-331) in 1990 to 238 million (209-272) in 2005 but increased to 260 million in 2021. Atopic dermatitis cases consistently rose from 107 million (103-112) in 1990 to 129 million (124-134) in 2021. However, age-standardised prevalence rates decreased-by 40·0% (from 5568·3 per 100 000 to 3340·1 per 100 000) for asthma and 8·3% (from 1885·4 per 100 000 to 1728·5 per 100 000) for atopic dermatitis. In 2021, there were substantial variations in the burden of asthma and atopic dermatitis across different SDI groups, with the highest age-standardised DALY rate found in south Asia for

asthma (465·0 [357·2-648·9] per 100 000) and the high-income super-region for atopic dermatitis (3552·5 [3407·2-3706·1] per 100 000). During the COVID-19 pandemic, the decline in asthma prevalence had stagnated (AAPC pre-pandemic -1·39% [-2·07 to -0·71] and during the pandemic 0·47% [-1·86 to 2·79]; p=0·020); however, there was no significant difference in atopic dermatitis prevalence in the same period (pre-pandemic -0·28% [-0·33 to -0·22] and during the pandemic -0·35% [-0·78 to 0·08]; p=0·20). Modifiable risk factors were responsible for 29·9% of the global asthma DALY burden; among them, high BMI was the greatest contributor (39·4 [19·6-60·2] per 100 000), followed by occupational asthmagens (20·8 [16·7-26·5] per 100 000) across all regions. The age-standardised DALY rate of asthma attributable to high BMI was highest in high-SDI settings, whereas the contribution of occupational asthmagens was highest in low-SDI settings. According to our forecasting models, we expect 275 million (224-330) asthma cases and 148 million (140-158) atopic dermatitis cases in 2050, with population growth driving this increase. However, age-standardised prevalence rates are expected to remain stable (-23·2% [-44·4 to 5·3] for asthma and -1·4% [-9·1 to 7·0] for atopic dermatitis) from 2021 to 2050. **Interpretation:** Although the increases in the total number of asthma and atopic dermatitis cases will probably continue until 2050, age-standardised prevalence rates are expected to remain stable. A considerable portion of the global burden could be managed through efforts to address modifiable risk factors. Additionally, the contribution of risk factors to the burden substantially varied by SDI, which suggests the need for tailored initiatives for specific SDI settings. The growing number of individuals expected to be affected by asthma and atopic dermatitis in the future suggests that it is essential to improve our understanding of risk factors for asthma and atopic dermatitis and collect disease prevalence data that are globally generalisable.

KEYWORDS:

Global, regional, and national burden of household air pollution, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021

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2025 – The Lancet

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ABSTRACT

Background: Despite a substantial reduction in the use of solid fuels for cooking worldwide, exposure to household air pollution (HAP) remains a leading global risk factor, contributing considerably to the burden of disease. We present a comprehensive analysis of spatial patterns and temporal trends in exposure and attributable disease from 1990 to 2021, featuring substantial methodological updates compared with previous iterations of the Global Burden of Diseases, Injuries, and Risk Factors Study, including improved exposure estimations accounting for specific fuel types. **Methods:** We estimated HAP exposure and trends and attributable burden for cataract, chronic obstructive pulmonary disease, ischaemic heart disease, lower respiratory infections, tracheal cancer, bronchus cancer, lung cancer, stroke, type 2 diabetes, and causes mediated via adverse reproductive outcomes for 204 countries and territories from 1990 to 2021. We first estimated the mean fuel type-specific concentrations (in μg/m3) of fine particulate matter (PM2·5) pollution to which individuals using solid fuels for cooking were exposed, categorised by fuel type, location, year, age, and sex. Using a systematic review of the epidemiological literature and a newly developed meta-regression tool (meta-regression: Bayesian, regularised, trimmed), we derived disease-specific, non-parametric exposure-response curves to estimate relative risk as a function of PM2·5 concentration. We combined our exposure estimates and relative risks to estimate population attributable fractions and attributable burden for each cause by sex, age, location, and year. **Findings:** In 2021, 2·67 billion (95% uncertainty interval [UI] 2·63-2·71) people, 33·8% (95% UI 33·2-34·3) of the global population, were exposed to HAP from all sources at a mean concentration of 84·2 μg/m3. Although these figures show a notable reduction in the percentage of the global population exposed in 1990 (56·7%, 56·4-57·1), in absolute terms, there has been only a decline of 0·35 billion (10%) from the 3·02 billion people exposed to HAP in 1990. In 2021, 111 million (95% UI 75·1-164) global disability-adjusted life-years (DALYs) were attributable to HAP, accounting for 3·9% (95% UI 2·6-5·7) of all DALYs. The rate of global, HAP-attributable DALYs in 2021 was 1500·3 (95% UI 1028·4-2195·6) age-standardised DALYs per 100 000 population, a decline of 63·8% since 1990, when HAP-attributable DALYs comprised

4147·7 (3101·4-5104·6) age-standardised DALYs per 100 000 population. HAP-attributable burden remained highest in sub-Saharan Africa and south Asia, with 4044·1 (3103·4-5219·7) and 3213·5 (2165·4-4409·4) age-standardised DALYs per 100 000 population, respectively. The rate of HAP-attributable DALYs was higher for males (1530·5, 1023·4-2263·6) than for females (1318·5, 866·1-1977·2). Approximately one-third of the HAP-attributable burden (518·1, 410·1-641·7) was mediated via short gestation and low birthweight. Decomposition of trends and drivers behind changes in the HAP-attributable burden highlighted that declines in exposures were counteracted by population growth in most regions of the world, especially sub-Saharan Africa. **Interpretation:** Although the burden attributable to HAP has decreased considerably, HAP remains a substantial risk factor, especially in sub-Saharan Africa and south Asia. Our comprehensive estimates of HAP exposure and attributable burden offer a robust and reliable resource for health policy makers and practitioners to precisely target and tailor health interventions. Given the persistent and substantial impact of HAP in many regions and countries, it is imperative to accelerate efforts to transition under-resourced communities to cleaner household energy sources. Such initiatives are crucial for mitigating health risks and promoting sustainable development, ultimately improving the quality of life and health outcomes for millions of people.

KEYWORDS:

Global, regional, and national prevalence of adult overweight and obesity, 1990-2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021

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2025 – The Lancet

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ABSTRACT

Background: Overweight and obesity is a global epidemic. Forecasting future trajectories of the epidemic is crucial for providing an evidence base for policy change. In this study, we examine the historical trends of the global, regional, and national prevalence of adult overweight and obesity from 1990 to 2021 and forecast the future trajectories to 2050. **Methods:** Leveraging established methodology from the Global Burden of Diseases, Injuries, and Risk Factors Study, we estimated the prevalence of overweight and obesity among individuals aged 25 years and older by age and sex for 204 countries and territories from 1990 to 2050. Retrospective and current prevalence trends were derived based on both self-reported and measured anthropometric data extracted from 1350 unique sources, which include survey microdata and reports, as well as published literature. Specific adjustment was applied to correct for self-report bias. Spatiotemporal Gaussian process regression models were used to synthesise data, leveraging both spatial and temporal correlation in epidemiological trends, to optimise the comparability of results across time and geographies. To generate forecast estimates, we used forecasts of the Socio-demographic Index and temporal correlation patterns presented as annualised rate of change to inform future trajectories. We considered a reference scenario assuming the continuation of historical trends. **Findings:** Rates of overweight and obesity increased at the global and regional levels, and in all nations, between 1990 and 2021. In 2021, an estimated 1·00 billion (95% uncertainty interval [UI] 0·989-1·01) adult males and 1·11 billion (1·10-1·12) adult females had overweight and obesity. China had the largest population of adults with overweight and obesity (402 million [397-407] individuals), followed by India (180 million [167-194]) and the USA (172 million [169-174]). The highest age-standardised prevalence of overweight and obesity was observed in countries in Oceania and north Africa and the Middle East, with many of these countries reporting prevalence of more than 80% in adults. Compared with 1990, the global prevalence of obesity had increased by 155·1% (149·8-160·3) in males and

104·9% (95% UI 100·9-108·8) in females. The most rapid rise in obesity prevalence was observed in the north Africa and the Middle East super-region, where age-standardised prevalence rates in males more than tripled and in females more than doubled. Assuming the continuation of historical trends, by 2050, we forecast that the total number of adults living with overweight and obesity will reach 3·80 billion (95% UI 3·39-4·04), over half of the likely global adult population at that time. While China, India, and the USA will continue to constitute a large proportion of the global population with overweight and obesity, the number in the sub-Saharan Africa super-region is forecasted to increase by 254·8% (234·4-269·5). In Nigeria specifically, the number of adults with overweight and obesity is forecasted to rise to 141 million (121-162) by 2050, making it the country with the fourth-largest population with overweight and obesity. **Interpretation:** No country to date has successfully curbed the rising rates of adult overweight and obesity. Without immediate and effective intervention, overweight and obesity will continue to increase globally. Particularly in Asia and Africa, driven by growing populations, the number of individuals with overweight and obesity is forecast to rise substantially. These regions will face a considerable increase in obesity-related disease burden. Merely acknowledging obesity as a global health issue would be negligent on the part of global health and public health practitioners; more aggressive and targeted measures are required to address this crisis, as obesity is one of the foremost avertible risks to health now and in the future and poses an unparalleled threat of premature disease and death at local, national, and global levels.

KEYWORDS:

Global, regional, and national prevalence of child and adolescent overweight and obesity, 1990-2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021

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ABSTRACT

Background: Despite the well documented consequences of obesity during childhood and adolescence and future risks of excess body mass on non-communicable diseases in adulthood, coordinated global action on excess body mass in early life is still insufficient. Inconsistent measurement and reporting are a barrier to specific targets, resource allocation, and interventions. In this Article we report current estimates of overweight and obesity across childhood and adolescence, progress over time, and forecasts to inform specific actions. **Methods:** Using established methodology from the Global Burden of Diseases, Injuries, and Risk Factors Study 2021, we modelled overweight and obesity across childhood and adolescence from 1990 to 2021, and then forecasted to 2050. Primary data for our models included 1321 unique measured and self-reported anthropometric data sources from 180 countries and territories from survey microdata, reports, and published literature. These data were used to estimate age-standardised global, regional, and national overweight prevalence and obesity prevalence (separately) for children and young adolescents (aged 5-14 years, typically in school and cared for by child health services) and older adolescents (aged 15-24 years, increasingly out of school and cared for by adult services) by sex for 204 countries and territories from 1990 to 2021. Prevalence estimates from 1990 to 2021 were generated using spatiotemporal Gaussian process regression models, which leveraged temporal and spatial correlation in epidemiological trends to ensure comparability of results across time and geography. Prevalence forecasts from 2022 to 2050 were generated using a generalised ensemble modelling approach assuming continuation of current trends. For every age-sex-location population across time (1990-2050), we estimated obesity (vs overweight) predominance using the log ratio of obesity percentage to overweight percentage. **Findings:** Between 1990 and 2021, the combined prevalence of overweight and obesity in children and adolescents doubled, and that of obesity alone tripled.

By 2021, 93·1 million (95% uncertainty interval 89·6-96·6) individuals aged 5-14 years and 80·6 million (78·2-83·3) aged 15-24 years had obesity. At the super-region level in 2021, the prevalence of overweight and of obesity was highest in north Africa and the Middle East (eg, United Arab Emirates and Kuwait), and the greatest increase from 1990 to 2021 was seen in southeast Asia, east Asia, and Oceania (eg, Taiwan [province of China], Maldives, and China). By 2021, for females in both age groups, many countries in Australasia (eg, Australia) and in high-income North America (eg, Canada) had already transitioned to obesity predominance, as had males and females in a number of countries in north Africa and the Middle East (eg, United Arab Emirates and Qatar) and Oceania (eg, Cook Islands and American Samoa). From 2022 to 2050, global increases in overweight (not obesity) prevalence are forecasted to stabilise, yet the increase in the absolute proportion of the global population with obesity is forecasted to be greater than between 1990 and 2021, with substantial increases forecast between 2022 and 2030, which continue between 2031 and 2050. By 2050, super-region obesity prevalence is forecasted to remain highest in north Africa and the Middle East (eg, United Arab Emirates and Kuwait), and forecasted increases in obesity are still expected to be largest across southeast Asia, east Asia, and Oceania (eg, Timor-Leste and North Korea), but also in south Asia (eg, Nepal and Bangladesh). Compared with those aged 15-24 years, in most super-regions (except Latin America and the Caribbean and the high-income super-region) a greater proportion of those aged 5-14 years are forecasted to have obesity than overweight by 2050. Globally, 15·6% (12·7-17·2) of those aged 5-14 years are forecasted to have obesity by 2050 (186 million [141-221]), compared with 14·2% (11·4-15·7) of those aged 15-24 years (175 million [136-203]). We forecasted that by 2050, there will be more young males (aged 5-14 years) living with obesity (16·5% [13·3-18·3]) than overweight (12·9% [12·2-13·6]); while for females (aged 5-24 years) and older males (aged 15-24 years), overweight will remain more prevalent than obesity. At a regional level, the following populations are forecast to have transitioned to obesity (vs overweight) predominance before 2041-50: children and adolescents (males and females aged 5-24 years) in north Africa and the Middle East and Tropical Latin America; males aged 5-14 years in east Asia, central and southern sub-Saharan Africa, and central Latin America; females aged 5-14 years in Australasia; females aged 15-24 years in Australasia, high-income North America, and southern sub-Saharan Africa; and males aged 15-24 years in high-income North America. **Interpretation:** Both overweight and obesity increased substantially in every world region between 1990 and 2021, suggesting that current approaches to curbing increases in overweight and obesity have failed a generation of children and adolescents. Beyond 2021, overweight during childhood and adolescence is forecast to stabilise due to further increases in the population who have obesity. Increases in obesity are expected to continue for all populations in all world regions. Because substantial change is forecasted to occur between 2022 and 2030, immediate actions are needed to address this public health crisis.

