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MIT ADTU School of Bioengineering Sciences & Research

9th INTERNATIONAL CONFERENCE ON

RECENT TRENDS IN BIOENGINEERING

(ICRTB 2026)

January 23rd - 24th 2026

ABSTRACTS

MIT ADTU School of **Bioengineering Sciences & Research**

Breathe Life into Engineering Career!

A Constituent Unit Of MIT ADT University

MIT-ADT UNIVERSITY

PUNE, INDIA

A Leap Towards World Class Education

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About ICRTB 2026

International Conference on Recent Trends in Bioengineering (ICRTB) is an annual flagship event, organized by MIT ADTU School of Bioengineering Sciences & Research, Pune. This conference is sponsored by DST-SERB, Anusandhan National Research Foundation (ANRF), Government of India. The main objective is to bring together engineers, researchers, practicing clinicians, academicians, industry luminaries and government agencies to discuss the latest research in bioengineering and allied fields. The organising committee of ICRTB 2025 is pleased to invite prospective authors to submit their original abstracts to icrtb@mituniversity.edu.in for oral and poster presentations. Selected abstracts will be considered for oral presentation and proceeding will be published as a special issue in John Wiley Journal of Biotechnology and Applied Biochemistry. Prizes will beawarded for the best oral and poster presentations.

Conference Theme Areas

- Biomedical Imaging Signal
- Processing
- Artificial Intelligence, AI
- Agents & Digital Twin in
- Healthcare
- Biomedical Engineering,
- Devices & Robotics
- Biomechanics, Biomaterials & Regenerative Medicine
- Health care Informatics
- Biomedical Devices
- Multi-Target Drug Design and Network pharmacology
- Bioinspired Scaffolds for
- Next-Generation
- Therapeutics
- Translational Advances in Drug Delivery Systems
- Omics-Driven Precision
- Medicine
- Computational Biology
- Biologics and Biosimilars
- Emerging technologies in Bioenergy
- Carbon capture utilisation and storage with Bioenergy
- Microbial and algal platforms for Bioenergy production
- Waste to energy and circular bioeconomy models
- Next generation Biofuels

9th International Conference

on

Recent Trends in Bioengineering (ICRTB-2026)

Editors

Prof. Vinayak Ghaisas

Dr. Renu Vyas

Organized by

Breathe Life into Engineering Career!

MIT ADTU School of Bioengineering Sciences & Research

MIT Art, Design and Technology University, Pune - 412201

India

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January 23rd – 24th, 2026

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9TH INTERNATIONAL CONFERENCE ON RECENT TRENDS IN BIOENGINEERING (ICRTB-2026)

(January 23-24, 2026)

Detailed Schedule

Day 01: January 23, 2026 (Friday)

Venue: Urmilatai Karad Auditorium,
MIT Art, Design and Technology University, Pune

Inauguration (Venue: MIT ADT University Auditorium)	
8.30 am to 9.30 am	Spot registrations, arrival of guests, speakers and delegates and breakfast
9.30 am to 11.00 am	Inaugural program presided by Vishwadharmi Prof. Dr. Vishwanath D. Karad sir, Founder MIT Group of Institutes and President MIT-ADT University
9.30 am to 9.35 am	Welcome of audience by the anchors, World Peace prayer and lamp lighting by dignitaries on the dais
9.35 am to 9.40 am	Welcome speech by Prof Vinayak Ghaisas Founder Executive Director, MIT Bioengineering and Trustee MAEER Pune
9.40 am to 9.45 am	Introduction of guests and conference theme by Convenor Dr. Renu Vyas
9.45 am to 9.50 am	Felicitation of guests by dignitaries
9.50 am to 09.55 am	Release of abstract book by dignitaries on the dais
09.55 am to 10.10 am	Inaugural Talk by Chief Guest and Guest of Honor
10.10 am to 10.15 am	Address by Dr. S Rajesh, Hon. Vice Chancellor, MIT ADT University
10.15 am to 10.30 am	Speech by Hon. Prof Dr. Mangesh Karad, Executive President & Pro-Chancellor, MIT Art, Design and Technology University, Pune
10:30 am to 10:35 am	Vote of Thanks
10:35 am to 11.00 am	Tea break and group photo
11.00 am to 1 pm	Keynote Addresses (Venue: University Auditorium) Session Chair: **Dr. Justin Dauwels,** Professor, TU Delft University of Technology, Netherlands
11.00 am to 11.30 am	**Dr. Michael Sauer** Talk Title: This is not Waste – a Future Built on Circular Thinking Catalyzed by Biotechnology

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	Head of Department Biotechnology (OMV AG), Vienna, Austria
11.30 am to 12.00 pm	**Dr. Sudip Paul** Biomedical Engineering NIT, Raipur
12.00 pm to 12.30 pm	**Dr. Renu Vyas** Talk Title: Special Lecture on Three Decades of Interdisciplinary Research Professor and Dean, School of Bioengineering Sciences & Research
12.30 pm to 1.00 pm	Inauguration of Center of Excellence (For Guest and MITADTU Leadership) for Biomedical Devices with Syna Johari and AI Center for drug design with Molecular Solutions
1.00 pm to 2.00 pm	Lunch Break
2.00 pm to 3:30 pm	Plenary Session I Session chair: **Dr. Stuart Wagland,** Cranfield University, UK
2.00 pm to 2.30 pm	**Dr. Senthil Naggapan Annamalai** SSS National Institute of Bio-energy, Ministry of New and Renewable energy
2.30 pm to 3.00 pm	**Dr. Richard Morgan** Dean, Biosciences, University of West London, UK
3.00 pm to 3.30 pm	**Dr. Kaushik Chatterjee** IISc, Bangalore
3.30 pm to 3.40 pm	Tea break
3.40 pm to 4.00 pm	**Dr. Siddhartha Jhunjhunwala** IISc, Bangalore
4.30 pm to 5.00 pm	**Dr. Krishna Ethiraj** Aragen Life Sciences, Hyderabad
5:00 pm to 5:30 pm	**Dr. Andreas Bender (Online Session)** Professor, Khalifa University, Abu Dhabi
5.30 pm to 6.15 pm	Oral/Poster sessions by delegates (parallel sessions) (MIT Bioengineering Auditoriums) **Session chair for Poster Evaluation: Dr.Abdul Rahim Chethikkattuveli Salih** Post Doctoral Researcher, Terasaki Institute for Biomedical Innovation. Los Angeles, United States.
6.30 pm	Day One conclusion

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Day 02: January 24, 2026, Saturday

8.00 am to 8.30 am	Tea and Breakfast
8.30 am to 10.30 am	Plenary Session II Session chair: **Dr. Michael Sauer** Head of Department Biotechnology (OMV AG), Vienna, Austria
8.30 am to 9.00 am	**Dr. Sreekumar Kurungot** Chief Scientist, CSIR- National Chemical Laboratory, Pune
9.00 am to 9.30 am	**Dr. Stuart Wagland** Cranfield University, UK
9.30 am to 10.00 am	**Dr. Czarny Bertrand** Assistant Professor, Nanyang Technological University NTU
10.00 am to 10.30 am	**Dr. Justin Dauwels** Professor, TU Delft University of Technology, Netherlands
10:30 am to 10:45 am	Tea break
10.45 am to 12:45 pm	Plenary Session III Session Chair: **Dr. Sreekumar Kurungot** Chief Scientist, CSIR- National Chemical Laboratory, Pune
10.45 am to 11.15 am	**Dr. Monali Rahalkar** Agarkar Research Institute, Pune
11.15 am to 11:45 am	**Dr. Sirisha Potala** Amgen, Hyderabad
11:45 am to 12.15 pm	**Prof. Dr. Kavita Reginald** Faculty of Medical and Life Sciences, Sunway University, Malaysia
12.15 pm to 12:45 pm	**Dr. Raghu Rangaswamy** CEO, Molecular Solutions
12:45 pm to 1.30 pm	Lunch break
1.30 pm to 3.00 pm	Plenary Session IV Session Chair: **Dr. Richard Morgan** Dean, Bio sciences, University of West London, UK
1.30 pm to 2.00 pm	**Dr. Sandeep Gaudana** Reliance Industries ltd., Baroda
2.00 pm to 2.30 pm	**Dr. Umesh Shaligram** Executive Director, Serum Institute of India Pvt. Ltd, Pune, India
2.30 pm to 3.00 pm	**Dr. Rohini Kitture** Deputy Editor, Wiley
3:00 pm to 3.15 pm	Tea break

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3.15 pm to 4.30 pm	Oral/Poster sessions by delegates (parallel sessions) (MIT Bioengineering Auditoriums)
4.30 pm to 5.00 pm	Valedictory function, announcement of Prizes, concluding remarks by guests and Executive Director
5:15 pm	National Anthem

Kindly note all timings are in IST.

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Messages

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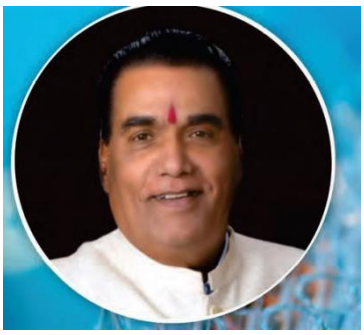

Hon. Prof. Dr. Vishwanath Karad

With profound sense of deep satisfaction, I congratulate MIT ADTU School of Bioengineering Sciences & Research for organising its 9th International Conference on Recent Trends in Bioengineering from 23rd – 24th January 2026. Bioengineering is a multidisciplinary field that is growing very fast and will have a deep impact in finding sustainable solutions for health care.

My best wishes for the event to the organizers!

Hon. Prof. (Dr.) Vishwanath D. Karad
Founder, MAEER's MIT Group of Institutions
Chancellor & President, MIT Arts, Design & Technology University Pune

Organized by:
MIT ADTU School of Bioengineering Sciences & Research,
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January 23rd – 24th, 2026

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Late Dr. Suresh Ghaisas

Dedicated in loving memory of Hon'ble Dr. Suresh Ghaisas whose blessings shall always stay with us.

Sir,
Your life was an inspiration,
Your good deeds our guiding path,
An epitome of generosity and gentleness
Bless us as always with your loving warmth.

Late Dr. Suresh Ghaisas
Founder Member, MAEER's MIT Group of Institutions

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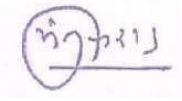
Hon. Dr. Mangesh Karad

Dear Delegates & Speakers,
Like every year I extend a warm welcome to you on the occasion of the 9th International Conference on Recent Trends in Bioengineering 2026.
I am proud to see the growth of School of Bioengineering Sciences & Research and its constant contribution to our New Age University in accelerating Research and innovation. The conference over the years has become an amazing platform that brings together performance of diverse disciplines to engage in intense discussions and deliberations at the forefront of emerging areas.
Very glad to host you at our campus and hope that you will enjoy the hospitality and carry good memories of the event.

Hon. Prof. Dr. Mangesh Karad



Pro-Chancellor & Executive President
MIT Arts, Design & Technology University

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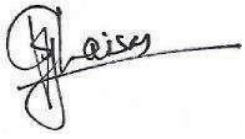
Prof. Vinayak Ghaisas

I am very happy & excited to host our annual "International Conference on Recent Trends in Bioengineering (ICRTB)". This is the 9th year of us hosting the conference. The sub themes for this year's conference are Biomedical applications, Drug Design and Bioenergy. With this conference we bring together various speakers and participants from India & abroad to discuss various interesting topics and advancements in field of Bioengineering focused on these themes. Bioengineering holds a great promise for the coming decades to solve some of the complex problems we have been facing as a society. Such conferences play vital role in advancing the knowledge in this multi-disciplinary field of Bioengineering. I am sure everyone at the conference will make the best use of this great opportunity to network and broaden their horizons.

Warm welcome to all delegates, speakers and hope you enjoy our hospitality!



Prof. Vinayak Ghaisas
Founder & Executive Director
MIT School of Bioengineering Sciences & Research
Trustee, MAEER's MIT Group of Institutions, Pune

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Dr. Renu Vyas

Warm welcome to the annual flagship program to our Institute's 9th International Conference on Recent Trends in Bioengineering 2026.

The idea of ICRTB was conceptualised in 2018 when the institute was barely two years old and today the seed has germinated and grown into a beautiful sapling. Through this platform, we strive to bring together heterogeneous fields and creative minds sharing common space where we can learn from each other.
This year's conference has three tracks viz. biomedical applications, drug design and bioenergy that are very important areas of nation building. We have good speakers from various disciplines at both national and international level who will share their distilled knowledge to all delegates on the two engaging days.

My sincere thanks to MIT management, eminent speakers, my staff and our publication partner John Wiley for continuous support for the event. Looking forward to meeting every delegate for fruitful discussions that will lead to a strong ecosystem that will nurture the next generation of innovators.

Principal
MIT School of Bioengineering Sciences & Research
Convenor ICRTB 2026

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Eminent Speakers

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Dr. Siddhartha Jhunjhunwala
Associate Professor
Centre for BioSystems Science and Engineering
Indian Institute of Science (IISc), Bangalore

Profile:

Siddharth Jhunjhunwala is an Associate Professor at the Department of Bioengineering, Indian Institute of Science (IISc), Bengaluru, India. His research interests include modulation of neutrophil and macrophage functions in diseases such as type-2 diabetes and its complications. He has published over 50 papers in international journals, has won numerous awards such as the India Alliance Intermediate Fellowship, the R. I. Mazumdar Young Investigator Award and the Ramanujan Fellowship. He has an avid interest in teaching and was awarded the Prof. Priti Shankar award for teaching at IISc. He received the B. Tech. degree in industrial biotechnology from Anna University, Tamil Nadu, India in 2006, and the Ph.D. degree in bioengineering from University of Pittsburgh, Pennsylvania, USA in 2011. He trained as a postdoctoral fellow and then as a Mazumdar-Shaw Oncology at the Massachusetts Institute of Technology for 4 years, before joining the IISc as an Assistant Professor in 2016.

Synopsis of the talk:

Immune Dysfunction in Diabetes: Insights from Neutrophil Biology Using Biomaterials as Model Systems

Chronic inflammatory conditions pose a significant burden on healthy lifespan, not only by sustaining low-grade inflammation but also by amplifying vulnerability to secondary insults. Individuals with such conditions—like type 2 diabetes—exhibit heightened morbidity and mortality when faced with additional inflammatory challenges, such as infections, trauma, or surgical interventions. This exacerbated response is thought to arise from dysregulated immune cell activity, yet pinpointing

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causative mechanisms remains difficult due to the complexity of the immune system and the lack of preclinical models that isolate individual contributors. In this presentation, I will describe experimental strategies developed in my laboratory to address this gap. We have established and refined mouse models of chronic inflammation, including diabetic models and biomaterial implant systems, to dissect the role of specific immune cell subsets. Our investigations have revealed that immature neutrophils—often elevated in chronic inflammatory states—play a central role in driving inflammation-associated tissue injury. These cells exhibit aberrant functional profiles and heightened inflammatory potential compared to their mature counterparts. Details on how we determined the role of the immature neutrophils will be presented. Our findings not only advance our understanding of neutrophil biology in disease contexts but also suggest novel therapeutic avenues for reducing inflammation-induced injury in patients with chronic inflammatory conditions. By leveraging mechanistic insights from preclinical models, we aim to inform translational strategies that enhance resilience to secondary inflammatory insults and improve long-term health outcomes.

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Dr. Richard Morgan
Dean, Biosciences University of West London, UK

Profile:
Dr. Morgan is the Dean of Biomedical Sciences at the University of West London, where he leads a newly established School that recruited its first cohort of students in 2020. In this role, he oversees the School's day-to-day operations and long-term strategic planning, while managing a multidisciplinary team of academics and researchers working in areas such as cancer drug discovery, antibiotic resistance, and osteoporosis. He is responsible for ensuring the delivery of high-quality teaching and research, as well as implementing the University's strategies in knowledge transfer and internationalization. Dr. Morgan's research focuses on targeting the HOX and Engrailed family of transcription factors, leading to the development of HXR9, the first and currently only available antagonist of HOX function, representing a novel therapeutic approach in cancer. In addition, his work explores the use of HOX and Engrailed transcription factors as diagnostic biomarkers, including the identification of EN2 as a highly sensitive marker for prostate cancer, demonstrating twice the sensitivity of PSA and a strong predictive value for tumor volume.

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Professor Simon Wang
Dept. of Pharmaceutical Sciences,
Howard University, Washington DC, USA

Profile:

Dr. Simon Wang is currently a tenured associate professor at the Department of Pharmaceutical Sciences, Howard University College of Pharmacy (HU COP). He also directs the Artificial Intelligence and Drug Discovery Core Laboratory for District of Columbia Center for AIDS Research (DC CFAR). Dr. Wang has about 20 years of experience in computer-aided drug design (CADD), machine learning, and structure-based drug design (SBDD), high-throughput screening (HTS), biomolecular simulation, and modern medicinal chemistry. He has published about 50 peer-reviewed research articles, reviews, book chapters and patents as well as 190 conference abstracts and invited lectures, also been awarded more than 20 university-, state-, federal- and internationally-funded grants. Dr. Wang has been a long-time reviewer for over 45 major research journals including Journal of Medicinal Chemistry and Journal of Chemical Information and Modeling, also served in review panels for funding agencies such as National Institute of Health (NIH), National Aeronautics and Space Administration (NASA), American Association of Colleges of Pharmacy (AACP) and Alzheimer's Drug Discovery Foundation (ADDF). In recent years, Dr. Wang has been keen on adapting Virtual Reality (VR), Augmented Reality (AR), and Artificial Intelligence (AI) onto pharmacy professional education as well as drug discovery research.