KEYWORDS:

Impact of Weather, Lockdown, and Fire on Air Quality: An Analysis of Particulate Matter in Kochi, India

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ABSTRACT

This study investigates Particulate Matter (PM) variations in Kochi, India, and its association with meteorological variables by analyzing five years of ground-based observational data. It focuses on PM pollution at the Vyttila Mobility Hub, using the hourly mean of PM2.5 and PM10 data from January 2018 to March 2023. Annual PM2.5, 41.78 µg/m3 and PM10, 76.64 µg/m3 levels exceeded Indian National Ambient Air Quality Standards and World Health Organization limits, notably in winter and post-monsoon seasons. Inter-annual trends showed a decline from 2018 to 2021, followed by a rise in 2022, with the most significant decline observed between 2019 and 2020 possibly due to COVID-19 restrictions. Monthly variations revealed elevated PM levels in winter and lower levels during the monsoon months. Sunday consistently recorded the lowest levels in the weekly analysis. Diurnal patterns displayed two peaks during morning and evening rush hours. Additionally, the study included an examination of ratios across different time periods. Winter's higher PM2.5/PM10 (0.65 ± 0.12) ratio indicated combustion emissions, while the monsoon's lower ratio, (0.47 ± 0.15) resulted from rainout. Correlation analysis of PM and meteorological variables showed temperature positively correlates with PM, while humidity and wind speed negatively correlate. Fire at the Brahmapuram solid waste treatment plant in March 2023 led to elevated emissions, resulting in a surge of around 78% in PM2.5 and 15% in PM10 compared to the mean value of previous years and the observed ratio was 0.65 ± 0.15, indicating the increased presence of PM2.5 due to the fire incident.

KEYWORDS: Air quality, Particulate matter, Meteorology, COVID-19, Fire, Kochi

Insight and empathy in schizophrenia: Impact on quality of life and symptom severity

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ABSTRACT

Background: Quality of life has emerged as a powerful indicator of therapeutic success. However, little research has been conducted to study potential factors that influence quality of life in persons with schizophrenia, particularly in low-income developing nations. **Aim:** This study aimed to investigate how insight and empathy impacted the quality of life and severity of symptoms in patients. **Methods:** A descriptive cross-sectional research design was conducted on 168 patients with schizophrenia using the PANSS Scale, Schizophrenia Quality of Life Scale R4, the Interpersonal Reactivity Index, and the Birchwood Insight Scale. **Results:** Our findings show that the mean score for quality of life was (70.9 ± 9.2), whereas the mean scores for empathy and insight were (60.8 ± 15.8) and (5.8 ± 1.9), respectively. Insight and empathy have predicted effects on QoL (adjusted r square = 0.035, sig = 0.009) and (adjusted r square = 0.012, sig = 0.027), respectively. On the other hand, the regression model also showed a substantial inverse relationship between the severity of the illness and both empathy and insight. **Conclusion:** The majority of the clients had poor quality of life, low insight, and low empathy. Insight and empathy play a role in anticipating the patient's perceptions of quality of life. They might affect how severe their illness is. Our findings highlight the importance of developing empathy and insight, and therapies that do so may aid patients with low quality of life.

KEYWORDS: Empathy; Insight; Quality of life; Schizophrenia; Severity; Symptom.

Knowledge, Attitude, and Practice of Antibiotic Use among Medical Students in the College of Medicine, National University, Oman

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ABSTRACT

OBJECTIVE: To assess the knowledge, attitude, and practice toward antibiotic use among medical students at the College of Medicine, Oman. **METHODOLOGY**: A cross-sectional study was conducted at the College of Medicine, where both premedical and medical students were included in data collection from November 2023 to January 2024. A structured pretested questionnaire was used to collect data from all students. SPSS version 20 was used for data analysis. Independent variables were presented as frequency and percentage, while the total knowledge score was presented as mean and standard deviation. The mean total knowledge score was associated with independent variables using a t-test. **RESULTS:** A total of 472 students participated in this study, where most (74.2%) did not receive any previous training on antibiotic use. Students with prior training on antibiotic use had better knowledge (81.5±18.4) than those without it (62.1±25). Most students (87.7%) knew that improper antibiotic use might cause antibiotic resistance in the future, and the mean total knowledge score was 67.14±24.9. A high percentage of students reported stopping the antibiotics once symptoms subsided (56.6%). **CONCLUSION:** Medical students' knowledge of proper antibiotic use was generally good. Knowledge of students with previous training courses and those from clinical years was higher. There was a very significant association between poor knowledge and bad antibiotic practices, like using antibiotics for self-medication and stopping antibiotics when symptoms subside.

KEYWORDS: Antibiotics, attitude, knowledge, medical students, Oman, practice, resistance

Maternal metabolic health conditions and risk of stillbirth in India: evidence from a nationwide survey

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ABSTRACT

Background: Stillbirth, defined by foetal death at or beyond 28 weeks of gestation, represents a significant challenge in India, contributing to approximately 500,000 foetal deaths each year. The country's stillbirth rate of 12.2 per 1000 births underscores the imperative to address this preventable occurrence. While maternal metabolic conditions diabetes, and hypertension, are widely recognized as established risk factors for stillbirth worldwide, the extent of their impact on India's stillbirth burden remains inadequately elucidated due to limited evidence. **Methods:** This cross-sectional study utilized NFHS-5 data to examine stillbirths in the most recent pregnancy outcomes of 204,723 women aged 15–49 years, sampled from all states and union territories of India. The primary exposures assessed were diabetes, and hypertension. Descriptive analyses were conducted to determine the prevalence of diabetes, hypertension and stillbirths. Logistic regression was used to quantify the association between diabetes, hypertension and the risk of stillbirth, indicated by adjusted odds ratios (AOR) with 95% confidence intervals (CI). The study also assessed effect modification by maternal age, education, wealth quintile, and social category. **Results:** The prevalence of diabetes and hypertension was 1% and 3% respectively, while the stillbirth rate was 1%. diabetes conferred a significantly higher risk of stillbirth with an increase of 74% (AOR 1.74, CI 1.14–2.67) as compared to women without diabetes. The risk was potential among mothers with hypertension with an increase of 50% (AOR 1.50, CI 1.16–1.95) on contrary to women without hypertension. The combined model (i.e. having diabetes or hypertension) also showed a significant risk of stillbirth with a higher risk of 58% (AOR 1.58, CI 1.25–1.99) indicating a synergistic interaction. Stratified analyses revealed the stillbirth risk among mothers belonging to the scheduled caste category (AOR 1.30, CI 1.10–1.53). **Conclusion:** Diabetes, and hypertension, increase stillbirth risk in India, highlighting the need for better metabolic health management pre- and during pregnancy. Our research highlights the need of integrated care for diabetes and hypertension is crucial. Targeted interventions for high-risk mothers and improved screening are vital to reduce stillbirth rates. More research is needed to understand these risks better. Collaboration across medical fields is essential to save lives and improve pregnancy outcomes.

KEYWORDS: Stillbirth, Hypertension, Diabetes, National family health survey, India, Metabolic health

Navigating the Currents: A virtual session on reflection to explore the challenges and lessons learned during online medical education in the COVID pandemic

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ABSTRACT

Purpose: An online session in this study was conducted to teach the importance of reflections and discuss the challenges faced in online classes during the pandemic. **Methodology:** An exploratory intervention-based study was conducted. A two-day Webex session introduced preclinical students to reflection. Day one included faculty-led sessions on reflection's importance in medicine. Whereas on day two there were presentation of selected student reflections and tips for future online learning from senior students. Quantitative and qualitative feedback was gathered through an online survey. Statistical analysis included descriptive statistics, Cronbach's alpha, Spearman's correlation, simple linear regression and nearest neighbor analysis to analyze participants' responses and examine the factors that contributed to their overall experience with reflective practice. **Results:** 97 pre-clinical students participated in the study. The survey showed strong internal reliability. The session was well received, with 79% of participants enjoying it. Reflective writing proved valuable, as 73% reported it aided their reflection, and 72% felt it helped them develop personal learning strategies. Listening to peers' reflections also proved beneficial, with 74% gaining new insights. Overall, the session had a positive impact. 69% felt similar sessions should be held frequently, and 63% reported feeling relaxed afterward. Spearman's correlation analysis indicated significant inter-item correlation. Results of linear regression analysis indicated that the enjoyment of the students during the session and self-improvement gains were high predictors to their overall experience. Nearest neighbor analysis suggests that enjoyment, the act of writing reflections, and developing learning strategies were key factors influencing students' preference for future sessions on reflective practice. **Conclusion:** The study showed reflecting is a powerful learning tool. It helps students express themselves, understand situations better, and plan for the future.

KEYWORDS: Alternative organisms, cell culture, refinement, replacement, vertebrate

Patterns of Emergency Surgical Diseases at a Secondary Care Teaching Hospital

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ABSTRACT

Background: Despite effective recording practices, there are no published data on surgical emergencies at Sohar Hospital. Understanding this data will enable policymakers and surgeons to enhance the efficiency, cost-effectiveness, and quality of emergency services, ultimately improving patient care. This study aims to document the patterns of emergency surgical diseases at Sohar Hospital and the immediate outcomes of their management. **Methods:** This is a descriptive, prospective study of patients admitted to Sohar's surgical emergency department between February 10 and March 10, 2023. Ethical approval was obtained, and data collection was performed using a form. Analysis was conducted using SPSS. **Results:** The study involved 272 patients. Among them, 31 (11.4%) were trauma patients, while 241 (88.6%) were non-trauma patients. Most trauma patients (80%) were under the age of 42, and 71% experienced road traffic accidents. More than half of the non-trauma patients (53.5%) presented with an acute abdomen, of which 44% reported nonspecific abdominal pain. The most commonly diagnosed acute abdominal condition was appendicitis, followed by cholecystitis, intestinal obstruction, diverticulitis, and peptic perforations. Regarding the immediate outcomes, 46.7% of the patients were treated in the emergency department and discharged, 22.1% were admitted and operated on, 16.2% were admitted and treated conservatively, 7.4% discharged themselves against medical advice, and 5.5% were referred to other specialties. The mortality rate was 2.2%, primarily due to sepsis. **Conclusion:** The study revealed the pattern of emergency surgical disease at Sohar Hospital, patient demographics, and treatment outcomes. This data is essential for effective resource allocation and improving patient care. Further research is necessary.

KEYWORDS: pattern of surgical emergencies, trauma, acute abdomen, Sohar Hospital, Oman

Post Pandemic influences on occupational wellbeing: Insights from a higher education institution in Oman

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ABSTRACT

Background: Globally, COVID-19 posed multifaceted challenges to the educational system, and employees were driven into completely unfamiliar territory. Assessing any residual impact that may influence employee well-being and productivity is vital. The objectives of the present study were to assess the impact of COVID-19 on the well-being of faculty and staff at the National University of Science and Technology, Oman & explore post-pandemic occupational well-being. Materials and Methods: 136 employees consented to participate in this study. The study design was cross-sectional, and convenient sampling was employed. The survey method involves item pooling from standardized scales, including the WHO Five Well-being Index, COVID-19 Stress Scale, Connor Davidson Resilience Scale and the WHO Quality of Life Questionnaire. Statistical methods, including correlation and regression analysis, were used. Results: Results indicate that employees (67.7%) experienced stress and anxiety during the pandemic. The support provided by the administration (64.9%) and access to vaccination services (48.6%) primarily contributed to the well-being of staff members. Participant responses also indicated that overall well-being and resilience capacity were adequate following the pandemic. However, 23.4% of employees reported that they currently experienced negative feelings. Conclusions: These findings reiterate that organizational interventions to reduce stress levels and enhance resilience and well-being are paramount.

KEYWORDS: Well-Being, Employee Health, COVID-19

Solid fuel combustion and adverse pregnancy outcomes: A nationwide study on stillbirth in India

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ABSTRACT

Objectives: Stillbirth is a significant public health challenge in India, accounting for a substantial portion of the global burden. Exposure to household air pollution from solid fuel combustion during pregnancy has been associated with adverse pregnancy outcomes, including stillbirth. This study aimed to investigate the association between solid fuel use and stillbirth risk in India, utilizing data from the National Family Health Survey 5 (NFHS-5). **Study design:** Nationwide cross-sectional study. **Methods:** The study employed data from the NFHS-5, a nationally representative cross-sectional survey conducted in India from 2019 to 2021. The study sample consisted of 204,723 women aged 15–49 years who had a pregnancy in the past 5 years preceding the survey. Stillbirth was calculated using calendar data, providing robust estimates. Logistic regression analysis was performed to assess the relationship between solid fuel use and stillbirth, adjusting for various sociodemographic and maternal factors. **Results:** The use of unclean cooking fuels was significantly associated with an increased risk of stillbirth (OR = 1.34, 95 % CI: 1.13–1.58, $p < 0.001$) compared to clean fuels. Other factors associated with higher stillbirth risk included rural residence, lower maternal education, belongingness to certain social categories, delivering at private healthcare facilities, limited antenatal visits, and undergoing caesarean delivery. **Conclusions:** The findings highlight the detrimental impact of solid fuel use on stillbirth rates in India, underscoring the need for targeted interventions to promote cleaner cooking technologies and address socioeconomic disparities. Efforts to transition households towards cleaner energy sources and improve access to quality maternal healthcare services are crucial for reducing the burden of stillbirth in India.

KEYWORDS: Stillbirth, Solid fuel, Household air pollution, India, National Family Health Survey, Pregnancy outcomes

Sustainable leadership styles adopted by small businesses in the UAE during and post COVID-19. Discover Sustainability

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ABSTRACT

COVID-19 emerged in late 2019 as a global crisis which led to major government restrictions on global populations. This had a detrimental impact on the survival and growth of smaller businesses. The resilience of smaller to medium enterprises (SMEs) was crucial to global economies as SMEs represent over 90% of businesses worldwide. However, due to the recent conclusion of COVID-19, there appears to be limited/no studies investigating the change in strategies adopted by businesses during the pandemic. The United Arab Emirates (UAE) established itself as the hub of business activity between Western and Eastern countries, however, this was halted by COVID-19. This study aimed to address this gap by examining the leadership philosophies adopted by SMEs in the UAE during the pandemic. Using a qualitative approach, semi-structured interviews were conducted with 70 SMEs between September and December 2023, and the data were analysed through thematic analysis. Out of the 70 interviewed SMEs, 42 SMEs changed their leadership style during the pandemic whereas 28 SMEs did not change their style. Sustainable leadership style was the most adopted style by SMEs in the UAE during the pandemic followed by transactional. After the pandemic era, the sustainable style was adopted by 46 SMEs, the transactional style is adopted by 24 SMEs and the transformational style is adopted by 10 SMEs. The findings suggested that most SMEs embraced sustainable leadership styles, characterized by agile decision-making, long-term resilience, and adaptive strategies shaped by pandemic-induced challenges. The findings contribute to the existing literature by providing insights into how small businesses in the UAE adapted their leadership approaches to maintain resilience and ensure business continuity during crises. Moreover, the study highlights the relevance of sustainable leadership in enhancing organizational adaptability and long-term survival in challenging environments, offering practical implications for business leaders and policymakers in developing crisis-resilient leadership frameworks.

KEYWORDS: Leadership framework, Sustainable leadership, Small to medium enterprises (SMEs), United Arab Emirates (UAE)

Tuberculosis in Saharia Tribe (a Particularly Vulnerable Tribal Group) of India: a Systematic Review and Meta-analysis

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2025 – Journal of Racial and Ethnic Health Disparities

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ABSTRACT

Tuberculosis (TB) remains a significant public health challenge in India, particularly among vulnerable populations. The Saharia tribe, a Particularly Vulnerable Tribal Group (PVTG), faces a disproportionately high TB burden. This study aimed to systematically review and quantify the TB burden among the Saharia tribe through meta-analysis. A comprehensive search was conducted in PubMed, Embase, Scopus, and Web of Science databases. Studies reporting TB prevalence in the Saharia tribe were included. The quality of included studies was assessed using the JBI Critical Appraisal Checklist. A random-effects model was used to estimate the pooled TB prevalence. Heterogeneity was assessed using I2 statistics, and publication bias was evaluated using funnel plots. Eight studies encompassing 163,562 Saharia individuals were included. The pooled TB prevalence was 2,416 per 100,000 population (95% CI: 1,827-3,004 per 100,000). Significant heterogeneity was observed ($I2 = 98.67\%$, $p < 0.05$). Sensitivity analysis revealed no significant influence of individual studies on the overall prevalence estimate. This meta-analysis reveals an alarmingly high TB prevalence among the Saharia tribe, far exceeding the national average. These findings underscore the urgent need for targeted interventions, improved healthcare access, and culturally sensitive TB control programs for this vulnerable population.

KEYWORDS: Tuberculosis, Saharia tribe, Particularly Vulnerable Tribal Group, India, Systematic Review, Meta Analysis

College of Pharmacy

3D-printed drug delivery system from food waste: a sustainable approach for the development of novel drug delivery systems

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ABSTRACT

Background: 3DP has emerged as an innovative technology in various industries, including pharmaceuticals and food. Notably, food waste is a useful resource for 3DP in drug delivery applications, helping to meet sustainability goals by recycling agricultural by-products. This concept is consistent with the circular economy since it uses elements from food waste, such as cellulose and lignin, to make bio-inks that may be used to fabricate customised drug delivery systems. **Aim:** The study investigates the use of food waste-derived biopolymers for developing 3D-printed drug delivery systems, addressing both medical and environmental problems. **Discussion:** Utilising food waste in 3DP drug delivery systems offers several advantages, including cost savings and reduced environmental effects. Biopolymers made from rice husk, soy protein, and eggshells improve the biodegradability and biocompatibility of pharmaceutical delivery systems. Furthermore, these food-derived biopolymers have intriguing properties such as regulated drug release and compatibility with patient-specific applications. However, there are issues in guaranteeing material consistency and stability, particularly in long-term drug release applications. Copolymerization and mixing with other biocompatible materials have the potential to improve mechanical stability and longevity, both of which are required for efficient drug administration. **Conclusion:** Food waste-derived 3D-printed medicine delivery devices are an innovative and sustainable approach to healthcare, but further study is needed to increase scalability and consistency for broad utilization in clinical settings.

KEYWORDS: Additive manufacturing, Drug delivery, Biopolymers, Sustainability Circular economy, Scaffold

An Overview of Cardiomyopathies: Categorization, Development of Pathogenesis Concepts of Hypertrophic Cardiomyopathy and Takotsubo Cardiomyopathy, and Prospects for Innovative Treatments

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ABSTRACT

Component of MOGE(S) system involved morphofunctional, organ Involvement, genetic or familial Inheritance Pattern and etiological annotation functional status (MOGE (S) which provides a precise classification framework. Dilated cardiomyopathy, commonly associated with heart failure, is frequently caused by ischemic heart disease and hypertension. Hypertrophic cardiomyopathy (HCM) caused by sarcomeric protein gene mutations is characterized by diastolic dysfunction and arrhythmia. Restrictive cardiomyopathy, associated with conditions such as amyloidosis, leads to ventricular rigidity, while arrhythmogenic right ventricular cardiomyopathy, a hereditary condition, replaces myocardial with fibrofatty tissue, causing arrhythmias. Takotsubo cardiomyopathy, triggered by stress, results in left ventricular dysfunction. The causes of cardiomyopathies include inherited, acquired, and secondary factors, as well as inflammatory, endocrine, viral, and toxic origins. Recent advancements, such as the Food and Drug Administration (FAD) -approved mavacamten for HCM, pyridoxamine for doxorubicin-induced cardiomyopathy, and dexrazoxane for anthracycline-induced cardiotoxicity, highlight progress in the treatment. However, managing cardiomyopathies still remain challenging, emphasizing the need for further research to develop effective therapies.

KEYWORDS: arrhythmogenic cardiomyopathy; cardiovascular diseases; hypertrophic cardiomyopathy; peripartum cardiomyopathy; restrictive cardiomyopathy

Antifungal Prophylaxis Utilization and the Associated Clinical Outcomes Among Pediatric Patients with Hematological Malignancies or Undergoing Hematopoietic Stem Cell Transplantation

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ABSTRACT

Background/Objectives: Invasive fungal infections (IFIs) are a prevalent complication of intensive chemotherapy and hematopoietic stem cell transplantation (HSCT) in the pediatric population and are associated with high morbidity and mortality. We aimed to identify the utilization of antifungal prophylaxis prescriptions and the associated clinical outcomes. Methods: A retrospective study included children (≤18 years old) diagnosed with hematological malignancies or undergoing HSCT who are at high risk for developing IFI and received systemic antifungal therapy between January 2018 and April 2024 at Sultan Qaboos University Hospital (SQUH), Oman. Results: A powered sample of 222 patients was included, and 208 (93.69%) received antifungal prophylaxis. Among those who received prophylaxis, 148 (66.67%) received appropriate prophylaxis, 86.06% (n = 179) received appropriate dosage. The patients who did not receive antifungal prophylaxis had higher rates of inpatient IFI requiring treatment (85.71% versus 12.02%, $p < 0.01$), a longer median length of hospital stay (LOS) (67.5 days versus 10 days, $p = 0.015$), and more incidence of 90-day all-cause mortality (21.43% versus 2.88%, $p < 0.01$) than those who received antifungal prophylaxis. Survival analysis demonstrated that these patients had a 12% higher risk for earlier death. Also, being on antifungal prophylaxis reduces the odds of inpatient IFI requiring treatment, with an adjusted odds ratio (aOR) of 0.13 [95% CI: 0.019–0.801]. Conclusions: Antifungal prophylaxis utilization was high, and it markedly decreases the occurrence and enhances the prognosis of IFI. Nonetheless, inconsistencies in practice and a lack of pediatric-specific data underscore the necessity for uniform guidelines and additional research to strengthen preventative methods in this population, and proper TDM utilization could provide more robust insights.

KEYWORDS: antifungal prophylaxis; invasive fungal infection; children; hematological malignancies; HSCT; clinical outcome

Application of HPLC for detection of sildenafil/tadalafil in marketed honey in Oman

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ABSTRACT

Honey adulteration allegedly with phosphodiesterase-5 (PDE-5) inhibitors including sildenafil, and tadalafil is a common and dangerous practice. This study aimed to develop a procedure to detect the presence of common adulterants namely sildenafil and tadalafil using RP-HPLC. Seven commercial honey samples of local and international origin were collected from supermarkets and honey sellers. Both the adulterants in honey samples were identified and quantified with the help of an HPLC technique. Chromatographic separation was done in RP-HPLC mode using buffer: methanol: acetonitrile (5.8: 2.5: 1.7) mobile phase and diode array as a detector. The buffer used was 0.05 M Triethylamine orthophosphate pH (3.0). The results showed that four honey samples (HAD1, HAD5, HAD6, and HAD7) were adulterated with sildenafil, and among them, HAD5 contained the maximum amount of sildenafil as 22.65 mg/g of the honey sample. However, only 2 honey samples HAD4 and HAD6 were found to be adulterated with tadalafil (1.248 and 0.7 mg/g) of the tested honey sample. The result of this study warrants rigorous quality control of the commercially available honey products in Oman by the authorities. The consumption of adulterated honey samples may impact the health of consumers hence further detailed studies must be carried out to confirm the findings of the current study and novel analytical methods be developed to detect the level of other possible adulterants in this valuable product.

KEYWORDS: RP-HPLC , Sildenafil , Tadalafil , Honey , Adulteration

Characterization and antimicrobial activity of silver nano-rods: Synthesized in green Ocimum sanctum leaf extract

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ABSTRACT

Ocimum sanctum (OS) Linn, is a medicinal herb that has been used in traditional medicine science ancient time. It contains an array of complex and diverse biologically active phytochemical constituents that can act as a reducing and stabilizing agent for synthesizing metal nanoparticles (NPs). Herein, OS aqueous leaf extract was used to synthesize eco-friendly round and rod-shaped Ag NPs. The synthesized spherical and rod-shaped Ag NPs were analyzed by indirect methods by analysis of plasma band (UV-vis spectra) and thin films X-ray diffraction (XRD) peaks. Whereas, for direct methods, morphologies of synthesized Ag NPs were recoded using HR-TEM. Ag NPs demonstrated dose-dependent antibacterial efficacy against bacteria (S. aureus). The MIC and MBC values of spherical Ag NPs against 10^6CFU/mL of S. aureus were found to be 2.74 and 3.80μ g/mL, respectively. However, MIC and MBC values of Ag nano-rod were observed at 7.20μ g/mL and 13μ g/mL, respectively. SEM micrographs indicate that morphologies of spherical shape and nano-rod Ag NPs treated S. aureus showed breakdown, merge, and elongated morphologies with the presence of Ag NPs (nano-rod) inside of the S. aureus.

KEYWORDS: Green Chemistry ; Ocimum sanctum ; Staphylococcus aureus ; Silver Nanoparticles ; Transmission electron microscope ; XRD

Chitosan- and heparin-based advanced hydrogels: their chemistry, structure and biomedical applications

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2024 – Pharmacological Research - Natural Products

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ABSTRACT

Chitosan and heparin are two biopolymers with different properties that can be combined to develop biomaterials with unique and desirable characteristics. Chitosan is a cationic polymer with antimicrobial, hemostatic, and wound-healing properties. Heparin is an anionic polymer with anticoagulant properties. The combination of chitosan and heparin can be used to develop biomaterials with a variety of applications, including drug delivery, wound dressing, and tissue engineering. These biomaterials can be fabricated into various forms, such as films, membranes, sponges, hydrogels, nanoparticles, and scaffolds. Chitosan is a natural polysaccharide, present in the form of copolymers of N-acetyl-D-glucosamine as repeating units. Heparin is a natural glycosaminoglycan; a linear sulfated molecule consisting of repetitive units of disaccharide containing uronic acid and N-acetyl glucosamine. Heparin binds and activates the vascular endothelial growth factor (VEGF), which in turn promotes proliferation and migration and thus results in angiogenesis and the formation of new blood vessels. These advantages make chitosan- and heparin-based biomaterials promising candidates for a variety of biomedical applications. However, there are still some challenges that need to be addressed before these biomaterials can be widely used in clinical practices. For example, the degradation rate of chitosan- and heparin-based biomaterials need to be better controlled, and the mechanical properties of these biomaterials need to be improved. Despite these challenges, chitosan- and heparin-based biomaterials have the potential to revolutionize the field of biomedicine. These biomaterials offer several advantages over traditional materials, and they have the potential to be used in a variety of innovative applications. The purpose of this review is to provide a comprehensive overview of the current state of research and applications in this field. It aims to summarize the key findings and advancements in the development and use of chitosan- and heparin-based hydrogels for various biomedical applications.