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Dr. Umesh Shaligram
Executive Director and
Serum Institute of India Pvt. Ltd, Pune, India

Profile:

Dr. Umesh Shaligram is the Executive Director and Board Member of Serum Institute of India Pvt. Ltd. (SIIPL), Pune, India, and a senior biopharmaceutical leader with extensive experience in vaccine research, development, and large-scale manufacturing. He leads the strategic planning and execution of major vaccine programs and next-generation biologics, including biosimilars and biobetters. Dr. Shaligram played a pivotal role in the development and manufacturing of billions of doses of COVISHIELD® and was instrumental in advancing India's indigenous COVID-19 vaccine, Covovax/Neuvaxovid. His expertise spans process development, scale-up, technology transfer, and global regulatory compliance. He actively drives initiatives to reduce the disease burden of tuberculosis, malaria, pertussis, and HPV, while also expanding access to personalised cancer care. With strong experience in global regulatory engagements, he has led numerous international collaborations, facilitated technology transfers, and built strategic partnerships with research organizations and industry leaders worldwide. He is deeply involved in mentoring scientific and technical teams, fostering innovation while ensuring the highest standards of quality and safety. His leadership continues to strengthen global vaccine supply capabilities and reinforce Serum Institute's position as a global leader in affordable and accessible immunization solutions.

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Dr. Stuart Wagland
Cranfield University UK

Profile:

Dr. Stuart Wagland is a senior academic and researcher at Cranfield University, United Kingdom, with expertise in environmental engineering and sustainable waste management. He is an experienced waste management professional with a strong background in chemistry, specializing in waste characterization, novel analytical techniques, and resource recovery. He holds a PhD in Waste Chemistry from Cranfield University, along with a BSc (Hons) in Chemistry and an MSc in Display Technology. Dr. Wagland is a Chartered Chemist (CChem), Fellow of the Royal Society of Chemistry (FRSC), and Fellow of the Higher Education Academy (FHEA). He joined Cranfield University in 2009 and progressed through the academic ranks to Reader in 2022. His research focuses on solid waste and biomass characterization, waste-to-energy technologies, circular economy approaches, and environmental impact assessment. He has extensive expertise in anaerobic digestion, incineration, gasification, pyrolysis, and enhanced landfill mining. His UK-wide waste assessment work contributed to major government investment in advanced thermal treatment demonstrator facilities. He collaborates closely with industry and policy stakeholders to develop practical and scalable sustainability solutions. Dr. Wagland has published widely in leading international journals. He is actively involved in applied research projects funded by national and international agencies. His work advances low-carbon, resource-efficient systems and waste valorization practices in the UK and globally.

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Dr. Rohini Kitture
Deputy Editor, Wiely

Profile:

Dr. Rohini Kitture is a senior scientific publishing professional currently serving as Deputy Editor at Wiley**,** with a strategic focus on nanoscience and materials science journals**.** She is Deputy Editor of *Small* and Cluster Deputy Editor for Wiley's flagship *Small* portfolio, including *Small Methods, Small Structures,* and *Small Science*. With over 15 years of experience in science and publishing**,** she specializes in editorial strategy, content curation, and portfolio development. Dr. Kitture plays a central role in overseeing rigorous peer-review and editorial decision-making for high-impact journals. She works closely with authors, reviewers, and editorial boards worldwide to ensure quality, ethics, and transparency in publishing. Her expertise includes manuscript evaluation, reviewer management, and ethical publishing practices. She is actively involved in global author engagement and researcher education initiatives. Dr. Kitture mentors authors to enhance clarity, structure, and research impact. She contributes to shaping journal vision and strategic content acquisition. She is passionate about amplifying scientific voices and connecting breakthrough research with global audiences. Dr. Kitture is the author of seven international books and a recipient of the STAR Award at Springer Nature**.** She was also a Former International Visiting Scientist Fellow at the Karlsruhe Institute of Technology, Germany**,** reflecting her strong academic and global research engagement.

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Dr. Justin Dauwels
Professor, TU Delft University of Technology,
Netherlands

Profile:
Dr. Justin Dauwels is an Associate Professor at TU Delft in the Signal Processing Systems group, Department of Microelectronics, and serves as co-Director of the Safety and Security Institute at TU Delft. He previously held an Associate Professor position at Nanyang Technological University, Singapore, until 2020. At TU Delft, he leads the Model-Driven Decisions Lab (MoDDL), a flagship collaboration between TU Delft and law enforcement under the Knowledge Building program. He also serves as Chair of the Electrical Engineering Board of Studies and as a board member of the Co van Ledden Hulsebosch Center, the Netherlands' Center for Forensic Science and Medicine. His research focuses on data analytics and signal processing with applications to intelligent transportation systems, autonomous systems, and human behaviour and physiology analysis. He obtained his PhD in Electrical Engineering from ETH Zurich in 2005 and held research positions at RIKEN Brain Science Institute and MIT. Dr. Dauwels is an IEEE Signal Processing Society Distinguished Lecturer for 2024-2025. He has held prominent editorial and leadership roles across IEEE and Elsevier journals and technical committees. His research team has received multiple best paper awards at leading international conferences and journals. His work on intelligent transportation systems has been widely featured by the BBC and major national newspapers. He actively collaborates with startups, SMEs, public agencies, and multinational companies in data-driven transportation, logistics, and medical analytics. His academic lab has successfully spun off four startups, including MindSigns Health and Sapience Automata.

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Synopsis of the talk: **Extreme precipitation nowcasting using deep generative models**

Extreme weather events, such as the floods recently in Valencia, Spain, have led to substantial impacts, including loss of life and major economic losses. Therefore, weather forecasts need to become more reliable, especially for extreme weather events. There has been a recent breakthrough in precipitation nowcasting, which is precipitation forecasting for the next few hours: Machine learning models, particularly deep generative models, can provide improved forecast quality compared to the state-of-the-art nowcasting and physics-based models. However, these new models are not adequate for extreme weather events. In our team, we are developing new deep generative models specifically for nowcasting extreme precipitation. Concretely, we are designing transformer-based generative models, in particular, VideoGPT with Extreme Value Loss (EVL) regularization. Leveraging a comprehensive dataset from the Royal Netherlands Meteorological Institute (KNMI), we aim to predict short-term extreme precipitation with high accuracy. We introduce a novel method for computing EVL without assuming fixed extreme representations, addressing the limitations of current models in capturing extreme weather events. Currently, we are also validating our deep generative nowcasting models on datasets from the US, Singapore, and India. We will present both qualitative and quantitative analyses, demonstrating the superior performance of the proposed VideoGPT-EVL in generating accurate precipitation forecasts, especially when dealing with extreme precipitation events.

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Dr. Czarny Bertrand
Assistant Professor
Nanyang Technological University NTU

Profile:

Joined the French governmental agency CEA (Atomic Energy Commission) in 2001. For more than 10 years, Dr Czarny was responsible for the studies conducted in Bio distribution, drug delivery and toxicology of nanoparticles as a Team Leader. During this period, he received a Ph.D. degree in structural and functional engineering of biomolecules from the University of Paris Descartes, Pharmacy Paris V (France). Following his PhD, Dr Czarny developed preclinical studies on different inflammatory diseases using nanoparticles drug formulations at Utrecht University (UU) Netherlands, at the National University of Singapore (NUS) or at Nanyang Technical University (NTU) as Research Fellow. Now, Dr Czarny is currently an assistant Professor of nanomedicine the School of Material Sciences and Engineering (MSE) and the Lee Kong Chian School of Medicine (LKC).His research is focused on the development of nanomedicines with large emphasis on extracellular vesicles mimetic and in vivo pre-clinical studies to deliver drugs, genes or act as a vaccine. The research activities aim to understand the mechanisms of actions of these engineered vesicles and the interaction with the different cells. His research is highly translational, and is broadly applicable to many pathological conditions. Bertrand published more than 50 research/review articles, and some book chapters and patents.

Synopsis of the talk:

Engineering Extracellular Vesicles and Hybrid Nanovesicles for Biomedical Applications, Therapeutic Discovery, and Sustainable Resource Integration.

Extracellular vesicles (EVs) and engineered hybrid nanovesicles represent a rapidly

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advancing frontier in biomedical innovation due to their intrinsic biocompatibility, cargo-carrying capacity, and ability to modulate cellular responses. This work presents an integrated research program leveraging natural EVs, synthetic mimetics, and renewable biomaterials to address unmet needs across vaccination, gastrointestinal disease, tissue repair, and antimicrobial resistance. We developed a scalable platform for producing bacterial extracellular vesicle mimetics (BEVMs) directly from multiple *Streptococcus pneumoniae* serotypes. These BEVMs preserve essential membrane antigens and display broadened antigenic repertoires, eliciting strong cross-protective immunity in vivo. Their manufacturability and serotype breadth position BEVMs as a promising next-generation pneumococcal vaccine platform. For gastrointestinal therapy, we generated high-yield probiotic mimetic vesicles (MEVs) from *Lactobacillus rhamnosus* GG, replicating the immunomodulatory properties of natural EVs and significantly reducing DSS-induced colitis in mice. To enable oral delivery, we engineered 3D-printed pH-responsive alginate carriers and double-coated stem-cell-derived EVs, achieving robust gastric protection and targeted colonic release. Leveraging renewable resources, we created human-hair-keratin hydrogels with tunable porosity, intrinsic antibacterial activity, and strong wound-healing performance that surpass GelMA in full-thickness models. Keratin-based IPC microfibers further function as biodegradable sutures with low inflammatory responses. Finally, EV-primed mesenchymal stem cells were used to identify novel antimicrobial peptides with potent activity against multidrug-resistant pathogens, revealing a new route for AMP discovery. Together, these advances demonstrate how engineered EVs, hybrid vesicles, and sustainable biomaterials can be translated into impactful solutions for vaccination, gut health, regenerative medicine, and antimicrobial resistance.

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Dr Andreas Bender

Professor, Khalifa University, Abu Dhabi

Profile:

Dr Andreas Bender is Professor for Machine Learning in Medicine at the Department of Medicine at Khalifa University, Abu Dhabi, analyzing heterogenous chemical, biological and medical data. Before this post, he has been Professor for Molecular Informatics at Cambridge University and a Director for Digital Life Sciences at Nuvisan/Berlin, as well as Associate Director for Data Science and AI in the Clinical Pharmacology & Safety Sciences group at AstraZeneca/Cambridge, UK. In his work, Andreas is involved with the integration and analysis of chemical and biological data from different sources, such as structural and bioactivity data, gene expression readouts, cellular imaging data, pathway information, electronic health records, etc., for clinically relevant decision making. On the entrepreneurial side, Andreas was involved in setting up Healx Ltd., for data-driven drug repurposing, and PharmEnable Ltd., for designing novel chemistry for targets that are difficult to drug conventially, both based in Cambridge/UK. More recently, he was involved in establishing Pangea Bio, a clinical stage company located in London/UK as well as Berlin/Germany, working on CNS drug discovery supported by historical use information. Andreas received his PhD from the University of Cambridge and worked in the Lead Discovery Informatics group at Novartis in Cambridge/MA as well as at Leiden University in the Netherlands before his current post.

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Professor Dr. Kavita Reginald
Deputy Dean (Employability and Alumni)
Sir Jeffrey Cheah Sunway Medical School
Faculty of Medical and Life Sciences Sunway University, MALAYSIA

Profile:

Professor Dr. Kavita Reginald is an immunologist and academic leader specializing in allergic disease mechanisms, translational immunology, and research-to-impact outcomes. She brings over 15 years of experience across research, teaching, and institutional leadership, bridging rigorous scientific inquiry with strategic academic and employability outcomes. Her research focuses on the genetic and molecular drivers of allergic diseases, allergen epitope characterization, and the development of safe immunotherapy molecules. This work has resulted in more than 40 peer-reviewed publications in high-impact international journals and the successful acquisition of competitive research grants. She is currently a Professor of Immunology at Sunway University. In addition, she serves as Deputy Dean (Employability & Alumni), where she leads faculty strategy for graduate success pathways, industry–academic partnerships, and stakeholder engagement. She designs and delivers programs that address skills gaps and enhance career readiness among graduates. Professor Dr. Reginald is recognized for integrating research excellence with curriculum innovation. She is deeply committed to mentoring the next generation of scientists for academic, clinical, and industry careers. Her leadership emphasizes translating complex research into real-world solutions. She thrives at the intersection of science, education, and institutional strategy. Her core strengths include immunology research, translational science, academic leadership, employability strategy, curriculum design, stakeholder engagement, grant acquisition, and scientific publishing.

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Dr. Senthil Naggapan Annamalai
Scientist, SSS National Institute of Bio-energy
Ministry of New and Renewable energy, Punjab, India

Profile:

Dr. Senthil Nagappan Annamalai is a senior scientist at the Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE**)**, an autonomous R&D institution under the Ministry of New & Renewable Energy (MNRE)**,** Government of India, focusing on bioenergy research and innovation. He holds a Ph.D. from BITS Pilani and completed postdoctoral research at the Centre for Sustainable Development, Qatar University. At SSS-NIBE, he leads efforts in algae biorefinery and sustainable bioresource utilization aimed at promoting circular economy models. His work includes developing efficient animal feed and aquafeed solutions from biomass and microalgae. Dr. Nagappan also researches biopigment extraction and application from microalgae for industrial and bioenergy uses. He is actively engaged in bioelectrosynthesis processes and methods related to carbon capture, storage, and utilization (CCUS). His expertise supports the institute's mandate on advanced bioenergy technologies and biomass conversion. The research contributes to sustainable bioenergy solutions that integrate with broader renewable energy systems. Dr. Nagappan has published research in his areas of specialization. His work aligns with MNRE's goals of promoting renewable and clean energy generation technologies. Through scientific innovation, he supports training and capacity building in the bioenergy sector. His contributions help advance India's transition toward sustainable energy and biomass valorization.

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Dr. Monali C. Rahalkar
Scientist E
Agharkar Research Institute (ARI), Pune, India

Profile:

Dr. Monali C. Rahalkar is a microbial ecologist specializing in methanotrophs—bacteria that oxidize methane and play a pivotal role in regulating greenhouse gas emissions. At ARI, she leads the Methanotrophs Laboratory, where her research focuses on the isolation, taxonomy, and functional characterization of methanotrophic bacteria from diverse ecosystems such as wetlands, rice paddies, and landfill environments. Her work integrates classical microbiology with molecular tools to uncover novel methanotroph lineages and understand their ecological roles in methane cycling. With a Ph.D. from the University of Konstanz, Germany, and postdoctoral training in Bremen, Dr. Rahalkar brings international expertise to India's microbial research landscape. Her contributions have advanced the understanding of methane biogeochemistry and the potential of methanotrophs in climate change mitigation and environmental biotechnology.

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Dr. Sreekumar Kurungot
Chief Scientist
CSIR- National Chemical Laboratory, Pune, India

Profile:

Dr. Sreekumar Kurungot is a distinguished scientist and Chief Scientist at CSIR–National Chemical Laboratory (NCL), Pune, India, and an internationally recognized expert in electrochemistry, energy materials, and nanostructured functional materials. His research focuses on electro catalysis, energy conversion and storage, fuel cells, and sustainable electrochemical technologies. He has made significant contributions to the development of advanced electrode materials and catalytic systems for clean energy applications. His research group specializes in material synthesis and system development for electrochemical power sources, including polymer electrolyte membrane fuel cells, super capacitors, and batteries. On the materials front, the group emphasizes the development of nanostructured electro catalysts, multifunctional materials, and nanocomposite ion-conducting membranes. In parallel, his work on system development focuses on electrode fabrication and full cell design and testing. Dr. Kurungot's research effectively bridges fundamental science with applied energy technologies. He has published extensively in high-impact international journals and holds several patents. He actively leads interdisciplinary research programs at CSIR-NCL. His laboratory is equipped with state-of-the-art facilities for material synthesis, characterization, system fabrication, and performance evaluation. He has mentored numerous PhD students and early-career researchers. His work supports national initiatives in clean energy and sustainable chemical technologies and has been recognized through several national and international research awards.

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Dr. Sudip Paul
Associate Professor,
Department of Biomedical Engineering
National Institutes of Technology (NIT), RAIPUR, India

Profile:

Dr. Sudip Paul is an Associate Professor in the Department of Biomedical Engineering at the National Institute of Technology (NIT), Raipur, India**.** He is actively engaged in teaching, research, and academic leadership in biomedical engineering. His expertise and research experience include Biomedical Instrumentation, Medical Devices, Rehabilitation Systems, Artificial Intelligence in Healthcare, and Electrophysiology. His work focuses on developing engineering-based solutions for diagnosis, therapy, and patient care. Dr. Paul integrates signal processing, intelligent systems, and clinical insights in his research. He has published his work in reputed national and international journals. He contributes to curriculum development and outcome-based education initiatives at NIT Raipur. He actively mentors undergraduate, postgraduate, and doctoral students. Dr. Paul is involved in interdisciplinary and collaborative research projects. His research emphasizes translational and clinically relevant biomedical technologies. His contributions strengthen biomedical engineering education and healthcare innovation in India.

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Dr. Michael Sauer
Head of Department
Biotechnology (OMV AG), Vienna, Austria

Profile:

An accomplished biochemist and biotechnology expert with extensive leadership experience in academia and industry. Since 2023, he has served as Head of Department Biotechnology at OMV AG, Austria. Dr. Sauer is also President of the Austrian Association of Molecular Life Sciences and Biotechnology (ÖGMBT) and a member of the Board of Trustees of the Federation of European Microbiological Societies (FEMS) since 2025.Previously, Dr. Michael Sauer held several key academic positions at the University of Natural Resources and Life Sciences, Vienna (BOKU), including Associated Professor, Deputy Head of the Department of Biotechnology, and Head of the Christian Doppler Laboratory for Biotechnology of Glycerol. He has also been a visiting professor in Italy and India, and co-founded Syconium Lactic Acid GmbH. Dr. Sauer holds a Venia docendi in Industrial Microbiology from BOKU, a Doctorate in Biochemistry, and a degree in Biotechnology from ETH Zürich.

Synopsis of talk:

This is not Waste – a Future Built on Circular Thinking Catalyzed by Biotechnology

Climate change is the biggest challenge of our time. The world demands more sustainable chemicals, fuels and energy. At OMV we are committed to achieving net zero by 2050 at the latest, a target which requires immediate action. A significant fraction of our global investment budget is used to deliver sustainable technologies and solutions. With our Strategy 2030 we strive to become an integrated sustainable chemicals, fuels and energy company — rooted in our firm

commitment to achieving net-zero emissions by 2050. Strategy 2030 is about value creation with sustainability at its core. To guide our journey, we have set ambitious interim goals:

- ✓ a 30 percent reduction in absolute greenhouse emissions in scope 1 and 2 by 2030,
- ✓ And a 20 percent reduction in scope 3 emissions by 2030, relative to our 2019 levels.