KEYWORDS: Chitosan, Heparin, Hydrogels, Angiogenesis, Biomedical applications

Combination Therapy Using Phytochemicals and PARP Inhibitors in Hybrid Nanocarriers: An Optimistic Approach for the Management of Colon Cancer

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2025 – International Journal of Molecular Sciences

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ABSTRACT

DNA damage repair is a hallmark of any cancer growth, eventually leading to drug resistance and death. The poly ADP-ribose polymerase (PARP) enzyme is vital in repairing damaged DNA in normal and cancer cells with mutated DNA damage response (DDR) genes. Inhibitors of the PARP enzyme aid in chemotherapy, as shown by drug combinations such as Olaparib and Irinotecan in breast cancer treatment. However, the effect of Olaparib in colon cancer has not been studied extensively. Synthetic drugs have a significant limitation in cancer treatment due to drug resistance, leading to colon cancer relapse. Bioavailability of Olaparib and other PARP inhibitors is limited due to their hydrophobicity, which poses a significant challenge. These limitations and challenges can be addressed by encapsulating Olaparib in nanoparticles that could possibly increase the bioavailability of the drug at the site of action. New age nanoparticles, such as hybrid nanoparticles, provide superior quality in terms of design and circulatory time of the drug in the plasma. The side effects of Olaparib as a chemotherapeutic pave the way for exploring phytochemicals that may have similar effects. The combined impact of Olaparib and phytochemicals such as genistein, resveratrol and others in nano-encapsulated form can be explored in the treatment of colon cancer.

KEYWORDS: PARP inhibitor; lipid hybrid nanoparticles; combination therapy; Olaparib; phytochemicals

Corchorus olitorius (Jute) fiber enforced sustainable polymeric dressing material for antimicrobial activity

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ABSTRACT

Drug delivery to wounds has developed over time from the rudimentary administration of medication on the wound or the site of infection to more sophisticated drug delivery systems. For effectively and rapidly curing wounds, a diverse range of anti-bacterial drug delivery systems must be developed. The current study investigates the possibility of using an inexpensive and environment-friendly sustainable Corchorus olitorius fiber (COF) as a drug carrier for the antibacterial drug tetracycline HCl and its potential as a dressing material. The fibers were purified, grafted using acrylamide monomer, and tested for SEM, FT-IR, TGA, swelling index, swelling-de- swelling behavior, and chemical resistance. Drug loading was carried out, the highest drug loading percentage was found at 99.97 % and the formulation released medication according to the Baker-Lonsdale release kinetics pattern. The anti-microbial study showed effective inhibition of Staphylococcus aureus. The study demonstrates the successful synthesis and application of acrylamide-grafted COF loaded with tetracycline HCl, showcasing its potential as an effective wound dressing for wound care and management. Corchorus olitorius fiber is a cost-effective and eco-friendly material for preparing medicated polymeric dressings.

KEYWORDS: Purification, Grafting, Drug loading, Wound dressing, Drug delivery, Biopolymer

Design, Synthesis, and Molecular Profiling of Pyrimidine-Furan Derivatives Targeting EGFRWT, EGFRT790M, and EGFRL858R/T790M/C797S in NSCLC: In Vitro and In Silico Evaluation

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ABSTRACT

Epidermal growth factor receptor (EGFR) mutations, especially in non–small cell lung cancer (NSCLC), present significant challenges to targeted therapies due to acquired resistance. This study reports the synthesis and evaluation of a series of 4-(2-substituted-6-(furan-2-yl)pyrimidin-4-yl)-substituted phenyl derivatives as potential anticancer agents. The compounds were screened using MTT and brine shrimp lethality assays, identifying R2, R10, and R12 as the most potent against NSCLC cell lines, particularly NCI-H522 and NCI-H1975. Compound R12 was most potent and selective against NCI-H522, with an IC50 value of 0.95 ± 0.02 μM as compared to standard afatinib (IC50 = 1.86 ± 0.22 μM). EGFR inhibition assays confirmed R12 effectiveness with IC50 values of 1.62 ± 0.15 μM, 0.49 ± 0.23 μM, and 0.98 ± 0.02 μM against EGFRWT, EGFRT790M, and EGFRL858R/T790M/C797S, respectively. The compound R12 led to the cell cycle arrest in the G2/M and S phase of NCI-H522 cells with an increase in apoptosis. Molecular docking studies showed R12 high binding affinity (ΔG = −10.2 kcal/mol for EGFRWT; Ki = 32.73 nM) and significant interactions with key amino acids in the active site. Molecular dynamics simulations demonstrated stable protein–ligand interactions with low RMSD (0.17–0.27 nm) and significant eigenvalue (1.706 × 10−4). Compound R12 also exhibited antioxidant properties against DPPH (IC50 = 12.11 ± 8.96 μM) and H2O2 (IC50 = 8.89 ± 1.72 μM). Furthermore, DFT analysis and ADMET predictions indicated that R12 possesses favorable physiochemical and pharmacokinetic properties, suggesting high bioavailability and minimal toxicity. These findings emphasize R12 as a promising lead for further preclinical investigation in overcoming EGFR mutations, including the challenging triple mutation.

KEYWORDS: EGFR; NSCLC; anticancer; molecular dynamics; pyrimidine linked furan.

Determination of the solubility of methyldopa in supercritical carbon dioxide for drug delivery applications: thermal analysis

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2025 – Scientific Reports

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ABSTRACT

The production of fine particles by green technology like supercritical carbon dioxide requires the assessment of substantial solubility data at high pressures. This study represents the first determination of the solubility of methyldopa in carbon dioxide at pressures and temperatures ranging from 12 to 30 MPa and from 313.2 to 343.2 K, respectively. The mole fractions were obtained under the aforementioned conditions and ranged from 0.805×10^{-5} to 11.345×10^{-5}. Four empirical models (Chrastil, Bartle et al., Mendez-Santiago, & Teja, and Kumar-Johnston) and two equations of state (Peng-Robinson and Soave-Redlich-Kwong) were used to correlate drug solubility. The K-J model demonstrated the highest accuracy, with an AARD of 8.38% and a R2 value of 0.988. Furthermore, the enthalpy values for the drug in SC-CO_2 were estimated using the Chrastil and Bartle models, resulting in values of 34.35 and 56.87 $kJ \cdot mol^{-1}$, respectively. The results demonstrate that the SRK more pronounced results than the PR model, with an AARD% of 23.03 and a R2 value of 0.903 compared to 26.42 and 0.837. The article's conclusions provide a valuable reference for the application of green method in the production of fine particles of methyldopa.

KEYWORDS: Supercritical fluid, Solubility, Thermodynamic modeling, Semi-empirical and enthalpy

Evaluation of acute plant toxicity, antioxidant activity, molecular docking and bioactive compounds of lemongrass oil isolated from Omani cultivar

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2025 –Toxicology Reports

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ABSTRACT

Lemongrass (Poaceae) is one of the aromatic plants with strong odors. Traditionally, lemon grass oil has been used for the treatment of many diseases such as gastrointestinal cramps, high blood pressure, high body temperatures, and fatigue, and is also considered an antibacterial and anti-diarrheal agent. Therefore, this study aims to investigate volatile active constituents and a few important biological activities of the volatile oil of lemongrass (Cymbopogon citratus) grown in Oman. To support the results of experimental studies, and to find out the main active constituents responsible for exhibiting biological activities molecular docking studies have also been performed. A sufficient amount of essential oil was obtained using steam distillation from fresh leaves of lemongrass. Volatile constituents were identified with the GC-MS analysis. Lemon grass oil exhibited a very good in vitro antioxidant activity (65.08–90.48 % inhibition of DPPH) with increasing concentration (31.25–1000 µg/mL) of oil. Isolated oil also exhibited good cytotoxic activity against the brine shrimps (100 % mortality at 1000 mcg/mL). Furthermore, molecular docking studies confirmed that beta citral is the monoterpene compound responsible for antioxidant and cytotoxic activity.

KEYWORDS: Lemongrass, Citral, Volatile oil, GC-MS, Cytotoxic: Antioxidant

Evaluation of Antihyperlipidemic Activity of Leaf Extracts of Rivea hypocrateriformis (Desr.) in High-Fat Diet-Induced Hyperlipidemia Rat Model with Focus on Gene Expression

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2025 - International Journal of Nutrition, Pharmacology, Neurological Diseases DOI: 10.4103/ijnpnd.ijnpnd_175_24

ABSTRACT

Background: Hyperlipidemia, characterized by a persistent elevation of lipid levels in the bloodstream, serves as a major indicator of cardiovascular risk. Although statin drugs are effective in managing this condition, their use is often accompanied with adverse side effects and drug reactions. Aim and Objective: In light of these limitations, the exploration of herbal and natural remedies for the treatment of hyperlipidemia has gained momentum. This study investigates the antihyperlipidemic potential of Rivea hypocrateriformis (Desr.) in experimental rats subjected to a high-fat diet (HFD)-induced hyperlipidemia model. Methodology: The study examines the potency of hypocrateriformis chloroform extract (HCE) and hypocrateriformis ethanol extract (HEE) of R. hypocrateriformis on the HFD-associated hyperlipidemia in two doses, 100 and 200 mg/kg b.w. The effect of extracts on the changes in body weight, lipid indices and levels, and antioxidant enzymes was measured using standard procedures. Results: HFD-induced hyperlipidemia

groups exhibit significant enhancement in all measured parameters among the drug-treated groups. Higher dose normalized the values significantly compared to the standard drug, atorvastatin (20 mg/kg). The results of the antioxidant enzymes showed a significant lowering of oxidative-free radicals and improving antioxidant defense in extract-treated groups. In comparison, HEE showed a significant activity compared to HCE at both doses. Histopathology analysis showed decrease in the size of adipocytes in adipose tissue. This suggests that HEE and HCE may have an inhibitory effect on adipogenesis and could potentially reduce the accumulation of fat in adipose tissue. Conclusion: The current study demonstrated that extracts of R. hypocrateriformis show antihyperlipidemic activity along with known antioxidant and inflammatory mechanisms, opening the scope for future research in developing lead molecules for treating the diseases effectively. Thus, the plant presents itself as a promising candidate which demands future research to improve cardiovascular health and overall life style of the patients.

KEYWORDS: antihyperlipidemic; antioxidant enzymes; cardiovascular health; high-fat diet

Evaluation of Awareness, Perception, and Opinions Toward Artificial Intelligence Among Pharmacy Students. Hospital Pharmacy

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2025 - Hospital Pharmacy Journal

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ABSTRACT

Background: Artificial intelligence (AI) helps to develop personalized medication therapy and regimens. It improves the patient care system. A cross-sectional study used and included pharmacy students, using validated survey questions. Objective: This study aimed to evaluate awareness, perception and opinion toward AI among pharmacy students. Design: This is a cross-sectional study (survey-based). Methods: A cross-sectional survey distribution among students in different levels of the college of pharmacy at National University (NU). The questions were classified to measure the variation of demographics, awareness, perceptions and opinions toward Artificial Intelligence (AI). Results: The results showed that more than 50% of pharmacy students are familiar with the uses of AI and know it's important in scientific research, 46.4% have a basic understanding of AI technologies. However more than 75% don't know the applications of AI used in pharmacy practice, 50.6 % don't know AI can support therapeutic diagnosis and 57 % don't know its importance in pharmacy education. A high perception was shown toward AI in facilitating pharmacy access to information (84.2%) and patients' access to the service (80.8%). In addition, 92% suggested that AI training is needed and 86.1 % recommended using AI in scientific research. The conclusion of this study identified the needs for awareness toward AI, and the important role of AI for education in pharmacy and health communities.

KEYWORDS: artificial intelligence; awareness; education; perception; pharmacy.

Expanding the therapeutic arsenal against cancer: a computational investigation of hybrid xanthone derivatives as selective Topoisomerase 2a ATPase inhibitors

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ABSTRACT

The DNA topoisomerase II (topo II) enzyme plays an important role in the replication, recombination, and repair of DNA. Despite their widespread applications in cancer therapy, new, selective, and potent topo II inhibitors with better pharmaceutical profiles are needed to handle drug resistance and severe adverse effects. In this respect, an array of 36 new anticancer compounds was designed based on a Xanthone core tethered to multifunctional Pyridine-amines and Imidazole scaffold via alkyl chain linkers. An integrated in silico approach was used to understand the structural basis and mechanism of inhibition of the hybrid xanthone derivatives. In this study, we established an initial virtual screening workflow based on pharmacophore mapping, docking, and cancer target association to validate the target selection process. Next, a simulation-based docking was conducted along with pharmacokinetic analysis to filter out the five best compounds (7, 10, 25, 27, and 30) having binding energies within the range of -60.45 to -40.97 kcal/mol. The screened compounds were further subjected to molecular dynamics simulation for 200 ns followed by MM-GBSA and ligand properties analysis to assess the stability and binding affinity to hTOP2α. The top-ranking hits 3,7-bis(3-(2-aminopyridin-3-ylhydroxy)propoxy)-1-hydroxy-9H-xanthen-9-one (ligand 7) and 3,8-bis(3-(2-aminopyridin-3-ylhydroxy)propoxy)-1-hydroxy-9H-xanthen-9-one (ligand 25) were found to have no toxicity, optimum pharmacokinetic and, DFT properties and stable intermolecular interactions with the active site of hTopo IIα protein. In conclusion, further in vitro and in vivo experimental validation of the identified lead molecules is warranted for the discovery of new human Topoisomerase 2 alpha inhibitors.Communicated by Ramaswamy H. Sarma.

KEYWORDS: DFT; Xanthone hybrids; anti-cancer; binding free energy; human topoisomerase 2 alpha; molecular dynamic simulation.

Exploring the community pharmacist's knowledge, attitude, and practices regarding adversedrug reactions and its reporting in the United Arab Emirates: a survey-based cross-sectional study

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2024 - Therapeutic Advances in Drug Safety

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ABSTRACT

Background: Adverse drug reactions (ADRs) contribute significant clinical and economic burden to the country's healthcare system globally. Prompt reporting of ADRs by the community pharmacist is essential to the active pharmacovigilance program. **Objectives:** This study assesses private community pharmacists' knowledge, attitude, and practice (KAP) about ADRs and reporting. **Design:** A cross-sectional, qualitative study was performed using a pre-validated self-administered questionnaire. **Methods:** This self-administered questionnaire was conducted at community pharmacies between March and July 2022. The data collected were analyzed using the Mann-Whitney and Kruskal-Wallis tests to examine the differences in overall KAP scores with a subgroup of sociodemographic characteristics of the study participants. Logistic regression analysis was used to analyze the predictors of practice. **Results:** In total, 156 fully completed questionnaires were collected by the community pharmacists. A positive association between the designation, qualification, and work experience with the total scores of the respondents was observed ($p < 0.05$).

Among the predictors of ADR reporting practice, a significant association was observed with knowledge score (⩾6, p = 0.0219), designation (pharmacists, p = 0.0102), qualification (masters, p = 0.0002), and work experience (⩾11 years, p = 0.0184). Most community pharmacists had good knowledge and attitude but poor practice toward reporting ADRs. Uncertainty of how and where to report, lack of training, lack of reporting forms, and insufficient clinical knowledge were the practice-based barriers in the ADR reporting process. **Conclusion:** Though the study found sufficient understanding and favorable views on ADR reporting, participants reported poor practices and barriers to reporting ADR. Therefore, structured continuing professional development programs for community pharmacists are needed to overcome the barriers and enhance the practice of ADR reporting.

KEYWORDS: adverse drug reactions; attitude; community pharmacist; knowledge; pharmacovigilance; practice.

Flavonoid Based Development of Synthetic Drugs: Chemistry and Biological Activities

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ABSTRACT

The toxicity associated with synthetic drugs used for treating various diseases is common. This led to a growing interest in searching and incorporating natural functional core structures such as flavonoid and their derivatives via chemical modifications to overcome the toxicity problems and enhance their biological spectrum. Natural core structures such as flavonoids are accepted due to their safety to the environment and owing to their varieties of biological activities such as anti-Alzheimer, antimicrobial, anticancer, anti-inflammatory, antidiabetics, and antiviral properties. Based on their chemical structure, flavonoids are classified into various classes such as flavone, flavanol, flavanone, isoflavone, and Anthocyanin, etc. The present review focuses on the potential role of the flavonoid ring-containing derivatives, highlighting their ability to prevent and treat non-communicable diseases such as diabetes, Alzheimer's, and cancer. The pharmacological activities of the flavonoid's derivatives are mainly attributed to their antioxidant effects against free radicals, and reactive oxygen species as well as their ability to act as enzymes inhibitors. The review covers the synthetic strategies of flavonoid derivatives, structure activity relationship (SAR), and in silico studies to improve the efficacy of these compounds. The SAR, molecular docking analysis will enable medicinal chemists to search further, develop potent and newer therapeutic agents.

KEYWORDS: Biological activity; Flavonoid; Molecular docking; Structure-activity relationships; Synthesis.

Harnessing the potential of polysaccharide-derived biomaterials for wound healing applications

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ABSTRACT

Introduction: Polysaccharide-derived biomaterials have emerged as promising candidates for wound healing applications due to their biocompatibility, biodegradability, and ability to mimic the extracellular matrix. These materials play a crucial role in maintaining a moist wound environment, promoting cell proliferation, and exhibiting anti-microbial properties, making them suitable alternatives to traditional wound dressings. **Methods:** A systematic literature review was conducted using reputable databases including ScienceDirect, PubMed, Scopus, and Google Scholar. Relevant studies were identified, screened, and analyzed to ensure comprehensive coverage of the topic. **Result:** Wound healing is aided by essential polysaccharides such as chitosan, alginate, cellulose, and carrageenan, which help to retain moisture, promote cell proliferation, and prevent infections. **Discussion:** Polysaccharide-derived biomaterials, including chitosan, alginate, and cellulose, facilitate wound healing by maintaining moisture, promoting cell migration, and exhibiting antimicrobial properties. However, challenges such as weak mechanical strength and rapid degradation limit their clinical use. Recent advancements in composite hydrogels, nanomaterials, and 3Dprinted scaffolds have improved stability, drug release, and anti-microbial efficacy. Further research is required to enhance their mechanical properties and long-term applicability for clinical wound care solutions. **Conclusion:** Biomaterials developed from polysaccharides have the potential to revolutionize wound healing by providing biocompatible, adaptable solutions that promote enhanced tissue regeneration and infection control.

KEYWORDS: Anti-microbial properties.; Biocompatibility; Chronic wound; Dressings; Nanocomposites; Polysaccharide derivatives; Targeted Therapy; Tissue regeneration.

In vitro antimicrobial activity of Frankincense combined with Turmeric extract

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2025 – Research Journal of Pharmacy and Technology

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ABSTRACT

Turmeric has potent ingredients rejuvenating skin lightening and glow. It has wound healing efficacy due to its antibacterial and anti-inflammatory action properties. Frankincense also protects skin cells and possesses anti-inflammatory actions. This research aims to study the role of whether frankincense modifies the action of turmeric as an antimicrobials. The Soxhlet apparatus and the maceration were used for taking turmeric and frankincense extract (including Al-Najdi and Al-Houjari) using ethanol and methanol as solvent. The turmeric and frankincense extract and their combination at three concentrations were used for the determination of antimicrobial activity by well diffusion method. The results showed that frankincense interferes with the antibacterial action of turmeric extract as it decreases the zone of inhibition to 14-15 mm/14-16 mm when combined (turmeric + Al-Najdi) and 15-17 mm/15-16 mm (turmeric + Al-Houjari) than turmeric extract alone 16-18 mm/18-20 mm against S. aureus and B. subtilis. The interference increases when both types of frankincense (Al-Najdi and Al-Houjari) were combined with turmeric extract as it shows no antibacterial action against S. aureus and decreased the zone of inhibition (14-16 mm) as compared to turmeric alone against B. subtilis. The frankincense might increase the anti-inflammatory actions and help rejuvenate and protect the skin with turmeric. However, frankincense is unable to increase the antimicrobial activity when combined with turmeric against S. aureus and B. subtilis compared to turmeric extract used alone.

KEYWORDS: Frankincense, Al Najdi, Al Houjari, Antimicrobial, Soxhlet extraction.

Integration of Nanotechnology with Quinazolines in the Medical Field

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ABSTRACT

Quinazoline, a magical and attractive compound, has a wide range of biological and pharmaceutical applications in the form of derivative compounds. The remarkable biological properties such as antibacterial, antifungal, anti-inflammatory, antimalarial, antiviral, and other unique features of quinazolines are mainly responsible for its novel structures, materials, and devices in medicinal chemistry and nanotechnology. This article describes the role of quinazolines in nanotechnology, their advantages and disadvantages, medical case studies, and future developments. In DNA nanotechnology, one of the quinazoline derivatives acts as a substitute for thymine in nucleic acid complexes. Drug dexrazoxane is a quinazoline derivative widely used as a cardio-protective agent in nanomechanics. The syntheses of biologically active quinazoline derivatives using nanocatalysts have shown efficient chemical transformations. Quinazolines, being antifungal agents, are widely used in humans and plants as nano-engineered medicines with low toxicity. Nowadays, new quinazoline-based compounds are being synthesized as possible drugs of anticancer effectiveness against bladder cancer, breast cancer, head and neck cancer, lung cancer, and many more anticancer therapies. Controlled release of quinazolines towards antibacterial action can be achieved by changing the pH < 7 or pH > 7 and with the solid support of using metal clusters and appropriate organic ligands.

KEYWORDS:

Investigating the Dual-Action Potential of (Z)-6-methoxy-2- (naphthalen-1-ylmethylene) Benzofuran-3(2H)-one (AU-23): A Novel Synthetic Aurone Derivative with Antibacterial and Anti-Inflammatory Activity

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ABSTRACT

Aim/Background: Aurone is a well-known, naturally occurring, minor flavonoid with significant biological properties. However, their low abundance in nature limits their application in the medical field. In this study, we investigated the antimicrobial and anti-inflammatory properties of a novel synthetic aurone, (Z)-6-methoxy-2-(naphthalen-1-ylmethylene) benzofuran-3(2H)-one (AU-23). Materials and Methods: AU-23 was synthesized via multistep synthesis reactions involving the oxidative cyclization of 2'-hydroxychalcones. AU-23 was tested for antibacterial, minimum inhibitory concentration and antibiofilm activity against several ATCC strains using agar well diffusion, broth-micro dilution and XTT assay methods respectively. Results: At various concentrations, it selectively inhibited the growth of four strains (P. aeruginosa ATCC 9027, methicillin-resistant S. aureus (MRSA) ATCC 33591, methicillin-sensitive Staphylococcus aureus (MSSA) ATCC 25923 and methicillin-resistant S. aureus (MRSA) ATCC 43300). Moreover, it was

observed that AU-23 had a bactericidal effect on sensitive strains of MSSA ATCC 25923 and P. aeruginosa ATCC 9027, as well as a bacteriostatic effect on MRSA ATCC 33591 and MRSA ATCC 43300. AU-23 also displayed effective antibiofilm activity against monomicrobial biofilms but not against polymicrobial biofilms. The findings of PCR study revealed that AU-23 downregulates the expression of pro-inflammatory cytokines and mediators (i.e., IL-6, IL-1β, iNOS and TNF-α), as well as crucial pattern recognition receptors (TLR4 and CD14) in LPS-stimulated RAW 264.7 cells. Molecular docking studies demonstrated that the ability of AU-23 to bind to the mouse TLR4/MD-2 complex was comparable to that of dexamethasone. Conclusion: the results of several studies conducted, suggests that AU-23 has the potential to function as an effective dual-action agent with antimicrobial and anti-inflammatory properties. Keywords: Aurone, Antimicrobial activity, Antibiofilm activity, Anti-inflammatory activity, Docking study.

KEYWORDS: Aurone, Antimicrobial activity, Antibiofilm activity, Anti-inflammatory activity, Docking study.

In-vitro Quality Evaluation of Various Commercially Available Brands of Atorvastatin Tablets Available in Oman

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ABSTRACT

Hypolipidemic drugs are widely used to lower the lipid profile and to prevent the primary and secondary risk of cardiovascular diseases. Among all the hypolipidemic agents, statins are the most prescribed drugs to treat hyperlipidemia. There are several statins' molecules available in the market, but atorvastatin is the most widely prescribed. Therefore, it is essential that the drugs should have the appropriate amount of active pharmaceutical ingredient and meet the necessary physical properties. The aim of the present work was to evaluate the quality of different marketed products of Atorvastatin calcium tablets 10 mg available in Muscat, Oman with a view to determine their interchangeability in clinical practice. The Quality assessment included visual examination for their organoleptic properties; official and non-official quality control tests, dissolution profile, and invitro bioavailability assessment. Comparison of in vitro drug dissolution profile of all samples shows approximately more than 90% drug release within 60 min. In vitro dissolution, friability, disintegration, and hardness test, all were passed by investigated generic version of atorvastatin tablets sold in the Muscat, Oman. From these results it was concluded that all samples of Atorvastatin calcium tablets may be interchangeable with other in Oman.