In order to reach those goals, we need to explore new energy and carbon sources replacing fossil resources. Societally, we cannot afford to produce any waste – as every dead end in terms of materials creates two problems at once: a loss of carbon, which must be replaced and a disposal problem. We at OMV do not see waste as the end of the story, but the beginning of something new. Waste is an opportunity. Circularity is at the heart of our vision, guiding our shift from a traditional linear economy to one where materials are continuously repurposed. We're pioneering technologies that transform discarded materials into valuable resources:

- ✓ Used cooking oil can be converted into Sustainable Aviation Fuel (SAF), an alternative to conventional jet fuel with an 80% lower greenhouse gas footprint over its lifecycle
- ✓ End-of-life plastics are processed into pyrolysis oil with our ReOil® technology and converted into new, virgin-quality plastics
- ✓ Agricultural residues are the focus of ongoing efforts to convert them into sustainable bio-based feedstocks for fuels and petrochemical products
- ✓ Carbon dioxide is being repurposed by integrating it into industrial value chains

We recognize that agriculture generates vast quantities of by-products – many of which are overlooked or discarded. We harness this untapped potential by converting materials like straw, corn stover, sugar beet residues, algae, and cashew nutshell liquid into bio-based feedstocks for fuels and petrochemicals. Biotechnology plays a central role in this transformation. By utilizing renewable raw materials and biological processes, we are pioneering innovative pathways that replace fossil-based inputs with sustainable alternatives. This approach not only reduces reliance on fossil resources but also promotes responsible land use – without competing with food production systems.

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Dr. Raghu Rangaswamy
CEO, Molecular Solutions

Profile:

Dr. Raghu. R is the CEO of Molecular Solutions, a next-generation in silico drug Discovery Company. Prior to Molecular Solutions, Dr. Raghu served for nearly 20 years as Vice President at Schrödinger, where he led scientific collaborations and was instrumental in expanding the company's global footprint across 20+ countries. He has also held research roles in prominent organizations such as Syngene, DSQ Biotech, and Tata Elxsi, specializing in bioinformatics and computational chemistry. A gold medalist in M.Pharm, Dr. Raghu holds a Ph.D. in Bioinformatics, along with an MBA and an Advanced Diploma in Bioinformatics. He is a sought-after speaker at national and international conferences and serves on several academic advisory boards. He is currently a Governing Board Member at PSG College of Pharmacy, and Board of Studies Member at Alagappa University, Pondicherry University, VIT University, and other academic institutions, actively contributing to curriculum development and digital research integration. He is also the Vice President and Trustee for Friends of Camphill India and Global organization for mentally challenged children and also Vice president of Dasappa trust dedicated for educational development of rural children.

Synopsis of Talk:

Digital Transformation in Pharma R&D: How AI/ML, LLMs and GenAI are transforming the Drug Discovery

Drug discovery is entering a new era of AI, machine learning, and digital innovation, where advanced *in silico* methodologies are accelerating timelines, reducing costs, and improving success rates.

Recent developments include:

- **Chemical-Space Docking,** enabling the screening of billions to trillions of molecules with hit rates approaching 40%.

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- **Free Energy Perturbation (FEP),** delivering accurate binding affinity predictions for small molecules, peptides, and diverse targets within hours.
- **Polymorphism prediction,** now achieving up to 98% accuracy.
- **AI/ML-driven formulation design,** tackling solubility and stability challenges with ~85% predictive accuracy.
- Computation of 200+ ADMET properties, high-throughput PBPK simulations, and early pKa predictions to prevent late-stage attrition.
- **AI/ML + literature-based retrosynthesis tools,** transforming synthetic route design, process chemistry, and impurity prediction.
- **Large Language Models (LLMs), Generative AI,** and AI-driven atomistic simulations, expanding the scope of digital drug design and development.

Together, these innovations are reshaping the drug discovery paradigm, enhancing hit identification, lead optimization, and translational outcomes.

Yet, many academic and research institutes continue to rely heavily on traditional methods, missing opportunities to harness these advances. This presentation will:

1. Explain the methodology and science behind these emerging approaches.
2. Highlight real-world case studies demonstrating measurable impact.
3. Share actionable strategies for institutions to adopt digital drug discovery and remain competitive in the evolving R&D landscape.

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Dr. Sridhar Kottakota
Vice President
Indian Immunologicals, Hyderabad

Profile:

Dr. Sridhar Kottakota is a senior biopharmaceutical scientist and industry leader with over 32 years of experience in the biopharma sector. He currently serves as Vice President and Head of Research and Development at Indian Immunologicals Limited, Hyderabad. His work focuses on recombinant monoclonal antibodies, human and veterinary vaccines, diagnostics, cell culture media, feeds development, and One Health products. Dr. Kottakota has extensive expertise across R&D, people management, and strategic leadership**.** He has significantly contributed to the process development, scale-up, and manufacturing of biologics, including biosimilars and recombinant proteins. His technical strengths include fermentation, cell culture, and downstream processing in GxP-compliant environments. He has played a pivotal role in developing robust, cost-effective, and scalable manufacturing platforms. His career spans innovation in microbial and viral vaccine development. Dr. Kottakota actively drives technology transfer and translational research**.** His work emphasizes sustainable biomanufacturing practices**.** He is deeply committed to strengthening indigenous vaccine development. His leadership supports improved human and animal health outcomes at national and global levels.

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Dr. Kaushik Chatterjee

Professor and Chair in the Department of Bioengineering

Indian Institute of Science (IISc), Bangalore

Profile:

Dr. Kaushik Chatterjee is a distinguished academician and researcher currently serving as Professor and Chair in the Department of Bioengineering at the Indian Institute of Science (IISc), Bangalore**.** He holds a Ph.D. in Bioengineering from The Pennsylvania State University and has completed postdoctoral research at the National Institute of Standards and Technology (NIST) and the National Institutes of Health (NIH), USA. His research focuses on the design, processing, and translation of advanced biomaterials for biomedical applications. Dr. Chatterjee's work spans tissue engineering, regenerative medicine, biomaterial–cell interactions, metallic biomaterials, additive manufacturing, and 3D bio printing. He is particularly recognized for developing clinically relevant biomaterial platforms and organotypic tissue models. His interdisciplinary research bridges materials science, engineering, and biology to address unmet medical needs. Dr. Chatterjee has published extensively in high-impact international journals and holds several patents. He actively contributes to scientific publishing as an editor and editorial board member of reputed journals. He is a recipient of several prestigious awards, including the DST Ramanujan Fellowship. Through his leadership at IISc, he has strengthened translational bioengineering research in India. His work continues to influence next-generation biomedical devices and regenerative therapies.

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Sandeep B. Gaudana
Reliance Industries ltd. Baroda

Profile:

Sandeep B. Gaudana is passionate about applying synthetic biology, microbiology, and chemistry to address challenges in human health and environmental sustainability, with a strong interest in leveraging artificial intelligence for scientific innovation. He brings 15 years of hands-on research experience working with DNA, RNA, and proteins, and has expertise in advanced microbiology, genetic engineering across diverse hosts, probiotics, algal biotechnology, ion exchange resin applications, and industrial wastewater treatment. His leadership strengths include innovation, project conceptualization, and data-driven problem solving, complemented by an optimism- and empathy-driven people development approach. He currently leads a dynamic environmental science R&D team at Reliance Industries Limited, working toward environmentally sustainable and economically profitable manufacturing solutions. He has been selected for the prestigious Career Acceleration Program (CAP, Batch 5) and StepUp to First Level Leadership (FLL, Batch 3). His research journey spans immunomodulation through probiotics, biopesticide engineering, cyanobacterial metabolic network analysis, light-driven bicarbonate transporters, microalgal genetic engineering, heterologous expression of mammalian proteins, and integrated inorganic chemistry–synthetic biology solutions for wastewater treatment. He has published 14 peer-reviewed research articles in internationally reputed journals.

Sirisha Potala
Associate Director,
Strategic Planning & Operations, Amgen

Profile:

Dr. Sirisha Potala is a scientist turned strategic leader with over 15 years of experience in the global biopharmaceutical industry. She earned her Ph.D. from IIT Madras and completed postdoctoral research at Wake Forest University, specializing in biologics and translational science. Her career began in cutting-edge research, where she contributed to diagnostic and therapeutic innovations, and evolved into operational excellence—establishing Centers of Excellence to accelerate delivery and drive continuous improvement across global teams. Currently serving as Associate Director of Strategic Planning & Operations at Amgen, Dr. Potala combines deep technical expertise with strategic vision to align scientific capabilities with business priorities. She leads cross-functional initiatives that integrate science, technology, and operations to shape the future of biotech and deliver better patient outcomes. Beyond her corporate role, Dr. Potala is passionate about leadership development and inclusivity in STEM. The lessons hidden in everyday moments have shaped her journey, igniting a deep commitment to empower women and allies to rise, lead, and thrive. She actively engages with academic institutions and industry forums to inspire the next generation of scientists and leaders.

Synopsis of talk:

Science at the Helm: Biopharma's Future—for Industry and Individual Careers

This session delves into the multifaceted world of drug discovery, tracing the path from initial scientific ideas to the development of life-changing medicines. It offers an accessible introduction to each phase of the process, while spotlighting the

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diverse and evolving career opportunities within the biopharma industry—including laboratory research, regulatory affairs, and roles driven by technological innovation such as AI and data science. Emphasizing the value of interdisciplinary collaboration, adaptability, and ongoing learning, the talk aims to inspire participants to explore and contribute to the future of healthcare.

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Dr. Krishna Ethiraj
Senior Vice President
Aragen Life Sciences, Hyderabad

Profile:

Dr. Krishna Ethiraj is a Ph.D. in Organic Chemistry with post-doctoral experience and over 30 years of academic and industrial research expertise, including 20+ years exclusively in the CRO domain. He is currently Senior Vice President at Aragen Life Sciences, Hyderabad, India, where he leads discovery chemistry and advanced drug development programs for global clients across large Pharma, mid-Pharma, biotechs, and animal health. He has headed teams of 300–350 FTEs for over a decade, driving scientific excellence, operational efficiency, and profitability. As an Extended Leadership Team (ELT) member for 14+ years, he has contributed to strategy, organizational management, and business growth while overseeing key accounts, hit-to-lead and lead optimization programs, preclinical candidate selection, and non-GMP scale-ups. Dr. Ethiraj has played a key role in building and leading high-performance scientific teams and strengthening India's position in global drug discovery services. His expertise spans medicinal chemistry, integrated drug development, and translational research. He is recognized for delivering high-performance scientific contributions, ensuring quality, compliance, and risk-mitigated operations. He actively drives innovation, operational excellence, and end-to-end solutions from discovery to commercialization. He collaborates with international partners and stakeholders across the pharmaceutical value chain. His leadership emphasizes building world-class CRO capabilities and creating new business opportunities. Dr. Ethiraj continues to advance innovative therapeutic development at Aragen Life Sciences.

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Oral presentations

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OP-01

Hybrid wheelchair navigation system using eye blink control for quadriplegic patients and hand gesture control for mobility users

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Dr. Ngp Institute of Technology, Tamil Nadu, India

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Abstract: Quadriplegic patients have significant limitations in mobility because all four limbs are paralyzed. Traditional joystick-controlled wheelchairs are not practical for them. This paper presents a hybrid navigation wheelchair that combines eye blink detection and hand gesture recognition to offer an adaptable and easy-to-use mobility solution. The proposed system uses OpenCV for real-time eye blink detection and IMU sensors for gesture recognition, both connected through the ESP32 microcontroller for wireless communication and control. Safety is improved with ultrasonic obstacle detection and an emergency stop mechanism. The hybrid approach allows users to switch easily between control modes based on their comfort and physical abilities, ensuring flexible operation in various situations. Experimental testing shows reliable performance with high accuracy, quick response, and effective navigation even in complicated environments. Compared to existing single-input wheelchairs, this model shows better adaptability, safety, and cost efficiency. The developed prototype contributes significantly to assistive technologies that aim to enhance independence and quality of life for quadriplegic patients.

***Keywords*:** *Eye Blink Detection, Hand Gesture Recognition, OpenCV, ESP32, Assistive Mobility, Hybrid Wheelchair, Quadriplegic Patients*

OP-02

Network pharmacology-based molecular identification of novel targets of curcumenol against Parkinson's disease

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Abstract: Repurposing existing bioactive molecules has been a successful strategy for developing novel drugs. Curcumenol is one among numerous naturally occurring compounds that could potentially use as a treatment for a variety of disorders. This study employs the "network pharmacology approach" to investigate curcumenol's neuroprotective activity against Parkinson's disease, a well-known neurodegenerative disease marked by dopaminergic neuronal degeneration. The study identified 27 principal targets of curcumenol essential to the pathogenesis of Parkinson's disease and focused them down to 5 major proteins through the analysis of target interactions utilizing Protein-Protein Interaction (PPI) network building. The conclusive molecular docking analyses revealed the significant inhibition of curcumenol on both Caspase-3 and Caspase-9 proteins, which are the key activators in the apoptotic cascade. *In vitro* investigations conducted using the SHSY 5Y cell line model of Parkinson's disease validated the substantial neuroprotective efficacy of curcumenol, exhibiting optimum neuroprotection at 50 µg, whereas flow cytometry-based apoptosis experiments supported the bioinformatic predictions. Overall, the results demonstrated that curcumenol has strong neuroprotective properties, most likely through suppression of Caspase-3/9-mediated apoptosis. The evidences presented in this study conclusively recommends further research on establishing curcumenol as a promising therapeutic candidate against Parkinson's disease.

Keywords: *OMICS, STRING Database, Cytohubba, Molecular Docking, Apoptosis, 6OHDA, Cell viability assay*

OP-03

Exoskeleton for Carpal Tunnel Syndrome

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Abstract: CTS causes weakness diminished grip strength, discomfort, numbness, tingling in the hand and finger Carpal tunnel syndrome (CTS) is a prevalent condition caused by the compression of the median nerve as it travels through the carpal tunnel in the wrist. This condition results in pain, numbness, and weakness in the hand and arm, significantly impacting the quality of life and productivity of affected individuals. Conventional treatments for CTS, such as splinting, medication, and surgery, often have limited efficacy and may not address the underlying biomechanical issues contributing to the syndrome. This paper presents the design, development, and evaluation of a novel carpal tunnel exoskeleton aimed at alleviating the symptoms of CTS through biomechanical support and therapeutic intervention. In conclusion, the carpal tunnel exoskeleton represents a promising advancement in the management of CTS. By combining biomechanical support with real-time adaptive feedback, this innovative device offers a non-invasive, user-friendly solution to mitigate the symptoms of CTS and enhance the quality of life for sufferers. Future work will focus on refining the exoskeleton's design, expanding its therapeutic capabilities, and exploring long-term outcomes in larger, more diverse populations. Therefore, a simple system that consists of servo motor and controller board as an alternative therapy or treatment is proposed.

Keywords: *Carpal Tunnel Syndrome (CTS), exoskeleton, rehabilitation, arduino, wearable therapy*

OP-04

Enzymatic bio-detoxification: Producing safe, high-quality gluten-free wheat flour via targeted protein degradation

D. M. Patel, N. Kumar*

Department of Biotechnology, School of Sciences, P P Savani University, Surat-394125, India

**Corresponding author:* Narayan.jalan@ppsu.ac.in

Abstract: Wheat as well as other grains with gluten are to be strictly prohibited if someone has a wheat related problem, especially celiac disease or non-celiac gluten sensitivity. Conventional gluten free goods are frequently missing the important function, structural and sensory attributes of wheat, even though they utilize on replacement flour. This study introduces a novel and effective enzymatic cocktail breakdown method to satisfy the immediate demand for high-quality, nutritious, without gluten wheat flour. The main objective was to figure out how effectively the immunogenic gliadin and glutenin protein fragments in regular wheat flour can be degrade using a modified food grade enzyme complex. Despite significantly changing the bulk of the flour's physical properties, the method of degradation was designed to reduce the overall gluten amount below the world-wide threshold of 20 ppm for verified gluten-free status.

Keywords: *Gluten, Wheat flour, celiac disease, gluten-free diet, enzymatic degradation*

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OP-05

Artificial Intelligence in Polygenic Risk Scoring: A Review of SNP-Based Approaches and Multi-Omics Integration for Precision Health

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Abstract: Understanding how genetic variations influence the likelihood of developing complex diseases is becoming increasingly essential in modern healthcare. Polygenic Risk Scores (PRSs), which summarize the combined impact of multiple genetic markers, have gained recognition for their ability to personalize disease risk estimation. However, the traditional statistical methods used to calculate these scores often fall short when faced with the intricate, non-linear nature of genomic data. Recent breakthroughs in Artificial Intelligence (AI), especially machine learning (ML) and deep learning (DL) have significantly reshaped the PRS landscape. These advanced techniques allow researchers to process vast, high-dimensional datasets, integrate diverse biological layers such as genomics, transcriptomics, and epigenomics, and achieve more precise risk predictions. This review delves into the evolution of PRS development, beginning with conventional computational strategies and progressing toward intelligent, AI-powered systems that are now being used across a wide range of medical domains, including cancer, heart disease, and neurological disorders. We also explore how combining PRSs with lifestyle, environmental, and clinical data can enhance their real-world utility. Alongside the technical discussion, we address challenges such as bias from limited population diversity, the complexity of interpreting AI models, and ethical considerations surrounding the use of genetic risk in healthcare. By categorizing and analysing the most widely used PRS tools and techniques, this review aims to offer a clear roadmap for researchers and clinicians working at the intersection of genetics, data science, and personalised medicine. As AI continues to drive progress in this area.

Keywords: *Polygenic Risk Score (PRS), Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL), Multi-Omics Integration, Genome-Wide Association Studies (GWAS), Precision Health, Personalised Medicine*

OP-06

Integrated network pharmacology and molecular docking analysis of bioactive phytochemicals targeting temozolomide resistance in globlastomamultiforme

Priya Rithika Vella, Dinesh*

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Abstract: Glioblastoma multiforme (GBM) remains one of the most aggressive and treatment-resistant primary brain tumors, characterized by rapid proliferation, angiogenesis, and therapy evasion. Despite temozolomide (TMZ) being the standard chemotherapeutic agent, intrinsic and acquired resistance significantly limit its efficacy. Phytochemicals with multitargeted molecular actions offer promising adjunct strategies to overcome TMZ resistance. The present study investigates six bioactive phytochemical compounds - Thiamine, Withaferin A (a Withanolide from *Withania somnifera*), Curcumin, Resveratrol, Quercetin, and Luteolin derivatives (e.g., luteolin-7-glucuronide) for their therapeutic potential against GBM, focusing on their interaction with TMZ-related molecular pathways. Network pharmacology and molecular docking analyses were employed to identify potential targets, including apoptotic signaling pathways. Among these, Thiamine exhibited significant binding affinity, suggesting an inhibitory effect on tumor cell translation machinery. Withaferin A and Curcumin demonstrated strong synergistic potential with TMZ by promoting oxidative stress and DNA damage response modulation. Resveratrol and Quercetin enhanced TMZ-mediated cytotoxicity through suppression of survival kinases and induction of autophagy, while Luteolin derivatives showed promising anti-angiogenic effects. Collectively, these findings highlight the multitarget pharmacological relevance of selected phytochemicals as complementary therapeutic agents to improve TMZ responsiveness in GBM. The study underscores the potential of integrating natural bioactives into conventional treatment frameworks to enhance efficacy and reduce chemoresistance in glioblastoma therapy.

Keywords: *Glioblastoma, temozolomide, withanolide, curcumin, resveratrol, quercetin, luteolin, network pharmacology, MGMT*

OP-07

Arterease: A Next-Generation Electrochemical Biosensor for Rapid and Affordable Detection of Coronary Artery Blockage Biomarkers

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Abstract: Arterease is an innovative point-of-care electrochemical biosensor based medical diagnostic device engineered for early, accurate, and cost-effective detection of cardiovascular blockage biomarkers. It identifies arterial blockages by detecting specific cardiac biomarkers present in very low volumes (a few drops) of blood samples. The use of highly specific nanomaterials increases signal amplification efficiency and lowers detection limits, enabling highly sensitive measurements from low-volume (microliters) blood samples within minutes. The electronic interface, operating on the principle of voltammetry, acquires, processes, and displays results in minutes, further minimizing the need for complex instrumentation or skilled operators necessary in traditional angiography techniques. Arterease can be commercialized and scaled at a large scale owing to its non-invasive, low production cost, portable design, and rapid result time. By substituting conventional angiography with a non-invasive and accessible diagnostic tool, Arterease aims to transform preventive cardiology. The proposed system offers substantial advantages over traditional methods. Its simplicity and portability enable screening in diverse settings - from community clinics to remote outposts without complex equipment. This device is a significant leap towards accessible and affordable cardiovascular diagnostics.

Keywords: *Biosensor, electrochemical detection, nanoparticles, coronary artery disease, CRP, troponin I, point-of-care, clinical use, cardiovascular diagnostics*

OP-08

Evaluation of Cissus-mediated gold nanoparticles for cytotoxicity and its osteogenic potential

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Abstract: The repair of bone defects, a pervasive clinical challenge resulting from trauma, disease, and aging, is essential for maintaining skeletal function. While conventional biomaterials and synthetic bone substitutes are widely utilized, they frequently encounter limitations in terms of integration, mechanical properties, and long-term osteoinductivity. Consequently, the focus of regenerative medicine has shifted toward innovative strategies as gold nanoparticles with enhanced osteogenic properties-to precisely guide and accelerate bone repair. The plant *Cissus quadrangularis* has been traditionally known for its bone-healing properties is packed with bioactive compounds such as flavonoids, triterpenoids, and phenolic acids. These compounds have been shown to have multiple therapeutic effects, including anti-inflammatory, antioxidant, and bone-regeneration-promoting properties. The present study reports the green synthesis of gold nanoparticles (AuNPs) using *Cissus quadrangularis* extract as a natural reducing and stabilizing agent. The formation of nanoparticles was confirmed by visual color changes and characterized through UV-Visible spectroscopy, FTIR, XRD, and SEM analyses. UV-Vis spectra displayed surface plasmon resonance peaks at ~540 nm for AuNPs. FTIR revealed the presence of functional groups involved in nanoparticle stabilization, while XRD confirmed the crystalline nature with an average size range of 10–28 nm. SEM images showed predominantly spherical nanoparticles ranging from 15–30 nm. The synthesized nanoparticles were evaluated for their biological efficacy, including antioxidant, antibacterial, anti-inflammatory activities. AuNPs exhibited dose-dependent antioxidant activity, with AuNPs showing superior scavenging capacity. These findings suggest that *Cissus quadrangularis*-mediated green synthesis yields biocompatible and multifunctional nanoparticles with promising biomedical applications.

Keywords: *Cissus quadrangularis, bone regeneration, gold nanoparticles, osteogenesis*

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OP-09

A Neurobiological Digital Twin of Human Emotions: An AI-Driven Precision Mood Stabilization Framework for Healthcare

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Abstract: This research introduces a conceptual framework for a neurobiological digital twin designed to enhance mental health and well-being through advanced artificial intelligence techniques and emotional analytics. The framework leverages Human Digital Twin cutting-edge technologies, integrating brain-computer interface and neuromorphic computing for biologically-inspired technologies. By developing AI-driven digital twin frameworks for personalized mental health monitoring and intervention, this approach enables the identification of stress, anxiety, or other emotional factors that may affect well-being. The system incorporates emotion recognition for affective human digital twin through virtual reality enabling technologies and explores the neural mechanisms of feedback processing and regulation recalibration during neurofeedback training. This innovative approach represents a step toward digital twins and the future of precision mental health, providing valuable insights into the impact of Digital Twin technology on personalized healthcare.

Keywords*: Human Digital Twin, Emotion Recognition, Precision Mental Health, AI-Driven Healthcare, Neurofeedback, Emotional Analytics*

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OP-10

A comprehensive review on optimization of microbial lipase system for the degradation of lipid contaminated waste water from the food industry

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Abstract: Microbial lipases play a crucial role as biocatalysts in a wide range of catalytic reaction under both aqueous and non-aqueous conditions. Due to their exceptional stability and specificity lipases are increasingly preferred over chemical catalysts in various applications. Industries such as dairy, meat, oils and fats, cosmetics, surfactants and pharmaceuticals prominently utilize microbial lipases, particularly those derived from bacteria and fungi. Additionally lipases can effectively clean industrial waste water that contains high level of lipids. Excess lipids in wastewater can lead to significant problems including clogged sewer lines and the formation of greasy lawyers on water surfaces which block sunlight and oxygen adversely affecting aquatic life. Utilizing microbial lipase mediated bioremediation presents a promising alternative strategy to address these environmental challenges. To eliminate oils and address discharges for environmental benefit proper wastewater treatment is essential. In this context lipases can be utilized in various domestic and commercial wastewater bio treatment applications. The optimization of solid state fermentation (SSF) revealed that the highest lipase production occurred with an optimized inoculum size. Lipases are a subclass of esterases and that play a crucial role in the transport, digestion and processing of lipids in most living organisms. They are versatile enzymes involved in various bioconversion reactions including (alcoholysis, hydrolysis, esterification, acidolysis, aminolysis, and interesterification) in both unicellular and multicellular organisms. Lipases are essential for the bioconversion of triacylglycerol's (TAG) from one organism to another. The use of microbial lipases including those from fungi, yeast, and bacteria has garnered significant over the past several decades.

Keywords: *(SSF) Solid state fermentation, Microbial Lipase, Biocatalysts, alcoholysis, hydrolysis, esterification, acidolysis*

OP-11

A Modular ecosystem of vascularized and epithelial organ-chip platforms for human-relevant disease, immune injury, and regeneration modeling

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Abstract: A major global challenge is the scarcity of human-relevant microphysiological platforms that integrate vascular, epithelial, metabolic, and immune processes under defined microfluidic conditions, reinforcing the worldwide transition toward Non-Animal Model (NAM)–aligned testing. To address this need, we developed a modular ecosystem of independent organ-on-a-chip platforms, each tailored for discrete biological and translational applications. The vascularized liver tissueoid-on-a-chip supports long-term culture for up to 49 days and enables quantitative tracking of regeneration and functional maturation at Days 7, 14, 21, 28, and 49, providing a robust system for studying metabolism, toxicity, inflammation, fibrosis, and immune-mediated injury. Complementary 14-day epithelial barrier-on-a-chip platforms—including kidney proximal tubule and gut barrier models recapitulate tight junction regulation, transport dynamics, tubular stress responses, and barrier disruption, enabling investigations in nephrotoxicity, intestinal inflammation, and epithelial physiology. A vascularized heart-on-a-chip resolves microvascular and myocardial responses to cardiac injury, while an adipose-on-a-chip platform models adipose–immune–metabolic signaling. A vascularized tumoroid-on-a-chip reconstructs tumor architecture, immune infiltration, and cancer-associated inflammatory pathways. Each platform is developed and validated independently to support targeted experimentation without implying interconnection. Collectively, this ecosystem provides a versatile, physiologically relevant suite of human micro physiological systems to advance disease modelling, immune injury research, regeneration biology, oncology, and next-generation NAM-driven toxicity testing.

Keywords: *NAM, Organ-on-a-chip, vascularized models, liver tissueoid, epithelial barrier chips, tumoroid-on-a-chip, regeneration, toxicity testing*

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OP-12

Evaluating the efficiency of methanotrophic bioinoculants for enhanced rice crop growth while mitigating methane emissions from the fields

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Abstract: Rice paddies are a significant contributor to global methane emissions, thus underscoring the importance of applying sustainable mitigation strategies that also enhance crop productivity. Methanotrophs are methane-oxidising bacteria that offer a dual benefit by reducing methane flux and supporting plant growth through nutrient-associated metabolic pathways. Field experiments were conducted in the rice-growing regions of the Malegaon area in Lavasa, Pune district, India. Three methanotrophic strains, namely- *Methylomonas* strain Kb3, *Methylomagnum ishizawai* strain KRF4, and *Methylocystis* strain MB5- were evaluated individually and in a mixed-inoculation formulation. The treatment was administered by dipping the plantlet roots in a 1:10 ratio of bioinoculant for one hour before transplantation. Plant growth parameters, flowering time, and grain yield were measured throughout the growing season. *Methylomonas* strain Kb3 consistently produced the strongest plant growth responses, including early flowering, increased plant height, and up to a 17% increase in grain yield compared with untreated controls. A mixed *Methylomonas–Methylomagnum* inoculation resulted in a 15% yield increase, suggesting modest but limited synergistic benefit. Genomic characterisation of Kb3 revealed the presence of genes associated with nitrogen fixation and resistance to heavy metals and antibiotics, which may support its resilience and plant growth–promoting capabilities in field conditions. The root-dipping method proved to be effective, practical, and farmer-friendly for large-scale applications. These findings highlight *Methylomonas* strain Kb3 as a promising bioinoculant capable of substantially reducing methane emissions while enhancing rice crop yields. The strain's genomic features and strong field performance support its integration into climate-smart rice cultivation strategies.

Keywords: *Methanotrophs, Methylomonas, rice paddies, rice plant growth promotion, methane mitigation, climate change*

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OP-13

Understanding the structure-function relationship of Homeopathic Nosodes - Radical Scavenging and Cell Cycle Modulation

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Abstract: Nosodes are homeopathic remedies prepared from biological materials like diseased tissues, viruses and prepared by process called Potentization. These nosodes are observed to demonstrate their biological impact through the principles of Law of Similars, hormesis and nanotechnology. This work presents outcome of series of studies with Investigational Medicinal Products (IMPs) Nosodes, namely Carcinosin 30c, Cancer Nosode 30c and HIV Nosode 50c supplied by Biosimilia Pvt. Ltd. This study focuses on revealing the probable mechanism of action of drug formulation by correlating physicochemical structure with the biological activity observed. The nosodes showed selective cytotoxicity toward cancer cells while being non-toxic to normal fibroblast cells, with Adriamycin as the positive control in our previous studies. Studies conducted at ACTREC (Tata, Mumbai) have indicated their role in tumor management. To understand the observed cytotoxicity, IMPs were assessed for their radical-scavenging activity. The nosodes demonstrated significant free radical scavenging activity (around 60%). Their phenolic and flavonoid contents correlated positively with antioxidant strength. Cell cycle studies showed that nosodes caused G1 phase arrest in breast cancer (MCF-7) cells. Spectroscopic analysis revealed characteristic UV absorption peaks, suggesting distinct structural signatures for each nosode. Based on scientific rationale and our supportive findings of the observed cytotoxic and antioxidant effects of nosodes, further studies are underway to illustrate their potential role in integrative cancer care.

Keywords: *Homeopathy, carcinosin, cancer nosode, HIV nosode, antioxidant, spectroscopy, cell cycle, cancer*

OP-14

Valorisation of seed grain waste for sustainable bio hydrogen production

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Abstract: Seed grain waste produced by spoilage during storage, transportation, and handling is a rich carbohydrate-laden biomass that can readily be valorized into clean energy. In this work, spoiled cereal grain waste (SCGW), consisting of degraded rice, wheat, lentils, and other mixed grains, was explored as a feedstock for dark fermentative biohydrogen production. Extensive physicochemical characterization showed that SCGW contains the highest carbohydrate content among organic wastes tested thus far and optimal ranges for total solids, volatile solids, and C: N ratio for microbial fermentative metabolism. Fiber analysis further indicated a high degree of cellulose and hemicellulose fractions, thereby confirming its suitability for microbial hydrolysis and subsequent hydrogen production. Batch fermentation experiments indeed showed that SCGW supports efficient hydrogen production without thermal or chemical treatment, indicating intrinsic biodegradability and providing strong process economics. With respect to practical scalability, biohydrogen production was further successfully validated in 22 L anaerobic reactor systems, with a yield of 133 L H_2 per kg TS ranking among the highest ever reported for an untreated, grain-based waste. These findings position spoiled seed grain waste firmly as a robust, scalable feedstock for decentralized green hydrogen production. Results presented herein support the integration of such wastes into circular bioeconomy schemes and confirm spoiled seed grain waste as a promising contributor towards sustainable energy transitions at the rural-industrial interface.

Keywords: *Biohydrogen production, dark fermentation, spoiled cereal grains, waste valorization*

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OP-15

Compact and efficient phototherapy warmer for new-borns

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Abstract: The Compact Phototherapy Warmer is designed with one simple purpose: to make newborn care safer, easier, and more accessible. Many babies with jaundice need two treatments at the same time-proper phototherapy light and gentle warming. Instead of relying on separate, bulky machines, this device brings both functions together in one small and portable unit. Its compact form makes it especially helpful in rural clinics, crowded maternity wards, and low-resource hospitals where equipment availability can be limited. By providing the right wavelength of light to reduce bilirubin while maintaining a stable, comforting temperature, the device ensures that newborns receive timely and uninterrupted care during a very delicate phase of life. What sets this device apart is its thoughtful use of smart technology. The ESP32 microcontroller acts as the central control unit, enabling the entire system to be monitored and adjusted through a mobile application. This allows doctors and nurses to check temperature readings or change therapy modes without needing to stand next to the machine at all times. The DHT22 sensor continuously monitors the baby's temperature with gentle accuracy, helping maintain a safe, controlled environment. The LED array is optimized for efficient bilirubin breakdown using low power, while the LCD screen and simple button interface make operation straightforward for users. By combining practicality with modern connectivity, the Compact Phototherapy Warmer offers an affordable, reliable, and user-friendly solution that brings quality neonatal care closer to every newborn who needs it, regardless of where they are.

Keywords: *phototherapy, neonatal care, mode control*

OP-16

AI-Based detection of joint issues for elderly people using knee braces

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Abstract: The project presents an intelligent system designed to detect joint-related issues in elderly individuals using a smart knee brace integrated with MEMS-based motion sensors. As age progresses, joint flexibility, stability, and mobility decline, increasing the risk of pain, stiffness, and limited range of motion. Conventional clinical evaluation requires periodic hospital visits and lacks real-time monitoring, creating a need for a continuous and reliable assessment system. To address this gap, the proposed solution incorporates an accelerometer and gyroscope from a MEMS sensor within a wearable knee brace to measure movement patterns, angular displacement, and gait dynamics. These signals are processed to extract meaningful features such as joint flexion angles, tremor patterns, rotation irregularities, and motion asymmetry. A machine learning model is trained to classify joint flexibility levels and detect abnormalities associated with early degeneration or injury. The system continuously monitors knee movements during routine activities and provides data-driven insights into performance deviations. The predicted flexibility levels can assist physiotherapists and clinicians in early screening, recommending timely interventions, and tracking rehabilitation progress. The proposed device is lightweight, cost-effective, and non-invasive, offering an efficient alternative for elderly users who require long-term mobility support. With real-time analytics and personalized feedback, the system has the potential to significantly enhance preventive healthcare, reduce dependency, and improve the overall quality of life. This AI-driven knee brace framework provides a promising direction for creating smart wearable technologies aimed at detecting early joint issues with high accuracy and reliability.

Keywords: *Smart Knee Brace, Joint Flexibility Detection, Machine Learning Classification, Real-Time Monitoring, Gait Assessment*

OP-17

A Review on Advancements and Challenges in Upper Limb Prosthetics

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Abstract: Upper limb prosthetics have undergone transformative advancements in recent decades, driven by the need to enhance functionality, affordability, and user adaptability. Recent research emphasizes multi-degree-of-freedom actuation, myoelectric control systems, additive manufacturing techniques, and the integration of sensory-feedback technologies to provide more intuitive and natural user experiences. Despite these improvements, several persistent challenges remain, including high device rejection rates, elevated cost, limited functional capabilities, and difficulties in customizing designs to meet individual user requirements. By examining advances in control strategies, material innovations, and technology readiness levels, this review offers a comprehensive understanding of the current landscape of upper limb prosthetic development. It also highlights emerging research directions, particularly the use of artificial intelligence, adaptive algorithms, and lightweight, durable materials that enhance device performance. Beyond technical considerations, this work explores how psychological, social, and economic factors influence the acceptance and long-term use of prosthetic devices. Successful deployment of upper limb prosthetics depends heavily on structured rehabilitation programs, strong community support, and cultural acceptance, all of which contribute to long-term user satisfaction. Understanding these interconnected layers is essential for designing devices that not only restore physical capability but also enhance overall quality of life. Continued interdisciplinary collaboration is vital for addressing existing limitations and shaping the future of prosthetic innovation.