KEYWORDS: Atorvastatin, Organoleptic properties, Invitro dissolution studies, Invitro bioavailability

Marine Algae as a Potential Source of Bioactive Compounds for the Management of Diabetes

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ABSTRACT

Diabetes is an enormously understood disorder, having a paramount disease burden globally. Although treatments are available for the management of the disease, there are associated side effects. A deep-rooted need is to have a comprehensive treatment without any ramifications. Ethnomedicine has been practised in various regions and cultures for ages. However, a lack of significant scientific data has been a drawback for such treatment and its formulations. There is increasing empirical evidence for various phytoconstituents showing promising results for addressing the pathophysiology of diabetes. A plethora of phytoconstituents have been reported, and their mechanisms have been understood in detail. In this scenario, bioactive isolates obtained from marine algae offer numerous opportunities for managing the intricate blood-glucose dynamics associated with diabetes. Marine algal phytoconstituents inhibited several diabetes enzymes and improved serum parameters, which have also been shown to have antioxidant, anti-inflammatory, anti-obesity, and other therapeutic actions through in vitro and in vivo research. Hence, this article reviews the major marine phytoconstituents from macroalgae and their molecular mechanisms for managing diabetes. The results of this review indicate that marine bioactive components have demonstrated high potential to mitigate diabetes, but there have not been many clinical trials done in this area. A principal strategy for the success of any drug discovered belongs to commercialization, including clinical trials and production feasibility. The article also elaborates on the current challenges associated with the supply and consumption of commercial phytoconstituents.

KEYWORDS: Diabetes, marine algae, phytoconstituents, antioxidants, enzymes, drug targets, mechanisms.

Role of Natural Phytoconstituents as a Potential Bioenhancer of Anti-Cancer and Anti-Microbial Agents: Spotlight on the Mechanism of Action, Clinical Studies and Patents

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ABSTRACT

A drug design strategy with reduced side effects and economic feasibility is desirable for fatal diseases. Increasing the bioavailability of a drug using a bioenhancer is a smart strategy. Herbal/natural bioenhancers with no probable side effects are an ideal choice to enhance the pharmacokinetics of a therapeutic drug synergistically. The mechanism of bioenhancers relies on the retention of the drug molecule in the cell without causing any changes in the metabolic activity. Most of the herbal bioenhancers achieve this feat by inhibiting metabolic enzymes such as cytochrome P450 and Uridine 5′-diphospho-glucuronosyltransferase. The efflux pump p-glycoprotein, responsible for removal of xenobiotics, is also inhibited by herbal/natural bioenhancers. The increased bioavailability because of the higher Cmax and tmax of chemotherapeutics or anti-infectious agents such as rifampicin can result in a lower drug dosage regimen. The reduction in drug dosage is directly linked to fewer side effects and economic viability. Further, there is a significant effort in clinical trials to incorporate bioenhancers in drug regimens for cancer. The role of herbal/natural bioenhancers and their potential to augment the bioavailability of therapeutics used in cancer and infectious diseases, with a focus on the mechanisms of action, clinical studies and patents, have been summarized in this review article.

KEYWORDS: cancer; tuberculosis; bioenhancer; CYP; P-gp; Cmax; herbal

Novel indole-based synthetic molecules in cancer treatment: Synthetic strategies and structure-activity relationship

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2025- Medicine in Drug Discovery

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ABSTRACT

Indole is one of the naturally occurring nitrogen-containing bicyclic heterocyclic ring systems where benzene and pyrrole rings are fused. It has been demonstrated to exhibit versatile biological activities. The indole scaffold regulates many proteins and genes which play a significant role in cancer development. US Food and Drug Administration (FDA) approved anti-cancer drugs having indole rings in their structure including alectinib, sunitinib, osimertinib, anlotinib, and panobinostat. Several research studies have focused on developing new indole derivatives for the treatment of cancer. Various studies have shown that indole C-3 atom; π-bond in between C-3 and C-2; and nitrogen atom can be substituted with varieties of other structural fragments to overcome the problem of drug resistance and toxicity. The anti-cancer potential of various indole derivatives, their synthetic strategies, and structure–activity relationships (SAR) for the further development and advancement of anticancer therapy. The article also summarizes how different proteins like TRK, VEGFR, EGFR, CDKs, ERK, BRD4, genes like Bcl2, intracellular pathways such as PI3K/AKT/mTOR, enzymes like tubulin and topoisomerase II are inhibited by indole derivatives. Synthetic strategies and SAR will help medicinal chemists to design and develop effective indole derivatives as anticancer agents.

KEYWORDS: Cancer, Indole, Structure Activity Relationship, Antiproliferative activity, Synthesis

Polysaccharide-based implant drug delivery systems for precise therapy: Recent developments, and future trends, Annales Pharmaceutiques Françaises

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ABSTRACT

Implantable drug delivery systems offer numerous benefits, including effective drug administration at lower concentrations, fewer side effects, and improved patient compliance. Various polymers are used for fabricating implants, with biopolymers, particularly polysaccharides, being notable for their ability to modulate drug delivery characteristics. The review aims to describe the strategies employed in the development of polysaccharide-based implants and provide a comprehensive understanding of various polysaccharides such as starch, cellulose, alginate, chitosan, pullulan, carrageenan, dextran, hyaluronic acid, agar, pectin, and gellan gum in the fabrication of implant for targeted therapy. The review explores the biomedical applications of polysaccharide-based implantable devices, highlighting recent advancements in the development of these systems. Detailed discussions cover implants used in the oral cavity, nasal cavity, bone, ocular applications, and antiviral therapy. Additionally, regulatory considerations concerning implantable drug delivery are emphasized. The findings of the study show that polysaccharides can be used for the development of implants for drug delivery applications.

KEYWORDS:

PCR identification of Enterococcus Species as a Primary Pathogen in Neonatal Bloodstream Infections at Damascus University Paediatric Hospital

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2024 - Research Journal of Pharmacy and Technology

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ABSTRACT

Bacterial septicaemia is one of the most common causes of death in newborns throughout the globe. Recently, gram positive bacteria have been detected as a main responsible of hospital acquired blood infection in developed country especially Enterococcus sp. and Staphylococcus sp. This preliminary study aimed to identify Enterococcus species and Staphylococcus species isolated form acquired blood infection in the department of premature and neonates at paediatric university hospital in Damascus, based on PCR technology. the antibiotic sensitivity these pathogens was also investigated against common antibiotics usually used to treat septicaemia in this hospital. Bacterial gDNA was extracted directly from blood samples of children with acquired Septicemia. The bacterial infection was confirmed in 50 samples based on the amplification of 16srDNA gene. Genus Enterococcus sp. and Staphylococcus species were identified as source of infection in samples using specific primers via PCR technique. The antibiotic sensitivity of isolated bacterial strains was studied using Kirby-Bauer disc method. Our study showed that 47 of the 50 samples of the infection were bacterial.

The rate of blood infection caused by Enterococcus species was 24%, and 4% for Staphylococcus sp. the isolated bacteria showed a high sensitivity to Amikacin, medium sensitivity to Vancomycin, and less sensitivity to Ampicillin and Gentamycin. Enterococcus species Showed good sensitivity to Amikacin and Vancomycin and low sensitivity to Gentamycin, while was resistant to Ampicillin. Furthermore, the two isolated stains Enterococcus sp and Staphylococcus species showed a good sensitivity against chlorhexidine. This study confirmed the importance of molecular technologies in diagnosing the acquired septicaemia and identifying the specific infectious agent. The molecular test showed that Enterococcus sp. was an important cause of acquired blood infection in neonates respect to ampicillin resistant staphylococcus species.

KEYWORDS: Septicemia, PCR, Gram-positive bacteria, Antibiotic resistance.

Synthesis, in silico studies and biological evaluation of novel thiazolidinone [5,4-d] isoxazole derivatives as antidiabetic agents

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2025- Phosphorus, Sulfur, and Silicon and the Related Elements

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ABSTRACT

A new class of dihydrothiazolo-isoxazole-5-one derivatives were synthesized by a sequence of reactions starting from Knoevenagel condensation of different aromatic aldehydes with thiazolidinediones (TZD), amino alkylation by Mannich reaction and then cyclization to isoxazole with reaction with hydroxylamine. The titled compounds 4a–4j and 5a–5e were evaluated for in vivo antidiabetic evaluation as well as their effects on weight gain and results showed significant activity compared to pioglitazone. Compound 4j and 5c showed significant glucose lowering effect against streptozotocin–nicotinamide induced diabetic mice with no weight gains and the antidiabetic activity were comparable to the standard. The docking studies were performed against PPAR-γ receptor showed strong interactions and favorable binding energies. The present study suggests that dihydrothiazolo-isoxazole-5-one derivatives act as a promising new approach for the treatment of type-II diabetes.

KEYWORDS: Anti-diabetes, thiazolidinedione, isoxazole, pioglitazone, PPAR-γ

Synthetic Strategies and Structure Activity Relationships (SAR) of Biologically Active Coumarin-Based Hybrids

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2025 - Chemistry Select

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ABSTRACT

Coumarin (2-benzopyrone), a secondary plant metabolite, is considered a privileged scaffold in medicinal chemistry. Coumarin and its derivatives have been demonstrated to exhibit various biological activities such as antiviral, antibacterial, anticancer, anti-inflammatory, anticonvulsant, antioxidant, antidepressant, anti-Alzheimer, antidepressant, and antidiabetic. Because of its wide spectrum of biological activities, it has been explored extensively which has resulted in the development of many clinically useful drug molecules. Attempts have been made to prepare coumarin derivatives by either substituting them with a variety of aromatic heterocyclic rings and functionalities or by preparing its hybrids linked through an appropriate linker to obtain and develop potential therapeutic agents. The inclusion of natural secondary metabolites such as coumarin and its derivatives gained importance in the recent past to enhance biological activity. Coumarin moieties are easily synthesized by various chemical methods such as Knoevenagel reaction, Pechmann condensation, Kostanecki–Robinson coupling reaction, Claisen rearrangement, Michel addition reaction, Witting reaction, Reformatsky reaction, and Perkin reaction, and so on. The current review provides an overview of the classification of coumarins, and details of various approaches used for the synthesis of coumarin derivatives. Coumarin rings introduced in many synthetic compounds are discussed with structure-activity relationship (SAR) which are supported by their 2D molecular docking studies interaction within the receptors. The SAR of the coumarin derivatives will support the medicinal chemist in directing the synthesis of novel coumarin derivatives with diverse pharmacological properties.

KEYWORDS:

Therapeutic Applications of Nanoformulated Resveratrol and Quercetin Phytochemicals in Colorectal Cancer—An Updated Review

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ABSTRACT

Natural compounds such as polyphenols play several positive roles in maintaining the oxidative and inflammatory capacity of cells, which leads to their potential use as anticancer therapeutics. There is promising evidence for the in vitro and in vivo anticancer activity of many polyphenols, including resveratrol and quercetin, specifically in the treatment of colorectal cancer (CRC). There is a clear association between resveratrol and quercetin in interfering with the mechanistic pathways involved in CRC, such as Wnt, P13K/AKT, caspase-3, MAPK, NF-κB, etc. These molecular pathways establish the role of resveratrol and quercetin in controlling cancer cell growth, inducing apoptosis, and inhibiting metastasis. The major bottleneck in the progression of the use of resveratrol and quercetin as anticancer therapeutics is their reduced bioavailability in vivo because of their rapid metabolism in humans. Recent advancements in various nanotechnological formulations are promising for overcoming these bioavailability issues. Various nanoformulations of resveratrol and quercetin have shown an optimistic impact on reducing the solubility and improving the stability of resveratrol and quercetin in vivo. A combinatorial approach using nanoformulations of resveratrol with quercetin could potentially increase the impact of resveratrol in controlling CRC cell proliferation. This review discusses the mechanism of resveratrol and quercetin, the two bioactive polyphenolics, in colon cancer, with an emphasis on various types of nanoformulations of the two molecules targeting colon cancer. It also explores the synergistic effect of combining resveratrol and quercetin in various nanoformulations, targeting colon cancer. This research delves into the enhanced pharmacokinetics and potential chemotherapeutic benefits of these bioactive polyphenolics when used together in innovative ways.

KEYWORDS: AKT; MAPK; NF-κB; colon cancer; nanoformulations; polyphenols; quercetin; resveratrol.

Thiazolidinedione derivatives as anticancer agents: Synthetic strategies, SAR, and therapeutic potential

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ABSTRACT

Cancer is the second most common cause of mortality after cardiovascular diseases. Over the years, many chemotherapeutic agents have been developed, but the lack of target specificity and selectivity, toxicity to normal cells, and the problem of developing resistance limit their clinical usefulness. This has prompted the search for novel, safer, effective, and highly specific anticancer agents. Thiazolidinedione, a sulfur and nitrogen-containing five-membered heterocyclic ring, has shown promising anticancer potential in preclinical studies. Substitutions at different positions on the thiazolidinedione scaffold can overcome the problem of toxicity and drug resistance by targeting cancer with various mechanisms of action. This includes promoting apoptosis of the cancer cells, inhibiting signaling pathways, and cell proliferation in cancers by the activation of peroxisome proliferator-activated receptor gamma (PPAR-γ). The thiazolidinedione derivatives also act by inhibiting glyoxalase, TopI/II, GLUT, Bcl2, Ras/Raf, and tyrosine kinase involved in cancer pathogenesis. This review discusses the recent developments in synthetic strategies of thiazolidinedione scaffolds; their mechanism of action, anticancer potential, and structure–activity relationships (SAR) will provide guidance for future directions in cancer research. The recent advancements in the development of thiazolidinedione derivatives as anticancer agents will pave the way for medicinal chemists to direct the synthesis of novel thiazolidinedione derivatives for future clinical use.