Key words: *Upper limb prosthetics, Myoelectric control, Sensory feedback, Assistive technology*

OP-18

Study of Autonomic Modulation and Baroreceptor Response using Beat-to-Beat Cardiac Interval and Pulse Arrival Time

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Abstract: Continuous cardiovascular monitoring is critical in surgical and intensive-care settings. Beat-to-beat blood pressure (BP) monitoring typically requires invasive arterial cannulation, which is ethically justified only for patients requiring surgery. Noninvasive alternate Finapres has limitation of high cost and operational complexity. To address these limitations, pulse arrival time (PAT) has emerged as a promising surrogate for tracking rapid BP fluctuations through several studies. This work presents a compact, low-cost system for continuous BP variability monitoring based on synchronized electrocardiography (ECG) and photoplethysmography (PPG). The device comprises MAX30102 opto-electrical sensor and AD8232 ECG module with a high-speed Arduino Due to attain precise temporal alignment. R to R (RR) interval and PAT are derived from these two signals and their variability (heart rate variability and pulse arrival time variability) are obtained after interpolation, windowing and Fourier transform. Also their cross correlation and cross spectra is yielded by custom algorithms. The system has been used on 51 healthy volunteers and 22 hypertensive subjects under institutional ethical approval. Physiological analysis included time and frequency-domain metrics, cross-correlation, cross-spectral density, and coherence estimation to characterize interactions between RR intervals and PAT. Results show that PAT reliably reflects autonomic modulation, baroreceptor response, and vascular stiffness. Younger subjects demonstrated stronger HRV-PAT coupling and shorter latency, whereas hypertensive participants exhibited delayed minima and reduced correlation. The present development demonstrates stable signal acquisition and physiologically consistent characterization of beat-to-beat BP variability in comparison to that obtained by Finapres.

Keywords: *Pulse Arrival Time, Blood Pressure Variability, Autonomic Regulation, Baroreceptor Sensitivity, Cross Correlation, Cross Power Spectrum*

OP-19

Structure-Based In Silico Evaluation of *Moringa oleifera* Phytochemicals Targeting GbpC of *Streptococcus mutans* for Anti-Biofilm Therapy

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Abstract: One of the major causes of dental caries is biofilm formation by *Streptococcus mutans*, among which the GbpC protein plays a critical role in bacterial adhesion and virulence. This study was conducted to evaluate phytochemicals from a plant, *Moringa oleifera,* to understand its potential to inhibit biofilm formation using in silico approaches. Computational analysis was carried out using Molecular Docking on 6 phytochemicals selected through the Lipinski rule of 5 with AutoDock Vina, while pharmacodynamic profiling was carried out using Swiss-ADME, PLIP, and Molinspiration. To further analyse the interaction, the best GbpC-ligand complex – Viridiflorol was considered to perform Molecular Dynamics (MD) Simulations using GROWMACS. The complex stability was evaluated using the following parameters: RMSD, RMSF, Radius of gyration, Free energy landscapes, and binding free energy. To support the in-silico studies, an agar well-diffusion assay was used to assess the antibacterial activity. Viridiflorol (6.6 kcal/mol) showed the highest binding affinity. The robustness of the interaction was validated by MD Simulations, which resulted in low RMSF fluctuations and stable RMSD. It helped to understand a strong and long-lasting binding while the Rg values (2.28-2.58 nm) stayed constant, indicating a compact protein conformation. FEL analysis showed deep minima corresponding to thermodynamically favourable states. Additionally, phytochemical exhibited consistent negative binding free energy, which supported high stability and ligand affinity. In vitro analysis confirmed *Moringa oleifera* has inhibitory action against *S mutans*, indicating the therapeutic relevance of the selected medicinal plant.

Keywords: *Antibacterial assay, Glucan-binding proteins, Pharmacodynamics, Dental biofilms, Molecular docking, and Molecular dynamics simulations*

OP-20

Unravelling the lignocellulose-degrading and biohydrogen-generating potential of termite gut–derived *Clostridium diolis* XTS051-3 through integrated genomic and functional approaches

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Abstract: Hydrogen is emerging as a key clean fuel alternative, as its combustion produces only water and heat. Biological hydrogen production from lignocellulosic agricultural waste, such as rice straw, offers a cost-effective and sustainable alternative to conventional thermochemical methods, which are often expensive and complex. Utilizing rice straw-commonly burned by farmers-also transforms an agricultural residue into a valuable renewable energy resource. This study investigates the genomic and functional potential of termite gut–derived *Clostridium diolis* XTS051-3 for efficient lignocellulose degradation and biohydrogen generation. Genome annotation revealed the presence of both [FeFe] and [NiFe] hydrogenases, which are responsible for hydrogen production. Functional analysis also identified 191 CAZyme-encoding genes involved in breaking down complex lignocellulosic biomass into fermentable sugars. KEGG Mapper–based metabolic reconstruction demonstrated how lignocellulose-derived sugars are channeled into biohydrogen and other fermentation end-products through hydrogenase-linked pyruvate metabolism and the pentose phosphate pathway. This pioneering work provides the first genomic and functional characterisation of termite gut–derived *Clostridium diolis* XTS051-3, establishing it as a promising biocatalyst for converting lignocellulosic agricultural waste (rice straw) into biohydrogen and marking a significant advancement in both termite gut microbiome research and economical biohydrogen production technologies.

Keywords: *biohydrogen, lignocellulose, rice straw, Clostridium diolis, KEGG, CAZyme*

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OP-21

BIOTAP: A non-invasive blood group detection using fingerprints and deep learning

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Abstract: A new non-invasive mechanism of determining the blood group of a person is studied in the BIOTAP project which utilizes dermatoglyphic study. Instead of using venepuncture and the traditional serological tests, the system uses the ridge patterns and other fingerprints features of human fingertip to determine ABO blood type. It is deployed on a Raspberry 4, which acts as the central processing unit, coordinating the acquisition of images, pre-processing, deep-learning inference, and system control in general. R307s fingerprint reader provides high quality noise free images and the inbuilt 3.4 inch display displays results in an easy to use interface. After capture the fingerprint image is pre-processed to emphasize the salient image like the ridge flow, minutiae points and textural patterns. Such descriptors extracted are then sent through a convolutional neural network that has been trained to acquire statistical correlations between fingerprint signatures and blood group classifications. The device therefore approximates the most likely blood group within close real-time. Even though BIOTAP is not aimed at replacing usual laboratory tests, it offers a timely, painless and non-invasive screening mechanism, which is especially beneficial in cases when laboratory facilities are limited or unavailable. The project also demonstrates the intersection of biometric sensing, embedded computing, image analytics, and artificial intelligence, thus showing how such cost-effective, portable solutions can be used in emergency, rural, and field-based emergency room screening scenarios.

Keywords*: biotap, blood group, fingerprint sensor, raspberry pi 4, image processing*

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OP-22

Modular Diagnostic Health Monitoring Device

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Abstract: The project involves design and development of a portable biomedical monitoring system which incorporates pulse oximeter, electrocardiogram, and nerve detector into one rechargeable unit with a capacity to instantly read some vital health parameters like the heart rate, oxygen saturation (SpO2) and nerve activity. The primary aim of the project is to develop a miniature, cheap, and easy-to-use system of the continuous health control and the early alerts of the abnormalities. The device runs on a rechargeable battery and is also designed in a way to make it portable and easy to use both at home or at the clinical environment. It is developed to achieve a high level of reading accuracy by acquiring and processing signals accurately and present real-time results on a small user interface which is easily evaluated. This type of three diagnostic modules integration into a single unit minimizes the hardware complexity level, enhances usability, and consumption of power. This paper is a new multi-parameter health measurement technique of simplifying, increasing access to and making biomedical diagnostics more cost-effective. Therefore, this portability, together with power efficiency, suggests terrific possibilities of applying this equipment to remote healthcare, telemedicine, and education and becomes one of the steps towards the future of cheap and personalized health technology.

Keywords: *Biomedical monitoring system, pulse oximetry, electrocardiography (ECG), nerve detection, portable medical device, telemedicine*

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OP-23

Breathe-Evo: Comprehensive Evaluation of an Automated Ambu-Bag Emergency Ventilator System

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Abstract: The widely used life-saving technique of manually ventilating patients with a self-inflating resuscitation bag (Ambu bag) is used in emergency and critical care situations. However, manual operation is very operator-dependent and frequently leads to variations in compression force, tidal volume, and breathing rate, as well as early operator exhaustion during extended use. These restrictions may have a negative impact on patient safety, particularly in resource-scarce settings, ambulances, and rural healthcare institutions where sophisticated ventilators may not be easily accessible. The low-cost, automated Ambu bag compression system Breathe-Evo, which is intended to offer continuous and regulated ventilation support, is described in this paper. The suggested system uses a motor-driven rack-and-pinion mechanism to provide consistent and repeatable compression of the Ambu bag, allowing for the steady delivery of tidal volume and a controlled respiratory rate. Ventilation parameters can be changed in response to patient needs using a straightforward, user-friendly control interface, which lessens the need for ongoing human intervention. The system is built utilizing readily available mechanical parts and open-source electronic hardware, which makes it cheap, portable, and simple to put together. The design prioritizes mechanical dependability, operational safety, and minimal power usage. Because of its small size and cost-effective design, Breathe-Evo is ideal for use in emergency medical transportation, remote clinics, temporary healthcare facilities, and catastrophes.

***Keywords**: Emergency Ventilation, Ambu bag automation, Low-cost Ventilator, Patient Safety*

OP-24

Handheld vital parameter tracking using smartphone

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Abstract: Smartphones have evolved far beyond their original role as communication devices and are now widely adopted as platforms for basic health monitoring and digital diagnostics. Modern smartphones are equipped with a range of embedded sensors, including fingerprint readers, which were initially designed for secure user authentication. Recent research has demonstrated that these fingerprint sensors are capable of capturing subtle physiological signals associated with cardiovascular and peripheral health. Such signals include heart rate, blood oxygen saturation (SpO_2), skin temperature variations, and blood perfusion characteristics derived from optical and capacitive interactions with human skin. This review paper surveys existing studies that investigate the use of smartphone fingerprint sensors for non-invasive measurement of vital signs. In addition, it explores the emerging concept of integrating auxiliary sensing modules within smartphone cases to enable indirect monitoring of vital organ function through surface-level physiological indicators. The paper provides a detailed discussion of the underlying sensing mechanisms, signal acquisition principles, and preprocessing techniques used to extract meaningful biometric information from raw fingerprint data. Furthermore, it examines the role of machine learning and deep learning algorithms in enhancing signal interpretation, noise reduction, and prediction accuracy. The review also analyzes current system architectures, experimental validations, and performance benchmarks reported in the literature. Key limitations, including sensor sensitivity, motion artifacts, inter-user variability, and calibration challenges, are highlighted. Finally, future research directions are discussed, focusing on hardware–software co-design, multimodal sensor fusion, and clinical validation to improve reliability and enable widespread adoption of smartphone-based non-invasive health monitoring systems.

Keywords*: Smartphone health monitoring, fingerprint sensors, non-invasive sensing, vital sign estimation, machine learning, signal processing, wearable diagnostics*

OP-25

An Integrated In-Silico Framework for Therapeutic Target Identification in Retinoblastoma

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Abstract: Retinoblastoma (RB), a rare pediatric retinal cancer is associated with complex genetic alterations. The molecular landscape of RB is not fully unravelled, making it challenging to identify effective therapeutic targets. To address this, we developed a multistep bioinformatics pipeline that combines transcriptome analysis with a fully automated computational drug-discovery pipeline. The pipeline identified specific genes relevant to the disease so as to obtain potential drug targets for retinoblastoma. In the phase I, the GSE97508 microarray dataset was processed. The processing involved normalization, differential expression analysis using limma, probe to gene mapping and GO/KEGG functional enrichment. Through these, we identified the dysregulated pathways such as cell-cell progression, DNA replication, and mitotic spindle organization. As curated PPI data is limited for the rare disease, the PPI network construction did not work. A co-expression network was opted, which revealed statistical relationships in RB tumors, even for unstudied genes. Among these, TOP2A was shown to be consistently upregulated and biological relevant candidate for further drug-discovery analysis. In the phase II, a basic QSAR model was developed in Python using PaDEL generated descriptors and Random Forest regression. The Python QSAR logic was validated using Orange. Since the PaDEL workflow was cloud restricted, we rebuilt the full pipeline in Python using RDKit so as to run the system locally. The new RDKit based pipeline include clean data processing, correct IC50 to pIC50 conversion, generation of ~2,200 molecular descriptors, Morgan fingerprints, Random Forest model retraining, similarity scoring to known TOP2A inhibitors, pharmacogenomic scoring heuristic and automatic ligand file preparation for future docking. This workflow can be applied to other genes obtained through co-expression such as CDK1, CCNB1 and AURKA and the drug discovery pipeline can be adapted for the same.

Keywords: *Retinoblastoma, bioinformatics pipeline, differential gene expression, co-expression network, TOP2A, QSAR modelling, random forest, molecular descriptors*

OP-26

Understanding the cumulative effect of glycation and lipotoxicity in diabetic tubulopathy in diabetic kidney disease

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Abstract: Diabetic kidney disease (DKD) develops in 40% of diabetic patients and diabetic tubulopathy (DTP) is an emerging pathology responsible for early DKD progression. One of the major reasons for the progression of DKD is non-enzymatic formation of advanced glycation end products (AGEs). Interaction of AGEs with the receptor for AGEs (RAGE) instigates inflammation, oxidative stress enhancing DKD progression. Nonetheless, hyperglycemia instigated lipotoxicity activates sterol regulatory element binding protein (SREBP) for lipogenesis. Moreover, reabsorption in renal proximal tubule epithelial cells (RPTECs) demands high energy which is supplied by mitochondria. Lipotoxicity induces inflammation and mitochondrial dysfunction in DTP. However, the systematic association of glycation and lipotoxicity in RPTECs may act for early detection and timely progression of DKD. For this, human serum albumin (40 mg/ml) was glycated with methylglyoxal (55 mM). RPTECs were treated with glycated albumin and 300 µM palmitic acid (PA) along with RAGE and SREBP inhibitors - FPS-ZMI (150 nM), fatostatin (20 µM), respectively. Intracellular glycation markers, gene expression (RAGE, NF-κB, SREBP, CHOP, Drp1) by RT-qPCR, the nuclear translocation of NF-κB and SREBP by immunofluorescence were quantified. The transcriptional activity of NF-κB and ATP content were measured by luciferase reporter assay. The treatment of AGEs and PA instigated RAGE and SREBP pathways simultaneously. This triggered NF-κB nuclear translocation inducing inflammation. Reduced ATP content in AGEs and PA treated cells indicated mitochondrial dysfunction in RPTECs. The present study established the fact that glycation and lipotoxicity in DTP pathogenesis would serve as an early detection for DKD progression.

***Keywords**: Diabetic kidney disease, diabetic tubulopathy, glycation, lipotoixicty, mitochondrial dysfunction*

OP-27

Detection of landmarks in peripheral blood flow signal

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Abstract: Measurement of an electrical impedance of a body segment, involves injecting a constant current of low amplitude and high frequency using a pair of current injecting electrodes and picking up induced voltage using another pair of electrodes. The induced voltage is proportional to the impedance and it varies with variation in the blood volume in the segment. The negative of the first derivation of the impedance signal is a peripheral blood flow (PBF) signal. The landmarks in PBF are associated with different events in a cardiac cycle which are used for estimation of cardiovascular indices and their variability. A peak blood flow in the segment is associated with peak in PBF signal. A notch before upstroke reaching towards the peak in the PBF signal is associated with opening of aortic valve and the valley after peak is associated with its closing of an aortic valve. In this study the methods (M1-M3) based on custom logic, methods (M4-M5) based on wavelet transform, the methods (M6-M7) based on adaptive multi-stage designs and the method (M8) based on wavelet–adaptive peak are proposed for detection of peaks in PBF signal. The methods are implemented on the PBF signal recordings from 86 healthy and pathological subjects. The detected landmarks were evaluated with reference to visually marked points on PBF signals using definitions of the landmarks reported in the literature. The sensitivity, precision, F1 score, and detection error rate (DER) were used as a performance measures. The methods M1-M3 showed limited sensitivity and poor robustness, M4-M5 shows improved noise suppression but it is susceptible to inaccuracies and M6-M7 enhances detection accuracy. Method M8 showed sensitivity of 99.9%, precision of 99.9%, F1 score of 99.9%, and DER of 0.18%. This method shows best results as compared with all other methods. Using the detected peaks in PFB, similar results were observed in detection of the landmarks associated with opening and closing of aortic valve.

Keywords: *Peripheral Blood Flow (PFB), Landmarks, Wavelet, Methods, Sensitivity, Precision, Detection Error Rate, F1 score*

OP-28

MoS2 nanosheet -decorated cost-effective Cu-wire electrode for electrochemical sensing of creatinine

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Abstract: As a crucial clinical kidney biomarker for assessing muscle metabolism and renal function, creatinine (CRT) needs to be precisely and rapidly quantified in biological samples. In this work, we are developing a non-enzymatic electrochemical sensing platform based on molybdenum disulfide nanosheets modified copper wire electrode for highly selective and sensitive CRT detection. The Cu/MSNS electrode was electrochemically characterized through differential pulse voltammetry (DPV) and chronoamperometry (CA), showing a wide linear detection range of 2.0–717.0 $\mu mol \cdot L^{-1}$, with a limit of detection (LOD) of 0.083 (DPV) and 22 $\mu mol \cdot L^{-1}$(CA), and a sensitivity of 11.03 ± 0.12 μA/μM. The sensor demonstrated strong selectivity against common interfering biological species, including ascorbic acid, glucose, cysteine, urea, thiourea, uric acid, and dopamine. The CRT analysis was done in diluted human serum samples, which yielded good recoveries of 92.80 % -109.09 % with RSD values below 3.6 % indicating the practical applicability. Thus, the recently developed Cu/MSNS sensor provides a reliable and affordable substitute for traditional rigid electrodes for quick and precise CRT detection.

Keywords: *Creatinine, electrochemical non-enzymatic sensor, MoS2 nanosheet, Cu - wire electrode*

OP-29

Portable Patient Vitals Monitoring Devices

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Abstract: The fast expansion of the Internet of Things (IoT) and embedded systems has deeply affected the healthcare industry, as it opened to continuous and remote patient monitoring. There are portable patient vital monitoring systems for monitoring central parameters like heart rate: ECG, body temperature and the environment. In this review paper we perform a detailed analysis on portable patient vitals monitoring systems, especially those which are developed using IOT based architectures involving microcontroller like ESP32 and Arduino. Different biomedical sensors and communication types such as GSM, GPS and SOS (Save Our Souls) are considered. The article describes previous research efforts, compares various techniques among themselves, highlights deficits of state-of-the art systems, and concludes that affordable, trustworthy and portable healthcare services are needed. The study suggests that such an integrated monitoring system with real-time alarms and location tracking can play an important role in enhancing patient safety, as well as decreasing emergency response time for elderly or chronically ill patients.

Keywords: *Portable health monitoring, patient vitals, IoT in healthcare, ESP32, GPS*

OP-30

Molecular Characterization and Biodiesel-Relevant Lipid Profiling of Freshwater Microalgae from Pune, India.

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Abstract: Escalating energy demand have accelerated global research efforts toward sustainable alternative energy sources. Among these, algae have gained prominence as an efficient third-generation biofuel resource. In this study, algal samples were collected from diverse freshwater bodies in Pune region from benthic and pelagic zones. All algal culture after screening by light microscope were maintained in lab conditions. Out of these we found 4 distinct strains based on microscopy morphological identification, 18S rDNA sequencing and biochemical characterization with emphasis on fatty acid profiling. Lipid content was quantified using gravimetric methods and further validated by Nile Red fluorescence spectrometry. Algal oil was extracted from this strain was subsequently converted to biodiesel via *in situ* transesterification process. The biodiesel potential of the selected microalgae was evaluated through assessments of biomass productivity, lipid yield, TLC–based qualitative analysis, and FAME–based quantitative profiling of biofuel composition as well as purity. Overall, the findings of this study demonstrate that freshwater microalgae possess significant potential as multi-nutrient bioresources and can be strategically optimized for sustainable biodiesel production.

Keywords: *Freshwater microalgae, Algal-oil, Lipid profiling, Biodiesel production, Fatty acid methyl esters (FAME) analysis*

OP-31

Validation of experimental outcomes in Media and Fermentation optimization for vaccine Development using DoE

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Abstract: Media composition and fermentation conditions are critical determinants of antigen yield, consistency and overall process performance in bacterial vaccine manufacturing. Experimental outcomes generated during media and fermentation optimization are frequently validated at a statistical level in academic research, while an industrial set up requires reproducibility, robustness and controlled variability in alignment with Quality Risk management and lifecycle process understanding. This study presents a structured approach for validating outcome of the media and fermentation condition optimization by integrating statistical design methodologies with industry aligned validation principles which are supported by Design of Experiment (DoE). The DoE strategy is applied to evaluate the key media components, Feed composition, feeding strategy and fermentation conditions influencing the antigen productivity. DoE is used for screening critical parameters and media components, followed by response surface methodologies (RSM) to establish statistically justified operating ranges and experimental design space providing a process standing in accordance with Quality by Design (QbD) approach. Statistical validation of optimized conditions is performed using DoE methods like ANOVA, Contour plot, Interaction surface plot etc. This type of analysis confirms the reliability and predictive capability of the experimental models. The validated experimental outcomes demonstrate the consistent performance across the repeated runs and defined variability ranges supporting the effective process knowledge and lifecycle thinking. By aligning academic experimentation with industrial expectation this framework enhances the translational value of media and fermentation optimization study and provides a scientifically and operationally sound basis for scale up, technology transfer and subsequent process validation in vaccine development.

Keywords: *Experimental outcome validation, DoE, QbD, Media and Fermentation optimization, Vaccine development*

OP-32

Copper MOFs as pH-Responsive Nanocarriers for Breast Cancer Therapy

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Abstract: Metal–organic frameworks (MOFs) are used as nanocarriers in cancer therapy, due to their customizable properties, diverse chemical functionalities, and controlled release of therapeutic agents. The unification of MOFs with chemotherapeutic drugs and plant bioactives offers a promising approach to enhance anticancer efficacy, thereby reducing the systemic toxicity caused by conventional chemotherapy. In our work, we synthesized and characterized copper-based MOFs as efficient nanocarriers. These MOFs were then loaded with Doxorubicin and Saponin to study their potential in pH-dependent drug delivery. Drug loading was confirmed by the peak shift observed in the FTIR spectrum. *In silico* studies, including density functional theory (DFT) analysis and molecular docking of saponin and doxorubicin against the top ten hub genes associated with breast cancer, were performed to elucidate molecular reactivity, binding affinity, and potential therapeutic mechanisms. Drug release studies carried out at pH 7.4 and pH 5.0 revealed a faster and more sustained release in acidic conditions, which closely mimic the tumour microenvironment. The biocompatibility of nanocarriers was supported by evaluating their antioxidant activity, where the drug-loaded MOF exhibited significantly lower IC50 values compared to MOF and Doxorubicin alone. A clear zone of inhibition was observed against *Staphylococcus aureus* (gram-positive) and *Escherichia coli* (gram-negative), resulting in potential antimicrobial activity. Finally, cytotoxicity assays demonstrated that Drug-loaded MOFs retained anticancer activity and showed acceptable biocompatibility. Collectively, these findings highlight that Cu-MOFs are promising candidates for stimulus-responsive drug delivery in cancer therapy.

Keywords: *Metal–organic frameworks, Stimulus-responsive, Saponin, Doxorubicin, Docking, Cancer, Biocompatibility*

OP-33

Transcriptomic profiling reveals FGF18-FGFR2-mediated MAPK pathway dysregulation in Rectum Adenocarcinoma

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Abstract: Mitogen-activated protein kinases (MAPKs) comprise a family of serine/threonine protein kinases that serve as central mediators of cellular signal transduction, which can be stimulated by generic extracellular signals, encompassing growth factors, cytokines, and both environmental and oxidative stress. These evolutionarily conserved kinases transmit extracellular stimuli into intracellular regulatory mechanisms that pilot proliferation, differentiation, migration, and apoptosis, which are often dysregulated in cancer. Rectum adenocarcinoma (READ) is a distinctive subtype of colorectal cancer in which dysregulation of the MAPK pathway contributes to tumor progression and poor clinical outcome. RNA-sequencing data for READ were obtained from the TCGA and analyzed using R (version 4.5.1). The DESeq2 package was used to identify differentially expressed genes (DEGs) between tumor and normal samples. DEGs were analyzed using DAVID, which indicated enrichment in Gene Ontology (GO) categories and KEGG pathway enrichment. Our studies revealed that 83 common genes are present in both MAPK pathway genes and DEGs. A protein-protein interaction (PPI) network was constructed in cytoscape 3.10.3, and hub genes were evaluated using cytohubba plugin. These hub genes were further analyzed for overall survival, highlighting that *FGF18* was significantly overexpressed ($p = 0.017$), suggesting its potential oncogenic involvement in READ. *FGF18* activates MAPK signaling primarily through *FGFR2*, making this receptor a suitable downstream target. Molecular docking was carried out using AutoDock tools 1.5.7 with *FGFR2* (PDB ID: 2PVF), where curcumin exhibited a favorable binding energy of -8.15 kcal/mol. Overall, this analysis points to alterations in the *FGF18-FGFR2-MAPK* signaling axis in READ.

Keywords: *Rectum adenocarcinoma, MAPK signaling, RNA-seq, FGF18, FGFR2, Curcumin, Molecular docking*

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OP-34

Discovery of Colchicine-Like Alkaloids from Endophytic Fungi as Potent Drug Lead

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Abstract: *Gloriosa superba* is a medicinal plant of significant pharmaceutical importance due to its ability to biosynthesize high-value alkaloids, including colchicine, thiocolchicine, gloriosin, and demecolcine, which are extensively used in the management of gout, rheumatoid arthritis, and other inflammatory disorders. Continued overexploitation of this species for medicinal applications has led to its classification as critically endangered, highlighting the need for sustainable and environmentally responsible approaches to bioactive compound production. Endophytic fungi, which reside asymptomatically within plant tissues, have been recognized as potential microbial producers of plant-associated secondary metabolites. Through long-term association and co-evolution with their host plants, these microorganisms may develop the capacity to generate metabolites that are structurally and functionally similar to those synthesized by the host. Chemical profiling of fungal crude extracts was performed using liquid chromatography–high-resolution mass spectrometry (LC-HRMS). The fungal isolate exhibited distinct molecular ion peaks with mass-to-charge (m/z) values closely corresponding to those of authentic colchicine and demecolcine standards, indicating the presence of colchicine-related alkaloid frameworks. Furthermore, similarities in chromatographic retention behaviour and ionization patterns further supported the structural resemblance of the detected metabolites to reference compounds. These alkaloids are of considerable pharmacological interest due to their anti-inflammatory properties and reported utility in mitigating inflammatory pathological features associated with gout, rheumatoid arthritis, and COVID-19-related conditions. Complementary structural validation was obtained using Fourier-transform infrared (FTIR) spectroscopy, which revealed characteristic functional group absorption patterns in the fungal extracts consistent with those of standard colchicine. Taken together, these results indicate that endophytic fungi associated with G. superba represent viable and sustainable sources of colchicine-like alkaloids and provide a robust platform for alkaloid-based drug discovery and lead optimization, while contributing to the conservation of endangered medicinal plant species.

Keywords: *Gloriosa superba, endophytic fungi, colchicine-like alkaloids, LC-HRMS, FTIR*

OP-35

Integrated GEO Meta-Analysis Identifies Prognostic Hub Genes in Recurrent, Advanced-Stage and Metastatic Ovarian Cancer

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Abstract: Ovarian cancer (OC) is the leading cause of cancer-related mortality among women globally. Current diagnostic methods, such as serum CA125 levels and transvaginal ultrasound, lack sensitivity and specificity for early-stage detection. This study aims to identify and validate hub genes that characterize recurrent, advanced-stage and metastatic ovarian tumours, elucidating their potential as prognostic markers for ovarian cancer progression and patient outcomes. In this study, gene expression profiles from 819 ovarian cancer samples across eight NCBI GEO datasets were analyzed and grouped by clinical features (recurrence, tumour stage, and metastasis). Differential gene expression analysis, protein-protein interaction network studies, gene ontology, pathway enrichment, tumour stage analysis, survival and roc curve analysis were performed. We identified 2387 differentially expressed genes across all the datasets, with 697 genes in recurrent tumours, 965 genes in late-stage tumours and 725 in metastatic tumours. Gene ontology and KEGG pathway analysis demonstrated the enrichment of tumour-associated biological processes, signalling receptor binding like molecular functions, extracellular matrix-associated cellular components and pathways related to cancer progression and immune response. Eight intersecting hub genes named *FN1, COL1A1, COL1A2, COL3A1, POSTN, LUM, IGF1* and *CXCL8* were identified among three categories. *COL1A2* emerged as a common hub gene across all three categories. Validation using UALCAN, Kaplan-Meier plotter databases and pROC package confirmed the clinical relevance of these hub genes in the tumour stage and patient overall survival, emphasizing their potential as prognostic markers of ovarian cancer. Overexpression of *FN1, COL1A1, COL1A2, COL3A1, POSTN, LUM* and *IGF1* correlated with worse survival outcomes and poor prognosis, conversely, reduced expression of *CXCL8* was linked with poorer survival outcomes and prognosis in ovarian cancer patients.

Keywords: *ovarian cancer, biomarker, differential expression analysis, NCBI GEO, TCGA, UALCAN, tumour stage analysis, survival analysis, ROC analysis*

OP-36

Bioprospecting *Azadirachta indica*-Associated rhizobacteria for sustainable nanobiofertilizer development

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Abstract: The **e**xpanding global population is driving up food demand, leading modern agriculture to depend more on agrochemicals to boost yields. Nonetheless, the environmental consequences of synthetic chemicals, such as soil degradation, water pollution, and biodiversity loss, are becoming increasingly alarming. To tackle these issues, scientists are exploring greener options, such as nanomaterials and biofertilizers derived from the rhizosphere of medicinal plants. In this study, rhizospheric bacteria were collected from *Azadirachta indica* (Neem), yielding 48 distinct strains. 14 are phosphate solulizers, 4 could solubilize potassium, 6 fixed atmospheric nitrogen, 27 produced siderophores, 24 generated indole-3-acetic acid, 8 showed strong antagonism against the fungal pathogen *Colletotrichum acutatum*, and 3 inhibited the bacterial pathogen *Xanthomonas pv. vesicatoria*. Molecular analysis identified a diverse beneficial microbial community, leading to the selection of three promising isolates: *Ectopseudomonas hydrolytica* (E41), *Agromyces arachidis* (C22b), and *Pseudomonas azotoformans (*D26), compatible for nanoformulation. Encapsulating this microbial consortium enhances nutrient bioavailability (Nitrogen, Phosphate, and Potassium) and promotes plant growth by approximately 2-3-fold. This encapsulation prolongs microbial-plant interactions and improves photosynthesis by increasing chlorophyll and carotenoid levels. Encapsulation provides sustained bacterial release, leading to continuous activation of the plant antioxidant machinery, explaining the superior morphological and physiological performance in tomato plants compared to commercial biofertilizers. This nano-biofertilizer approach offers a cost-effective, eco-friendly alternative to traditional products, delivering better crop quality, reducing environmental harm, and strengthening crop resilience.

Keywords: *nanobiofertilizer, sustained bacterial release, nutrient bioavailability, microbial-plant interactions, crop resilience*

OP-37

Repurposed Drug Candidates for Gastric Cancer: Integrated Computational and Cellular Evaluation

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Abstract: Gastric cancer remains a major cause of cancer-related mortality worldwide, highlighting the urgent need for effective and affordable therapeutic strategies. In this study, we employed an integrated computational and experimental approach to identify and validate repurposed drug candidates for gastric cancer. Initially, gastric cancer-associated genes were retrieved from multiple databases and analysed using protein-protein interaction network analysis to identify key molecular targets involved in disease progression. Pathway enrichment analysis further revealed the involvement of these targets in critical cancer-related signalling pathways. Based on network centrality and druggability assessment, approved drugs were shortlisted for repurposing. Molecular docking, followed by long-timescale molecular dynamics simulations (100-200 ns), was performed to evaluate binding affinity, stability, and interaction patterns with selected targets, particularly ACTB. In addition, a virtual compound library derived from repurposed drug scaffolds was screened to identify promising lead-like molecules. The top repurposed drugs, Norgestimate, Nimesulide, and Abacavir, were experimentally validated using the AGS gastric cancer cell line. Cytotoxicity was assessed by MTT assay, while anticancer efficacy was further confirmed through wound healing, clonogenic survival, and Annexin V-FITC/PI-based apoptosis assays. All three compounds demonstrated dose-dependent inhibition of cell viability, reduced migratory potential, suppression of colony formation, and significant induction of apoptosis. Overall, this study demonstrates the potential of integrating in silico drug repurposing with in vitro validation to identify promising therapeutic candidates for gastric cancer.

Keywords: *Gastric cancer, drug repurposing, protein-protein interaction network, molecular docking and simulation, cytotoxicity, migratory potential, apoptosis, AGS*

OP-38

Trispecific Antibodies Targeting tumor cells and engaging NK and T cells in Tumor microenvironment

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Abstract: Cancer-associated fibroblasts (CAFs) play a critical role in shaping the breast tumor microenvironment by regulating extracellular matrix remodeling, tissue stiffness, angiogenesis, and immune exclusion, thereby promoting tumor progression and resistance to therapy. Fibroblast activation protein-α (FAP-α), a surface protein selectively upregulated on activated CAFs with minimal expression in normal adult tissues, represents an attractive target for stromal-directed therapeutic localization. However, stromal targeting alone is insufficient to eliminate malignant epithelial cells, necessitating complementary engagement of tumor-cell antigens. Human epidermal growth factor receptor 2 (HER2) remains one of the most clinically validated targets in breast cancer and is expressed across a continuum from HER2-high to HER2-low disease, with preferential localization on malignant epithelium relative to stromal and immune compartments. Co-targeting FAP-α and HER2 therefore provides a dual-anchor strategy that integrates stromal localization with direct tumor-cell engagement, potentially enhancing tumor-bed retention and mitigating antigen escape. T-cell redirection through CD3 enables potent antigen-dependent cytotoxicity but requires spatial control to minimize systemic immune activation and cytokine release. Concentrating CD3-mediated activation within the tumor microenvironment through multi-antigen anchoring offers a promising approach to improve therapeutic selectivity. Based on this rationale, we propose a trispecific engager combining anti–FAP-α, anti-HER2, and anti-CD3 binding. In this design, FAP-α serves as a microenvironmental docking module, HER2 provides tumor-cell specificity, and CD3 drives localized T-cell activation and cytolysis. The objective of this work is to develop and characterize a trispecific molecule optimized for enhanced tumor retention, efficient tumor-cell killing, and spatially restricted T-cell activation, with the goal of improving the safety and efficacy of T-cell–redirecting immunotherapy in breast cancer.

Keywords: *Breast cancer, Cancer-associated fibroblasts, Fibroblast activation protein-α (FAP-α), HER2, CD3, Trispecific antibody, Tumor microenvironment, T-cell redirection*

OP-39

Potential Biomarker of Plasma Glycated CD59 in Patients with Diabetic Nephropathy

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Abstract: Diabetic nephropathy (DN) is a common and serious complication of type 2 diabetes mellitus (T2D), and traditional indicators such as albuminuria and HbA1c are suboptimal for early risk detection. Glycated CD59 (gCD59), a complement-regulatory protein altered by sustained hyperglycemia, has recently been proposed as a novel biomarker. This study evaluated the relationship between plasma gCD59 and renal function, tubular damage, inflammation, endothelial dysfunction, and complement activation in individuals with T2D. A total of 320 adults with T2D were included and divided equally into normoalbuminuria and microalbuminuria groups. Plasma gCD59, glomerular filtration rate (eGFR), urinary NGAL and KIM-1, hs-CRP, soluble ICAM-1 and VCAM-1, ApoB, and soluble membrane attack complex were evaluated. Hierarchical multivariable logistic regression models were applied with stepwise adjustment for demographic factors, duration of diabetes, blood pressure, and medication use. Compared the results with normoalbuminuric patients, those with microalbuminuria exhibited significantly higher levels of plasma gCD59, NGAL, KIM-1, hs-CRP, sICAM-1/sVCAM-1, ApoB, and sMAC, along with reduced eGFR. Plasma gCD59 showed a strong correlation with sMAC, tubular injury markers NGAL and KIM-1, and HbA1c. In the fully adjusted model, plasma gCD59, urinary NGAL, and sMAC remained independent predictors of microalbuminuria. Overall, plasma gCD59 was closely associated with complement activation, tubular injury, and albuminuria in T2D. Its combination with tubular and complement biomarkers may enhance early identification of DN risk. Longitudinal studies are needed to confirm causality and establish its role in clinical practice.