KEYWORDS: anticancer | cell apoptosis | structure–activity relationship | synthesis | thiazolidinedione

Unveiling the therapeutic potential of prenyl motif-containing derivatives: A key structural fragment for designing antidepressant compounds

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ABSTRACT

Depression is a complex mental disorder, and consequently, the successful treatment of the depressive disorder remains challenging. The available medications often show limitations in terms of both safety and efficacy. In this case, the presence of the prenyl motif in pharmaceutical compounds has resulted in a broad spectrum of biological activities. Various studies have highlighted that the potent antidepressant activity of many natural compounds is associated with the presence of the prenyl motif. Thus, some studies have attempted to prepare prenyl fragment derivatives with the aim of enhancing their hydrophobicity and developing promising antidepressant compounds. Prenyl motif-containing compounds exhibit antidepressant action via multiple mechanisms, including selective serotonin/norepinephrine reuptake inhibition, blocking of NMDA receptors, 5-HT6 antagonism, TREK-1 inhibition, MAO-A inhibition, and anti-inflammatory and antioxidant properties. This review presents synthetic derivatives of xanthones, flavonoids, and chalcones bearing prenyl groups. It also covers polyprenylated benzoyl phloroglucinols/acylphloroglucinols, naphthoquinones, volatile oils, tricyclic products, and steroidal saponins containing prenyl motifs. This study aims to further guide and support medicinal chemists in directing the synthesis of more potent compounds possessing prenyl fragments as antidepressants, thus advancing treatment options for depression.

KEYWORDS:

International Maritime College Oman

A Mini Review on the Opportunities for Membrane Pervaporation Technology for Energy-Efficient Removal of Dispersed Oil and Dissolved Hydrocarbons from Produced Water

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2024 - Recent Innovations in Chemical Engineering

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ABSTRACT

Produced water is reported to have the largest volume of waste stream associated with hydrocarbon recovery. It was estimated to increase from 250 million B/D in 2007 to more than 300 million B/D between 2010 and 2012. Market research conducted by Adroit put the globally produced water treatment market at a value of USD 5.10 billion in 2022. This value is anticipated to be USD 9.80 billion in 2032 at a compound annual growth rate (CAGR) of 5.80% over the prediction period. Oil and gas companies have been mandated to comply with the newly enacted environmental regulations that require extensive treatment of this water before discharge or reuse. The limited quantity of freshwater resources coupled with the increasing oil and gas production activities has made it necessary for all stakeholders to look for sustainable management of this water. Presently, a certain percentage of produced water is reused while the rest is discharged into the ocean. In both cases, the water needs to be thoroughly treated. The choice of technologies for produced water treatment depends on numerous factors, such as the chemical composition of the water and the level of purity that must be attained before disposal, recycling, or re-use. Some of the technologies used for produced water treatment include physical separation methods such as gravity, adsorption, filtration, coalescence, cyclones, flotation, centrifuges, membranes, and oxidation. There are also chemical and biological separation methods. Contaminants such as small droplets of dispersed oil and dissolved hydrocarbons (DODHs) are very challenging to remove using the above-listed water treatment technologies. Moreover, the use of membrane technology has been limited only to the use of reverse osmosis and membrane filtration for removing salinity, metals, and other inorganics. This article highlights the opportunities for the use of membrane vapor permeation and pervaporation for the removal of the small droplets of DODHs, which have been reported to be very challenging contaminants to remove. The use of 3D printing technology for the fabrication of membrane materials was

reviewed. The 3D membrane development method can be used to fabricate almost any shape of the material in a highly customized manner using computer-aided design. The information presented in this article will serve as a useful reference for the technologies used for a sustainable water treatment strategy in the oil and gas industry.

KEYWORDS: 3D printing technology; Energy efficiency; membrane separation technology; oil and gas production; sustainable water management

Advanced tumor growth modeling: A numerical study integrating phase plane analysis with finite volume method

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ABSTRACT

This study investigates tumor density dynamics through computational modeling, focusing on key parameters: proliferation rate m, diffusion coefficient τ, and additional factors c and κ. Systematic exploration reveals nuanced interactions shaping tumor growth, regression, and dispersal. Higher m values accelerate proliferation, while increased τ facilitates dispersal. Parameters c and κ further refine our understanding of tumor behavior. These insights inform the development of computational models for oncological research, with implications for targeted therapeutic interventions. The aim can be realized by utilizing the propose Finite Volume Method to develop a representation of cancer models and improve the efficiency of their simulations. Furthermore, the numerical results will be validated by comparing them with the Tanh-Coth method formulation to assess the model's accuracy and efficiency. The findings suggest that accurate modeling of tumor dynamics can aid in predicting tumor progression and response to treatments, ultimately contributing to personalized medicine and more effective therapeutic strategies. Phase plane analysis shows the schemes are conditionally stable and accurate to the fourth order in time. The method demonstrates exceptional agreement and error-free findings compared to 3D plots, underscoring its potential utility in clinical and research settings.

KEYWORDS: Oncological computing Cancer system modeling Computational simulation Tanh-coth method approach Phase plane analysis Finite volume method

Advances in membrane technology for nitrogen-methane separation with focus on design performance and future trends

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2025 - Discover Materials

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ABSTRACT

The energy-intensive nature of nitrogen/methane (N_2/CH_4) separation in natural gas upgrading presents a persistent industrial challenge due to the close physicochemical properties of the two gases. This review systematically evaluates recent frontier advancements in polymeric, inorganic and mixed matrix membranes (MMMs) with emerging nanostructured membrane architectures for efficient N_2/CH_4 separation. Emphasis is placed on the design of membrane materials with metal-organic frameworks (MOFs), hydrogen-bonded organic frameworks (HOFs), carbonized MOF derivatives, and 2D MXene nanosheets, which allow the selective control of molecular sieving, sorption selectivity, and transport pathways. The high-performance MMMs, including HOF-21/6FDA-DAM, Ni-MOF-74/SBS, and ACU/PVA, have shown great advancements in permeability-selectivity trade-offs with improved filler-polymer compatibility, pore engineering, and design of functional sites. Notably, recent studies on the use of Cr-activated MXene membranes demonstrate outstanding N2 permeance (381 GPU) and selectivity (13.76), revealing the potential of lamellar structures with unsaturated metal sites in N2-philic separations. Critical comparative analysis reveals convergences in metal site coordination, filler dispersion strategies, and divergences in membrane architecture and gas affinity orientation (CH4-philic vs. N2-philic). Although the performance at laboratory scale is promising, there remain critical issues in the control of agglomeration, long-term stability, and scalability to realistic feed conditions. Future directions are proposed to address these limitations through hybrid membrane configurations, process integration, and rational material–structure–performance correlations. This review provides a comprehensive platform for the rational design of next-generation membranes, advancing the feasibility of energy-efficient N_2/CH_4 separation.

KEYWORDS: N_2/CH_4 separation, Mixed matrix membranes (MMMs), Metal–Organic frameworks (MOFs), Gas permeation performance, Gas transport mechanisms

Analysis of heat mass transfer in a squeezed Carreau nanofluid flow due to a sensor surface with variable thermal conductivity

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ABSTRACT

This research offers an advanced investigation into the examination of squeezed flow and heat mass transfer mechanisms of non-Newtonian Carreau dissipative nanofluids across a sensor surface. This analysis takes into consideration both variable thermal conductivity and variable viscosity aspects. It is widely accepted that the phenomenon of viscous dissipation has a significant impact on both the temperature distribution and heat transfer characteristics within nanofluids. Hence, it is being considered here. The governing equations of the problem are formulated using the Carreau model for the non-Newtonian fluid for the nanofluid. The thermal conductivity of the sensor surface is assumed to vary linearly with the temperature. The resulting nonlinear ordinary differential equations are solved numerically using the shooting method. The effects of various parameters such as suction parameter and magnetic parameter on the flow, the solutal characteristics, and thermal characteristics are analyzed. The results show that the slip parameter, the magnetic parameter, and the suction parameter have a significant effect on the flow and thermal fields. The heat transfer rate is improved by the squeezed flow index parameter and the Weissenberg number, but reduced by the power law index parameter and the Eckert number. Ultimately, the precision and reliability of the proposed approach are confirmed by benchmarking our data against previous findings. Understanding how variable viscosity impacts flow characteristics, heat transfer efficiency, and the performance of heat exchangers and cooling systems optimizes the design of nanofluids for efficient thermal systems in practical applications.

KEYWORDS: Carreau nanofluid; two-dimensional squeezed flow; sensor surface; variable fluid viscosity

Comparative Assessment of Membrane Separation and Cryogenic Distillation for Propane/Propylene: A Multi-objective Process Intensification Approach

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2025 - Arabian Journal for Science and Engineering

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ABSTRACT

The use of cryogenic distillation for separating olefins and paraffin is an energy-intensive process due to the need for large columns and multiple trays. Recent innovations in non-thermal techniques, such as membrane separation, aim to reduce energy consumption. This study compares membrane separation and cryogenic distillation for separating propane/propylene mixtures. Multi-objective optimization technique was used to identify the membrane with the best separation performance from over 100 polymeric membrane samples. The data collection process utilized a 50:50 volume mixed gas composition to simulate real-life industrial scenarios. The separation performance of the membrane and cryogenic distillation units were modeled and simulated using Aspen Plus, Aspen HYSYS, and Aspen Custom Modeler. This was followed by a comparative analysis using process intensification (PI) metrics integrated into the digitally modified logic method. The study revealed that membrane separation is superior to cryogenic distillation in terms of productivity by weight with installation, flexibility (temperature, pressure, number of equipment), production purity, rejection purity, and modularity. In contrast, distillation was observed to outperform membrane only in mass and waste intensity, which was expected due to the separation mechanism of the distillation. Overall, membrane separation was preferred in 68% of the PI metrics, while distillation was favored in 32%. Therefore, based on these PI metrics, membrane separation was found to be more efficient in separating propane/propylene mixtures when compared to cryogenic distillation.

KEYWORDS: Process intensification, Separation technology, Propylene/propane separation

Membrane and distillation column

Decarbonization Potential of Alternative Fuels in Container Shipping: A Case Study of the EVER A LOT Vessel

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2025 - Environments

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ABSTRACT

Environmental emissions from the maritime sector, including CO2, NOx, and SOx, contribute significantly to global air pollution and climate change. The International Maritime Organization (IMO) has set a target to reduce greenhouse gas emissions from international shipping to reach zero GHG by 2050 compared to 2008 levels. To meet these goals, the IMO strongly encourages the transition to alternative fuels, such as hydrogen, ammonia, and biofuels, as part of a broader decarbonization strategy. This study presents a comparative analysis of converting conventional diesel engines to dual-fuel systems utilizing alternative fuels such as methanol or natural gas. The methodology of this research is based on theoretical calculations to estimate various types of emissions produced by conventional marine fuels. These results are then compared with the emissions generated when using methanol and natural gas in dual-fuel engines. The analysis is conducted using the EVER ALOT container ship as a case study. The evaluation focuses on both

environmental and economic aspects of engines operating in natural gas–diesel and methanol–diesel dual-fuel modes. The results show that using 89% natural gas in a dual fuel engine reduces nitrogen oxides (NOx), sulfur oxides (SOx), carbon dioxide (CO2), particulate matter (PM), and carbon monoxide (CO) pollutions by 77.69%, 89.00%, 18.17%, 89.00%, and 30.51%, respectively, while the emissions percentage will be 77.78%, 91.00%, 54.67%, 91.00%, and 55.90%, in order, when using methanol as a dual fuel with percentage 91.00% Methanol. This study is significant as it highlights the potential of natural gas and methanol as viable alternative fuels for reducing harmful emissions in the maritime sector. The shift toward these cleaner fuels could play a crucial role in supporting the maritime industry's transition to low-emission operations, aligning with global environmental regulations and sustainability goals.

KEYWORDS: dual fuel engine; IMO regulations; methanol; natural gas; ship emission reduction

Hydrodynamic Cavitation and Advanced Oxidation for Enhanced Degradation of Persistent Organic Pollutants: A Review

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2024 - Sustainability

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ABSTRACT

Water pollution has become a major environmental menace due to municipal and industrial effluents discharged into water bodies. Several processes have been devised for the treatment and disposal of wastewater and sludge. Yet, most of the conventional technologies do not meet the requirements of sustainability as they impose a higher load on the environment in terms of resource depletion and toxic waste generation. Recently, sustainable innovative technologies, like hydrodynamic cavitation (HC), have emerged as energy-efficient methods, which can enhance the conventional wastewater treatment processes. HC is a very effective technique for the intensification of processes, like aeration, activated sludge treatment, and anaerobic digestion processes in conventional wastewater treatment plants, particularly for the enhanced degradation of persistent pollutants. On the other hand, advanced oxidation is a proven enhancement method for wastewater treatment. This review provides a comprehensive overview of recently published literature on the application of HC for the treatment of persistent organic pollutants. The potential synergistic impact of HC coupled with advanced oxidation and alternative pre-treatment methods was also reviewed in this study. Moreover, an overview of the present state of model-based research work for HC reactors and a feasibility analysis of various advanced oxidation process is also covered. Options for the pilot-to-large scale implementation of HC and advanced oxidation technologies to ensure the better sustainability of wastewater treatment plants are recommended.