Keywords: *Plasma gCD59, Diabetic nephropathy, T2D, Micro albuminuria, Biomarkers*

OP-40

Fabrication of a Miniaturized Multi-layered Vasculature-on-chip

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Abstract: Animal models often lack in representing human responses, triggering ethical and societal debates about their use. Therefore, many nations are seeking alternatives to the drug testing regime. Organ-on-a-chip technology is a promising three-dimensional (3D) dynamic culture method that ensures accuracy and efficiency in cell culture and has immense potential for replacing animal models in preclinical testing. Researchers have attempted to mimic organs such as the kidney, lung, heart, liver, etc. However, vasculature; the most abundant organ of human body is unexplored. Vasculature plays a crucial role in transporting the necessary substances throughout the body and facilitating communication between organ systems. Thus, it is essential to integrate the vasculature into an organ-on-a-chip to recreate tissue and organ microenvironments and physiological functions. This work discusses the fabrication process of a miniaturized in-vitro vascular model using the soft-lithography technique to replicate physiological capillary dimensions and behavior. A three- layered vascular system is fabricated using Polydimethylsiloxane (PDMS), cellulose acetate, sodium alginate, and graphene oxide scaffolds. PDMS provides hyperelastic behavior along with optical transparency and gas permeability, whereas cellulose-acetate forms nanofibers. Sodium alginate provides porous structure to the scaffold and graphene oxide, enhances the mechanical strength and hydrophilicity of scaffold. The vascular is treated in oxygen plasma to improve interfacial bonding between layers (See Fig1). The construct successfully demonstrates spontaneous capillary-driven flow, confirming its potential as a stable and scalable platform for applications in organ-on-chip technologies.

Key words: 3D Cell, culture, Organ-on Chip, Vasculature, softlithography

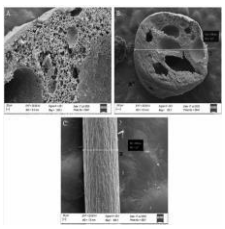

Figure 1: Demonstrates the SEM analysis, A. The intermediate scaffold layer with porous nature for cell adhesion, B. The complete intermediate layer (cross-section) and C. The innermost PDMS-cellulose capillary (top view).

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PP-01

Machine-Learning-enabled prediction and optimization of bioethanol yields across the hydrolysis-fermentation workflow

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Abstract: Advancements in bioenergy demands an integrated and data driven approach which will give strength to every stage of converting lignocellulosic biomass into clean fuels. This study looks at both the pre-fermentation and post-fermentation phases of bioethanol production. The pre-fermentation part focuses on how lignocellulose and cellulose breakdown during hydrolysis and how intermediates formed during hydrolysis. The post-fermentation part analyses the key parameters that ultimately controls the final ethanol production. Since these stages involve highly non-linear and interdependent variables, conventional optimization approaches are not enough. This is where machine-learning tools become useful, as they capture hidden patterns and enhance yield prediction. To build our models, we compiled 483 carefully selected data points from 50 peer-reviewed research articles, covering all major variables used in hydrolysis and fermentation experiments. We trained Artificial Neural Network (ANN), Support Vector Machine (SVM), Random Forest (RF), and hybrid ensemble models and evaluated their performance using R^2, MSE, and RMSE.For hydrolysis, ANN model achieved R^2 of 0.618, while the hybrid models showed superior robustness and stability. During the fermentation stage, RF and a weighted hybrid (RF: ANN = 0.8: 0.2) reached R^2 of 0.73, and the auto-tuned hybrid improved to R^2 of 0.75 with RMSE of 48.48. Our feature importance analysis highlighted temperature, acid concentration, and enzyme loading as the most influential factors for glucose release during hydrolysis, and for ethanol production fermentation time and substrate concentration played the biggest role. Taken together, this study presents a practical, data-driven approach for predicting and improving bioethanol yields from lignocellulosic biomass. The findings contribute to ongoing efforts in developing more efficient next generation biofuels and promoting cleaner energy technologies.

Keywords: *Bioethanol, Lignocellulosic biomass, Enzymatic hydrolysis, Fermentation parameters, Machine learning, Hybrid modelling, Artificial Neural Network, Random Forest*

PP-02

Fabrication of a chitosan-based injectable hydrogel for tissue regeneration

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Abstract: Injectable hydrogels have gained significant importance in tissue regeneration. These scaffolds can mimic the extracellular matrix, providing a conducive microenvironment for cell growth, proliferation, and differentiation. The versatility of injectable hydrogels makes them an excellent biomaterial to encapsulate bioactive agents and drugs for targeted drug delivery. While injectable hydrogels are currently being used for pain management and drug delivery, tissue regeneration still remains a challenge. The goal of this work is to study a new injectable, biocompatible hydrogel scaffold from natural polymers and inorganic material like hydroxyapatite/metal nanoparticles cross-linked with reversible chemical interactions for shear-thinning and in situ gelation properties. We engineer a chitosan-based hydrogel system with adjustable reciprocal covalent by dynamic Schiff-base linkages and physical cross-linking like hydrogen-bonding network for in situ formation. This ensures rapid formation and self-healing after extrusion through a syringe. The hydrogel was characterized using FTIR spectroscopy to confirm functional groups and crosslinking, while Young's modulus was measured to determine its elasticity and mechanical strength. Biocompatibility testing was performed using L929 cell line. Additionally, an in vitro degradation assay was performed to assess the hydrogel's stability and biodegradation profile under the physiological conditions. Thus overall, we can conclude that combination of chitosan, hydroxyapatite nanocomposite shows properties suitable for tissue development with further customization potential.

Keywords: *Injectable hydrogel, tissue regeneration, chitosan, hydroxyapatite, biodegradable scaffold*

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PP-03

Phytochemical analysis of secondary metabolites of Terminalia Arjuna, Veld grape, *Rauvolfia serpentina* & their Bio-medical application

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Abstract: Medicinal plants contain many important secondary metabolites that show different biological activities. The plants selected for the present study Terminalia arjuna, Veld grape, and Rauvolfia serpentina are traditionally used for various health treatments, but their chemical composition needs scientific confirmation. The main reason for taking these three plants is that this plants are traditional medicinal plants and this plants are found in region of Maharashtra making them rare medicinal plants, Collection of these plants was done in local region of Chhatrapati Sambhajinagar. Phytochemical analysis, antimicrobial testing, and advanced techniques like TLC and GC-MS help in understanding which compounds are actually responsible for these medicinal properties. This study was carried out to scientifically verify and identify such useful metabolites. Objectives are Collection of medicinal plant from local region for crude extract preparation, Preparation of crude extract from the various plant parts, phytochemical analysis of the crude extract, Antimicrobial activity of the selected extract**.** Leaves and stems of all three plants were collected and dried in the dark for eight days. The dried samples were crushed to fine powder using a mortar and pestle. Crude extracts were prepared using ethanol and a chloroform + methanol mixture. Qualitative tests such as Salkowski, Dragendorff's, Molisch's, and others were performed to detect alkaloids, flavonoids, terpenoids, and similar compounds. Antimicrobial activity was tested, followed by TLC and GC-MS analysis to identify major bioactive components. The study confirmed the presence of several secondary metabolites. Antimicrobial tests showed positive activity. GC-MS identified E-2-Tetradecen-1-ol as a major antimicrobial compound at a retention time of 19.44 minutes. Other detected compounds showed possible anticancer, anti-inflammatory, cardioprotective, and antidiabetic effects. These results support the medicinal value of the selected plants. The identified compounds may be useful for developing new herbal formulations, and further studies can help standardize their medical use.

Keywords: *Terminalia arjuna, Rauvolfia serpentina, Veld grape, Ethanol, Medicinal importance, Phytochemical screening, TLC, GC-MS*

PP-04

Design and Development of Insulin-Loaded Chitosan Microneedles for Effective Diabetes Treatment

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Abstract: Type 1 diabetes mellitus (T1DM) is a chronic autoimmune disorder characterized by the destruction of pancreatic β-cells, resulting in absolute insulin deficiency and necessitating lifelong exogenous insulin administration. Conventional delivery methods such as multiple daily injections and continuous subcutaneous insulin infusion are clinically effective but often associated with pain, anxiety, and poor adherence, particularly among pediatric and adolescent populations. To address these limitations, the present study investigates the development of a chitosan-based microneedle system for transdermal insulin delivery. Chitosan is a biocompatible and biodegradable polysaccharide with mucoadhesive properties. It is a highly suitable material for developing microneedles due to its excellent biocompatibility, biodegradability, and non-toxicity, making it an ideal candidate for transdermal drug delivery systems. We have fabricated the microneedle array of chitosan using 3 D printing. Insulin will be encapsulated within the microneedle arrays using solvent casting and micromolding techniques, followed by optimization of mechanical strength and drug-loading efficiency. The fabricated microneedles will be subjected to characterization, including morphological assessment, mechanical testing, ex vivo skin penetration studies, and in vitro release profiling. Preliminary results demonstrate that the chitosan-based microneedles possess sufficient mechanical integrity for skin insertion and enable sustained insulin release over extended durations. This minimally invasive delivery platform offers a promising alternative to conventionally insulin administration, with potential to improve patient compliance, reduce needle-associated discomfort, and enhance glycemic control. The proposed microneedle system represents a significant advancement in diabetes management, particularly for pediatric patients, by integrating biopolymer engineering with transdermal drug delivery.

Keywords: *Chitosan Microneedles, Diabetes, glycemic control, pediatric patients*

PP-05

Microalgae-Based Approaches for Sustainable Sewage Water Treatment

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Abstract: Sewage water contains high levels of organic matter, nutrients, and suspended solids that can severely impact aquatic ecosystems if released without proper treatment. Microalgae have emerged as a sustainable and eco-friendly alternative for wastewater remediation due to their rapid growth, high nutrient uptake capacity, and ability to form symbiotic relationships with bacteria. The present study investigates the potential of locally isolated microalgae cultures for the treatment of domestic sewage water. Microalgae were cultivated in Bold Basal media (BBM) and under controlled conditions, and their performance was assessed by monitoring changes in Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS),Total Dissolved Solid (TSS) and Electrical conductivity (EC) and other physicochemical parameters. The microalgae cultures demonstrated efficient biomass production along with significant removal of nutrients and organic pollutants. Their photosynthetic activity contributed to oxygen generation, which supported the breakdown of organic matter by associated microorganisms. Overall, the results highlight the effectiveness of microalgae-based systems as a low-cost, energy-efficient, and environmentally sustainable method for sewage water treatment. This approach not only improves water quality but also generates valuable biomass that can be utilized for biofertilizers, animal feed, or bioenergy applications. The study supports the integration of micro algal technology into modern wastewater treatment frameworks for enhanced resource recovery and environmental protection.

Keywords: *Bioremediation, Microalgae, Sewage water, Bioenergy production, Environmental sustainability*

PP-06

Cultivation of Methanotrophs from Wetland Habitats in Maharashtra for Applications in Methane Mitigation

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Abstract: Wetlands are among the largest natural sources of atmospheric methane, yet they also support diverse communities of methanotrophic bacteria that naturally mitigate methane emissions through biological oxidation. The present study focuses on the cultivation and characterisation of methanotrophs isolated from selected wetland habitats across Maharashtra. Methanotrophs from sediment and water samples were cultured using a standardised protocol by supplying methane and air in the headspace. Successful enrichment led to the isolation of Type I and Type II methanotrophs, as confirmed by morphological traits, methane-dependent growth, and molecular analysis targeting the *pmo*A gene. Laboratory methane oxidation assays demonstrated that several isolates exhibited high methane consumption rates, highlighting their potential as efficient biological sinks. These findings suggest that methanotrophs originating from Maharashtra's wetlands represent a valuable biological resource for methane mitigation strategies. Their ability to oxidise methane at low concentrations underscores their applicability in bioreactors, biofilters, and other nature-based solutions aimed at reducing greenhouse gas emissions. Further optimisation of cultivation conditions and scale-up studies will support the development of cost-effective, sustainable methane mitigation technologies.

Keywords*: methanotrophs, wetland habitats, pmoA, methane mitigation*

PP-07

Exploring prodigiosin extracted from *Serratia marcescens* for industrial dyeing application

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Abstract: Prodigiosin is a bright red pigment naturally produced by *Serratia marcescens* when it grows at cooler temperatures around 20–25°C. This compound is gaining attention because it offers a strong natural colour along with useful biological activities, such as antibacterial, antifungal, and immune-modulating effects. Since industries are now moving toward safer and more sustainable colouring agents, prodigiosin is considered a promising alternative to synthetic dyes. In this project, *S. marcescens* was isolated from bathroom tile samples by streaking on nutrient agar, where red colonies appeared after 24 hours. Further purification on MacConkey agar resulted in pale, non-lactose-fermenting colonies typical of *S. marcescens*. Contamination in initial plates required the use of modified media and extended incubation for up to 72 hours to obtain clear reddish-orange colonies. Confirmation was done using Gram staining, which revealed gram-negative rods, along with catalase-positive and oxidase-negative biochemical reactions. Pigment extraction and dye application studies are still underway. The project aims to extract prodigiosin using solvent-based methods and later evaluate its colouring ability, dye uptake, and stability on different materials to assess its suitability as an eco-friendly industrial dye.

Keywords: *Prodigiosin, Serratia marcescens, microbial pigment, natural dye, industrial dyeing, sustainable dye, Gram-negative bacteria*

PP-08

Structure and dynamics analysis of a bifunctional xylanase and cellulase from *Ruminococcus flavefaciens*

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Abstract: This project focuses on the in silico structural and functional characterization of a bifunctional xylanase/β-glucanase enzyme from Ruminococcus flavefaciens (UniProt ID: Q53317), which plays an important role in breaking down plant-derived polysaccharides. Domain analysis identified multiple conserved regions, including glycosyl hydrolase families GH11 and GH16, a carbohydrate-binding module, and a Dockerin-like domain, that indicates a potentially versatile enzymatic function. A 3D structure of the enzyme was predicted using SWISS-MODEL and further refined through energy minimization in YASARA. Structural validation using tools like PDBsum, SAVES, and RMSD comparison confirmed that the model was reliable and well-folded. Additionally, a 50 ns molecular dynamics simulation in water confirmed that the enzyme model remained stable over time. Active site residues were predicted through sequence alignment with known structures and verified using FTsite, which aligned well with the sequence-based predictions. Substrates representing three types of oligosaccharides (xylo-, cello-, and laminarin-based) were designed using the Glycam Carbohydrate Builder, and molecular docking was carried out using SwissDock. Among all the substrates, the hexose forms showed the strongest binding affinities, suggesting that the enzyme may act on all three types, which highlights its possible trifunctionality. Overall, this study provides preliminary structural and functional insights into a potentially industrially relevant enzyme, and sets the stage for future MD simulations of enzyme-substrate complexes to better understand its mechanism of action.

Keywords: *Xylanase, β-Glucanase, Ruminococcus flavefaciens, Bifunctional enzyme, Molecular docking, MD simulation, Active site prediction, Biomass degradation, Computational biology*

PP-09

The effect of carbonated drink on the development of chick

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Abstract: Pepsi is a widely consumed carbonated soft drink that appeals to all age groups particularly adolescents and young adults. The present study investigates the effect of pepsi on chick embryo development. Various concentrations of Pepsi (20%, 40%, 60% 80% and 100%) were used to treat chick embryo and incubated under standard conditions. The embryos were extracted after seventeenth day of incubation to investigate the morphological, biochemical and histological parameters to assess developmental effects. The morphological parameters such as Body weight, eye diameter, beak length, claw length, neck length, back head width, body length were assessed after the treatment. Pepsi exposure led to significant reductions in body weight and claw length compared to controls with stronger effects at higher concentrations. Histopathology revealed significant abnormalities in heart and kidney tissue while elevated creatinine levels indicate renal impairment. These findings indicate that Pepsi is a potential teratogen in Chick embryo development.

Keywords: *Chick Embryo, development, Pepsi, carbonated drink, histopathology, creatinine*

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PP-10

Developmental effects of processed tomato sauce on Chick embryo

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Abstract: Packaged foods are widely consumed, yet their safety remains poorly characterized. This study investigated the effect of tomato sauce on chick embryo (Gallus domesticus) development. Fertilized eggs were assigned to control and experimental groups, the latter treated with tomato sauce at concentrations ranging from 20% to 100% and incubated for seventeen days. Morphological parameters, including body length, beak and claw length, neck length, eye diameter, and body weight, back head width, were systematically assessed. Histopathological examination of kidney and heart tissues, alongside biochemical analysis of amniotic fluid gave us additional information about developmental outcomes. Embryos exposed to tomato sauce exhibited concentration-dependent reductions in body weight and length, with notable alterations in neck and claw length. Histological studies revealed structural damage in kidney and heart tissues, while biochemical assay indicated metabolic disruption. Collectively, these findings suggest that high levels of tomato sauce exposure can compromise embryonic growth, organ development, and biochemical balance. This work underscores the potential developmental risks of packaged food consumption.