KEYWORDS:

Dynamics of a Fractional-Order Within-Host Virus Model with Adaptive Immune Responses and Two Routes of Infection

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ABSTRACT

This paper introduces a novel fractional-order model using the Caputo derivative operator to investigate the virus dynamics of adaptive immune responses. Two infection routes, namely cell-to-cell and virus-to-cell transmissions, are incorporated into the dynamics. Our research establishes the existence and uniqueness of positive and bounded solutions through the application of the generalized mean-value theorem and Banach fixed-point theory methods. The fractional-order model is shown to be Ulam–Hyers stable, ensuring the model's resilience to small errors. By employing the normalized forward sensitivity method, we identify critical parameters that profoundly influence the transmission dynamics of the fractional-order virus model. Additionally, the framework of optimal control theory is used to explore the characterization of optimal adaptive immune responses, encompassing antibodies and cytotoxic T lymphocytes (CTL). To assess the influence of memory effects, we utilize the generalized forward–backward sweep technique to simulate the fractional-order virus dynamics. This study contributes to the existing body of knowledge by providing insights into how the interaction between virus-to-cell and cell-to-cell dynamics within the host is affected by memory effects in the presence of optimal control, reinforcing the invaluable synergy between fractional calculus and optimal control theory in modeling within-host virus dynamics, and paving the way for potential control strategies rooted in adaptive immunity and fractional-order modeling.

KEYWORDS: adaptive immune response; fractional-order model; Ulam–Hyers stability; sensitivity analysis; Pontryagin's maximum principle; optimal control

Factors Influencing Cross-Border E-Commerce Adoption of Thai MSMEs: A Fuzzy DEMATEL Approach. Sustainability

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2025 - Sustainability

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ABSTRACT

This research investigates the factors influencing the adoption of cross-border e-commerce (CBEC) among manufacturing micro, small, and medium enterprises (MSMEs) in Thailand by integrating the Diffusion of Innovation (DOI), Resource-Based View (RBV), and Technology–Organization–Environment (TOE) frameworks with the Fuzzy Decision-Making Trial and Evaluation Laboratory (DEMATEL) method. The findings reveal that knowledge of e-commerce, international marketing capabilities, and security and risk concerns are primary drivers of CBEC adoption, while socio-cultural factors and cost-related issues are secondary enablers. This study contributes to the e-commerce adoption literature by developing a context-specific, integrated conceptual framework and empirically validating the causal interrelationships among technological, organizational, and environmental factors in CBEC adoption using Fuzzy DEMATEL. The results provide actionable insights for both MSMEs and policymakers to strengthen Thailand's participation in the digital economy and advance Sustainable Development Goals (SDGs) 8 and 17.

KEYWORDS: cross-border e-commerce (CBEC); Thai MSMEs; fuzzy DEMATEL; international marketing capabilities; SDG 8; SDG 17

Municipal sewage sludge dewatering performance enhancement by ultrasonic cavitation and advanced oxidation: A case study

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2024 - Water Science & Technology

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ABSTRACT

The number of published literature on the effect of ultrasonic cavitation and advanced oxidation pretreatment on the dewatering performance of anaerobically digested sludge is very limited. This study aims at determining the optimum operating conditions of large-scale filtering centrifuges in wastewater treatment plants. The optimum dose of hydrogen peroxide, ultrasonic power, ultrasonic duration, ultrasonic pulse and particle size distribution for improved dewatering performance were determined in this study. In addition, shear stress–shear rate and viscosity–shear rate rheograms were developed to show the rheological flow properties for varying ultrasonic power and treatment duration. Optimum sonication power, time, pulse and amplitude were determined to be 14 W, 1 min, 55/5 and 20%, respectively. At a pH of 6.8, the optimum concentration of hydrogen peroxide was found to be 43.5 g/L. The optimum hydrogen peroxide dose in the combined conditioning experiments was determined to be 500 mg/L at a pH of 3. Under these optimum conditions, capillary suction time was reduced significantly by 71.1%. This study helps to reduce polymer consumption and provides the optimum pretreatment and dewatering operating conditions, and better monitoring and control in the dewatering unit has significant impact in the overall economy of wastewater treatment plants.

KEYWORDS: Logistics service quality, warehouse productivity, decision criteria, warehouse management, productivity indicator, fuzzy-AHP method

Physical Characteristics Due to Activation Energy of Dissipative Heat Transfer in Reiner-Philippo Nanouid with Darcy-Forchheimer Model

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2024 - Case Studies in Thermal Engineering

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ABSTRACT

This study aims to thoroughly investigate the flow behaviour of a Reiner–Philippoff nanofluid over a nonlinearly stretching sheet, with a particular focus on the effects of viscous dissipation. The research delves into the complex interactions within the nanofluid, assessing how viscous dissipation influences heat and mass transfer rates. To model the nanofluid flow, the Darcy–Forchheimer model was employed alongside slip velocity effects. Thermal radiation was incorporated to control heat transfer, while activation energy was considered for mass transfer regulation. The Buongiorno hypothesis was used to account for thermophoresis and Brownian motion in the governing equations. Following appropriate transformations, the nonlinear ordinary differential equations were formulated and solved using the shooting method. Key parameters such as skin friction, Nusselt number, and Sherwood number were analysed in tabular form, while graphical representations highlighted the impact of variables like concentration, velocity, and temperature. The study found that considering slip velocity in combination with the Darcy–Forchheimer model significantly enhances mass transfer. A comparison with existing data demonstrated the consistency of the results. This research holds relevance for applications in acid rain, pollution migration, groundwater treatment, and related environmental processes. It has been noted that raising the porosity parameter and the Forchheimer number causes the temperature and concentration levels to drop while boosting the fluid's velocity.

KEYWORDS: Darcy–Forchheimer model Two dimensional Reiner–Philippoff model Activation energy Viscous dissipation

Reactive Flow Dynamics of Conductive Maxwell Nanofluids Past Heated Stretching Surfaces with Slip and Thermal Radiation

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2025 - Journal of Modern Physics Letters B

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ABSTRACT

In this paper, we thoroughly examine the influences of slip effects and stagnation point flows in the context of an upper-convected non-Newtonian Maxwell nanofluid interacting with a stretching sheet. The existence of a heat generation, transverse magnetic field, and thermal radiation induces a flow resulting from a linearly stretched sheet. The application of the shooting method involves deriving nonlinear ordinary differential equations from the governing partial differential equations, followed by their solution. The effects of dimensionless governing parameters, including velocity ratio, Brownian motion parameter, thermophoresis parameter, velocity slip parameter, Lewis numbers, solutal slip parameter, Maxwell parameter, magnetic number, Eckert number, thermal slip parameter, chemical reactions parameter, and heat source parameter, are examined. The outcomes are illustrated and discussed through graphical representations, showcasing their impact on the velocity field, as well as heat and mass transfer characteristics. Tabular data are generated to display numerical values for physical parameters, including the skin-friction coefficient, local Sherwood number, and the reduced local Nusselt number. The findings suggest that an increase in the velocity slip parameter results in a reduction of both the local Sherwood number and the local Nusselt number. Furthermore, an increase in the strength of the magnetic field leads to a decrease in velocity profiles while simultaneously elevating temperature and concentration profiles.

KEYWORDS: Stagnation point Maxwell nanofluid chemical reaction numerical solutionslip effects

Role of microbial electrolysis desalination cell in sustainable water and energy management: Performance assessment of platinum and nickel foam cathodes and simulating integration with reverse osmosis systems

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2025 - International Journal of Hydrogen Energy

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ABSTRACT

This research introduces the microbial integrated cell (MIC), a bioelectrochemical system that combines microbial electrolysis and desalination for sustainable energy and water purification. Efficiency evaluations of nickel foam and Pt/CC cathodes for hydrogen production and desalination showed nickel foam achieving a 91% desalination efficiency, closely following Pt/CC's 99%, with hydrogen generation rates of 0.96 m3H2/m3/d for Pt/CC cathodes and 0.72 m3H2/m3/d for nickel foam. Despite marginally lower performance, the cost advantages of nickel foam suggest its feasibility for large-scale deployment. Further exploration into MIC integration with reverse osmosis (RO) system aims to enhance the sustainability of the combined system. Simulation outcomes indicate that MIC-RO integration can significantly reduce energy consumption and brine concentration discharged into the sea, highlighting its potential to improve desalination plants' efficiency and environmental impact. This research facilitates the transition of these green technologies to practical applications, optimizing efficiency and environmental benefits.

KEYWORDS:

Sustainable Aluminium Production Process: Solid Wastes Mineralization and use of Hydrogen Enhanced Natural Gas as an Alternative Fuel

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2024 - 2024 AIChE Annual Meeting

ABSTRACT

Carbon dioxide emissions from process industries such as aluminium pose a long-term challenge to sustainable industrial growth. A variety of solutions have been published on the menace of CO2 emission most of which are either pre-treatment of fuels or post treatment of waste generated by the fuel. However, little has been done on the aspect of combining these two methods. Thus, the use of hydrogen enhanced natural gas (HENG) as an alternative fuel and the capturing of carbon dioxide by mineralization of wastes generated during aluminium production were evaluated. While the use of pure hydrogen can lead to zero emission, the challenge of implementing this idea is the need to build completely new facilities for hydrogen combustion and safe handling. The use of HENG will require very little or no modification to the existing facilities in the industry. In this study, aluminium production process was simulated using Aspen Plus by considering HENG as alternative energy source and placing a carbon capture and mineralization unit downstream of the production process. The feasibility of the carbon capture and mineralization unit was experimentally investigated using aluminium wastes slag that was collected from local aluminium industry. These samples were carbonated with a high pressure and high temperature reactor using mixture of CO2 and N2. The mineralization was carried out at various operating conditions of gas pressure from (1 to 5bar), temperature (25 to 90oC), and reaction time (1 to 6 hours). Carbon mineralization was evaluated using dielectric permittivity, the TGA, XRF, and SEM-EDS. The results of the simulation showed that the use of HENG with 17mole% H2 can lead to 19.65% increase in energy generation, and 21.69% decrease in CO2 emission. Moreover, the results of SEM, corroborated by the XRF results, revealed the formation of flaky and clustered crystals of carbonates minerals. The results of TGA showed a distinctive carbonation profile which seems to be more pronounced at 5bar. Overall, synergistic use HENG and CO2 mineralization using solid wastes from aluminium industries are potential candidates for achieving net zero production process.

KEYWORDS: sustainable growth, process intensification, carbon mineralization, hydrogen enhanced natural gas, net zero emission.

The Scope of Integrating Artificial Intelligence on the Evaporation Traits of Additive Blended Fuels

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2025 - Nigerian Journal of Technological Development

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ABSTRACT

Nanoparticles and oxygenated additives significantly enhance fuel properties when blended with diesel or biodiesel, leading to improved engine performance and reduced harmful emissions. These additives influence ignition delay, a crucial factor in combustion. This study critically reviews the hot plate evaporation technique to evaluate the ignition delay of various blended fuels meticulously calibrated in diverse proportions and incorporated with cutting-edge additives, including nanoparticles (viz., CNT, CeO2, Al2O3), oxy-additives (viz., DEE, Ethylene glycol, Ethanol), and water emulsions to enhance the combustion, emission and performance characteristics of diesel engines. This fascinating research area has captured researchers' keen interest, marking it as an extensively explored scientific domain. This paper also explores the potential of integrating AI tools, such as artificial neural networks (ANN) and various algorithms, with the above technique to forecast combustion behaviour, enhance efficiency, and refine the emission characteristics of advanced fuels as a future scope of study.

KEYWORDS: Ignition delay, evaporation, artificial intelligence, machine learning, artificial neural network (ANN).

College of Advanced Technology

Differential privacy preserving based framework using blockchain for internet-of-things

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ABSTRACT

The Internet of Things (IoT) has enabled the collection of vast amounts of data that can be used to improve various aspects of our lives. However, the astronomical volume of data generated by these IoT devices has raised significant concerns pertaining to privacy preservation. The amalgamation of the Internet of Things (IoT) with blockchain technology has engendered a promising solution for securing and managing IoT data, but it is still susceptible to privacy breaches. Recently, differential privacy (DP) has been proposed as a promising technique to alleviate these issues. In this paper, we design and propound a complete end-to-end blockchain-based architecture by implementing differential privacy at the stream level generated by IoT devices by deploying Laplace noise and Gaussian noise utilizing low complex cryptography mechanism and fast convergence consensus protocol to surmount the privacy preservation issues in IoT based blockchain network. Our novel DP-based framework introduces the concept of privacy levels as low, medium, and high as set by the data owner and also analyzes the impact of different parameters on the effectiveness of the approach and provides recommendations for tuning them. The workflow of our proposed framework consists of three phases: Data generation phase, Data Sharing phase, and Data Analysis phase. During the Data generation phase, the data owner will first determine the desired level of privacy protection (low, medium, high) and set the privacy budget (epsilon) and sensitivity (delta) of the data. Based on the budget value, the privacy module will generate noise from either Laplace or Gaussian distribution as requested by the data owner. The Data Sharing phase is mainly responsible for transmitting and processing the transactions inside the blockchain network. This is followed by the data analysis phase, which will check for the budget value and the amount of noise added to the data before the noisy data is handed over to the end user. We demonstrate the efficacy of our approach through multiple experimental evaluations and simulation results evince that our approach attains high levels of privacy preservation while upholding data utility and blockchain consistency. Overall, our proposed framework provides a promising solution to the privacy challenges in IoT-based blockchain systems, offering adjustable privacy levels to accommodate different privacy requirements. This DP-based approach and the adjustable privacy levels ensure alignment with the growing regulatory requirements for data privacy, such as GDPR, demonstrating compliance with these regulations and building trust with customers.

KEYWORDS: Blockchain, Consensus mechanism, Distributed system, Internet of things, Security, Authentication, MIoT