Keywords: *Chick embryo Tomato sauce, Morphology, Histopathology, teratogen, Morphology*

PP-11

Isolation and characterization of mesophilic, thermophilic, and psychrophilic hydrogen-producing microorganisms from diverse environmental sources

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Abstract: Biological hydrogen production offers a sustainable alternative to conventional energy sources, and extremophilic microorganisms play a key role due to their ability to function under diverse environmental conditions. This study focuses on the isolation and preliminary characterization of hydrogen-producing bacteria belonging to three temperature-adapted groups: mesophiles, thermophiles, and psychrophiles. Environmental samples from organic waste, hot spring sediments, and cold-region soils were subjected to anaerobic enrichment using carbohydrate-based substrates. Selective cultivation techniques, including serial dilution and temperature-specific incubation, facilitated the recovery of distinct microbial isolates. Purified strains were screened for hydrogen production through qualitative gas formation and quantitative measurements using standard assays. Mesophilic isolates showed stable hydrogen yields under moderate temperatures, suitable for conventional fermentation systems. Thermophilic isolates demonstrated higher productivity at elevated temperatures, indicating their potential for industrial processes with faster reaction rates and reduced contamination risk. Psychrophilic isolates, although slower growing, produced measurable hydrogen at low temperatures, offering advantages for cold-environment or low-energy operations. This work enhances the pool of known hydrogen-producing extremophiles and provides promising microbial candidates for further studies aimed at improving biohydrogen production efficiency and developing temperature-specific bioprocesses.

Keywords: *Biohydrogen production, Extremophiles, Anaerobic fermentation, Microbial isolation, Renewable energy, Hydrogen-producing bacteria*

PP-12

Biohydrogen production from kitchen waste using dark fermentation in a anaerobic System

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Abstract: Biohydrogen production through dark fermentation offers a promising pathway for converting organic residues into clean energy. Kitchen waste, due to its high carbohydrate and nutrient content, represents an efficient, low-cost substrate for biological hydrogen generation. In this study, we evaluated hydrogen production from untreated kitchen waste using naturally occurring microbial consortia present in the waste itself and in inoculated anaerobic sludge. Batch-scale experiments were conducted to determine optimal operating parameters, including pH, substrate loading, temperature, and fermentation duration. Based on the laboratory-scale performance, the process was successfully scaled up to an anaerobic fermentation system to assess feasibility for larger-volume hydrogen generation. Hydrogen production was monitored through water-displacement and gas chromatography, while fermentation metabolites were analysed to understand pathway shifts. The results demonstrated that slightly acidic conditions (pH 5.0–6.0) and mesophilic temperatures supported maximal hydrogen evolution, with consistent gas production across both small and larger fermentation volumes. The 22 L system showed stable performance, confirming the potential for decentralized, community-level waste-to-energy applications using simple and cost-effective fermentation setups. This study highlights the viability of kitchen waste as a reliable feedstock for scalable biohydrogen production and provides insights for future process optimization and pilot-scale development.

Keywords: *Biohydrogen production, Kitchen waste, Dark fermentation, Anaerobic digestion, Scale-up, Renewable energy, Waste-to-energy*

PP-13

Thermodynamic investigation of caffeine partitioning between cyclohexane and an aqueous medium containing triethylamine-based protic ionic liquids at different temperatures

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Abstract: In this study, we examined how Triethylamine-based protic ionic liquids (PILs) affected the movement of caffeine from an aqueous medium to the cyclohexane phase. The standard enthalpy (trsH°) and entropy (trsS°). For the partitioning of caffeine, the standard Gibbs free energy was plotted against different temperatures (298K to 325 K). The positive values of trsG° for triethylamine-based PILs indicates that the process of caffeine transfer from the aqueous medium to the cyclohexane phase is non-spontaneous at 298 K. Irrespective of the nature of the cation, the trsG° and trsH° For caffeine transfer for carboxylate anions (acetate > propionate > butyrate) decreases with an increase in hydrophobicity of anions, indicating the increase in hydrophobic hydration with alkyl chain length of anions. The higher trsS° Values for the studied PILs reveal stronger interactions between PIL-caffeine and water-caffeine molecules. Overall, the study shows that the H-bonding and hydrophobic interactions between the cations and anions of PILs play a significant role in the extent of caffeine transfer from the aqueous to the organic phase.

Keywords: *Triethylamine-based PILs, Partition coefficient, Caffeine, Standard Gibbs free energy, hydrophobic hydration, H-bonding, Aqueous–organic phase equilibrium, Cyclohexane extraction, Temperature dependence*

PP-14

Physicochemical behaviour of ethanolammonium carboxylate protic ionic liquids in in molecular solvent

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Abstract: Volumetric and transport properties of protic ionic liquids (PILs) in molecular solvents provide essential insights into solute–solute and solute–solvent interactions in solution. In this study, the density and electrical conductivity of binary mixtures of ethanolammonium carboxylate PILs, ethanolammonium acetate, propionate, butyrate, and pentanoate with water and dimethyl sulfoxide (DMSO) were measured across the entire mole fraction range at 298 K. Excess molar volumes (V^E) were derived from density (ρ) data and correlated using the Redlich–Kister polynomial, yielding low standard deviations and confirming the reliability of the fits. The V^E values were negative over the full composition range for both PIL + water and PIL + DMSO systems, indicating strong ion–dipole interactions, extensive hydrogen bonding, and efficient molecular packing. Water, due to its higher dielectric constant and stronger hydrogen-bonding capability, produced larger negative VE values and substantially higher specific conductivity (κ) compared to DMSO. Increasing the alkyl chain length of the PIL anion decreased the magnitude of density and VE, highlighting the role of hydrophobicity in reducing packing efficiency and solvation. Specific conductivity (κ) exhibited a characteristic maximum at intermediate compositions, attributed to enhanced ion dissociation and mobility, followed by a decline at higher PIL mole fractions due to increased viscosity and ion–ion association. Overall, the results demonstrate that molecular interactions, volumetric contraction, and transport behavior in PIL–solvent mixtures are governed by the combined effects of solvent polarity, hydrogen-bonding ability, and anion hydrophobicity. The discussion highlights how hydrophobicity and the H-bonding characteristics of both PILs and solvents influence the excess molar volume and electrical conductivity of these binary mixtures.

Keywords: *Protic ionic liquid, excess molar volumes, hydrogen bonding, specific conductivity, hydrophobicity*

PP-15

Microbial Biodegradation of Kitchen Waste by *Bacillus* spp. for Sustainable Waste-to-Resource Conversion

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Abstract: Microbial biodegradation provides a sustainable method for converting waste to energy and resources. Efficient management of kitchen waste is a significant environmental challenge. *Bacillus* species were successfully isolated from kitchen waste samples in this study, and their potential for degradation was assessed. To evaluate potential synergistic interactions, the isolates were cultured both separately and in combination. The strains were individually inoculated into various kitchen waste substrates to examine their biodegradation efficiency after compatibility testing. The isolates' metabolic capacities were assessed using enzymatic tests. Protease activity was measured by casein hydrolysis, amylase activity by starch hydrolysis, lipase activity by tributyrin/lipid substrate assays, and cellulase activity by carboxymethyl cellulose (CMC) assay. Strong potential for the breakdown of complex kitchen waste components was indicated by the presence of multiple hydrolytic enzymes. For ten days, the inoculated kitchen waste was allowed to decompose at 37 °C under carefully monitored conditions on days one, two, three, and 10. To assess the rate of degradation, important physicochemical parameters like pH, moisture content, and temperature were routinely measured. The residual material was examined for its potential as a biofertilizer after complete degradation. Plant growth in soil treated with biofertilizer was compared to that of chemical fertilizer controls to assess fertility. The test plant was fenugreek seeds, and the group treated with biofertilizer showed improved growth parameters (like root, shoot, length and germination time). The results highlight the role of Bacillus species in sustainable waste management and circular bioeconomy approaches associated with waste-to-energy and resource recovery systems by showing that they can effectively transform kitchen waste into value-added biofertilizer.

Keywords: *Bacillus sp., consortium, kitchen waste, biofertilizer, sustainable, biodegradation*

PP-16

Green-synthesized silver nanoparticles from *Moringa oleifera* integrated into chitosan gelatin films for sustainable food packaging applications

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Abstract: Increasingly high demand for environmentally friendly substitutes for petroleum plastics has driven the generation of biodegradable polymer composites with improved functionality. In this research, chitosan (CH) and Gelatin (GE) were chosen as chief biopolymeric matrices because of their superior film-forming property, biodegradability, and biocompatibility, with polyethylene glycol (PEG) employed as plasticizer. Silver nanoparticles (AgNPs) were prepared through a green pathway using *Moringa oleifera* leaf extract as a green reducing and stabilizing agent. The prepared AgNPs were added into CH–GE films at various concentrations (0–50 mg/100 mL) to obtain composite films. The particles were characterized by UV-Vis spectroscopy, FTIR, DLS, zeta potential, and SEM, validating their stability, functional group interactions, and spherical morphology with nanoscale size distribution. Incorporation of AgNPs had a profound impact on the physicochemical characteristics of the composite films. Enhanced nanoparticle loads enhanced opacity, water resistance, and UV-light protection along with diminishing swelling behaviour. Antimicrobial activity against *Escherichia coli* and *Staphylococcus aureus* manifested increased inhibition zones as a function of AgNPs loading, with BCGF4 exhibiting maximum antibacterial activity. Cytotoxicity assessments against ovarian cancer cell lines indicated significant, dose-dependent decreases in cell viability, suggesting potential biomedical uses. Biodegradability tests validated that the inclusion of AgNPs did not inhibit soil degradation, providing environmental safety. In addition, application testing with carrot preservation showed increased shelf life and enhanced resistance to spoilage in AgNPs-containing films versus controls. In conclusion, CH–GE–AgNPs films offer a promising, ecofriendly, and multi-functional material for active food packaging and biomedical applications with the union of sustainability and improved antimicrobial and antioxidant activity.

Keywords: *Chitosan, gelatin, green synthesis, silver nanoparticles, nanocomposite, food packaging*

PP-17

In silico Evaluation of Metabolite–Protein Interactions of *Pseudomonas azotoformans* (D26) and *Bacillus safensis* (LE8) to Elucidate Their Biocontrol Activity Against *Xanthomonas campestris* pv. *vesicatoria*

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Abstract: *Xanthomonas campestris* pv. *vesicatoria* causes bacterial spot disease, which continues to be one of the most serious constraints to tomato productivity, owing to its rapid spread and progressive decline in efficacy associated with the use of conventional agrochemicals. Plants are always associated with beneficial microbiota in the rhizosphere and inside the tissue. This investigation deals with *in silico* analysis of two promising biocontrol strains: rhizospheric bacterium D26, *Pseudomonas azotoformans*, and endophytic bacterium LE8, *Bacillus safensis*, which had earlier shown growth suppression of *X. campestris* pv. *vesicatoria* in vitro and in vivo pot experiments. To understand their inhibitory role against *X. campestris* pv. *Vesicatoria* at the molecular level, metabolites reported for these strains were retrieved from the NCBI GenBank database. Each metabolite was structurally prepared and then submitted for batch molecular docking against selected pathogenicity-associated proteins of *X. campestris* using the DockThor platform. Several ligands exhibited strong binding affinities, supported by favorable intermolecular and van der Waals energy contributions, thus suggesting the inhibition of key virulence- or survival-related proteins. To further validate the stability of the interactions, molecular dynamics simulations were conducted for top-ranked ligand-protein complexes. The complexes maintained stable RMSD values throughout the simulation period, while the interaction patterns remained conserved. This confirms that the predicted binding is structurally stable under simulated physiological conditions. These in silico findings are consistent with our previous experimental observations where D26 and LE8 showed antagonism, disease suppression, and efficient plant colonization. This study integrates metabolite docking with dynamic modeling in order to reveal the role of specific metabolites that may be responsible for pathogen inhibition and would, therefore, represent candidates for further biochemical validation and formulation development.

Keywords: *Biocontrol, Pseudomonas azotoformans, Bacillus safensis, Xanthomonas campestris, molecular docking, molecular dynamics, OMICS, metabolite profiling, pathogen inhibition*

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PP-18

Iron-regulated siderophore production in endophytic and rhizospheric bacteria for Bioenergy Application

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Abstract: The worldwide shift towards sustainable sources aims to promote eco-friendly biological solutions which are capable of enhancing biomass output and efficiency for bioenergy conversion. It is observed that iron being a key micronutrient regulates many key enzymatic metabolic pathways that are associated in plant biomass growth, microbial progress, and bioenergy pathways. Thus, the present study aimed to harness siderophore-producing bacteria from endophytic and rhizospheric regions of neem plant and to find out a promising microbial strains for enhancing metal bioavailability under iron-limiting conditions for bioenergy applications. Out of 80 isolates, 27 rhizospheric and 14 endophytic isolates produce siderophores, with levels ranging from 44% to 59%, mainly of the hydroxamate and catechol types. We analyzed their responses under iron-rich and iron-deficient conditions and also evaluated their antimicrobial activity at varying iron levels. The study also explored non-Fe metal binding, to find out the potential metal immobilized isolates and their efficiency. This research provides a foundation for further studies on plant-microbe interactions and the development of beneficial microbial inoculants that can contribute towards eco-friendly plant disease management, sustainable agriculture, bioremediation and bioenergy conversion.

Keywords*: PGPR, siderophore, biofertilizer, sustainable agriculture, bioremediation, bioenergy conversion, metal immobilized*

PP-19

Green synthesis & characterization of silver nanoparticles using orange peel extract for enhancing dye degradation

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Abstract: Textile dye pollution poses a severe threat to water bodies, ecosystems, and human health, necessitating efficient remediation strategies. Conventional approaches like flocculation and adsorption using granulated or powdered activated carbon suffer from high costs and secondary pollution issues. To address these limitations, nanoparticles are gaining attention due to their high surface-to-volume ratios, catalytic properties, and unique optical characteristics, such as visible light absorption and white light reflection. Orange peel, comprising about 50% of the fruit, serves as a rich source of bioactive compounds. In this study, silver nanoparticles (AgNPs) were successfully biosynthesized using orange peel extract via a simple, eco-friendly method. The reduction and formation of AgNPs were confirmed by a color change from light yellow to brown and UV-Vis spectroscopy, revealing a characteristic surface plasmon resonance peak at 425 nm. Particle size analysis showed an average diameter of 142.3 nm, while a zeta potential of -22.5 mV confirmed excellent colloidal stability. FTIR spectroscopy identified key functional groups for nanoparticle formation and stabilization, including C-C bonds at 1638.22 cm^{-1} and O-H bonds at 3269.26 cm^{-1}. These biosynthesized AgNPs demonstrated remarkable photocatalytic efficiency under sunlight, fully degrading toxic dyes-malachite green, rhodamine B, methylene blue, methyl orange, phenol red, and trypan blue-within 24 hours. The findings highlight the substantial potential of orange peel-mediated AgNPs as sustainable photocatalysts for wastewater treatment. Ongoing research aims to optimize synthesis conditions for faster dye degradation.

Keywords: *Dye degradation, Silver nanoparticles, Green synthesis, Wastewater remediations, Textile dye pollution*

PP-20

Pangenome analysis of *Pseudomonas* strains isolated from cystic fibrosis

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Abstract: *Pseudomonas aeruginosa* exhibits extensive genomic heterogeneity driven by strong ecological and host-associated selective pressures. To quantify species-wide diversity and assess patterns of genomic adaptation, a comparative analysis of 55 genomes representing cystic fibrosis (CF), environmental, and laboratory lineages was conducted. Pangenome reconstruction revealed a large, open pan genome architecture characterized by a conserved core complemented by a broad and highly variable accessory gene repertoire. This structure highlights the evolutionary flexibility of the species and its ability to occupy diverse ecological niches. To complement the pan genome analysis, key genomic features commonly associated with adaptation, such as antimicrobial resistance determinants, virulence-associated factors, and mobile genetic elements were surveyed to obtain a broad functional overview. These traits varied across strain groups, broadly indicating distinct selective pressures between CF-associated and nonclinical isolates. All downstream comparative and statistical analyses were performed in R, enabling high-resolution interrogation of pan genome structure and group-wise variation. Collectively, this work provides a technical and integrative genomic framework that delineates the diversity, evolutionary plasticity, and adaptive signatures of *P. aeruginosa* across clinical and nonclinical environments.

Keywords: *Pangenome Analysis, Cystic fibrosis, Pseudomonas aeruginosa, Genome Plasticity*

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PP-21

PAWS: A Comprehensive Computational Platform for Random RNA Aptamer Generation

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Abstract: The conventional SELEX system to select aptamers is lengthy and consumes resources, and therefore needs computational pre-screening systems to streamline the process and save on costs. We developed a Python aptamer generation program called PAWS (Prediction of Aptamers without SELEX), which allows the generation of random RNA aptamers with highly customizable parameters like GC content ranging from 40 to 60% and length of aptamer between 20-80 nucleotides. The software was benchmarked on a mix of multiple computational tools: RNAfold and UNAfold web servers to predict a secondary structure, IDT OligoAnalyzer to estimate thermodynamic properties, RNA Composer to assemble a 3D structure, and four docking platforms (HADDOCK, HDOCK, MPRDOCK, and MDockPP) to measure a binding affinity. Our approach was evaluated by comparing it to four peer-reviewed aptamer research articles, and we publicly deployed it using an easy-to-use web server. We were able to generate different aptamer libraries with optimized binding profiles to the 4 targets that were of interest to our system. It was comparatively analyzed, and a 25-35 % improvement was noticed with regard to binding affinity prediction in comparison to literature controls. Correlation analysis across multiple platforms was found to be good ($r > 0.75$) across the docking servers, which confirmed our consensus scoring method. Annotation to rabies glycoprotein (PDB: 7u9g) identified high-affinity aptamer candidates ranging in binding of -374.46 to -352.32, all much higher than random sequences. PAWS offers an economical computational solution to perform pre-screening of aptamers, which will remove the experimental load and ensure that only the best quality candidates will be selected. The web interface makes high-end aptamer designing technologies equally available to the research community. The web server itself is freely available at https://paws.software , the backend code is available on the site at https://github.com/BAYUSH07/aptamer-tool-backend/ and the frontend code is available on the site at https://github.com/BAYUSH07/aptamer-tool-frontend/

Keywords: *RNA aptamers; computational aptamer design; rabies glycoprotein; molecular docking; SELEX alternative; in silico validation*

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PP-22

Machine Learning–Based Prediction of Cisplatin Resistance in Triple-Negative Breast Cancer Using Multi-Cohort Transcriptomic Signatures

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Abstract: Triple-negative breast cancer (TNBC) is characterized by marked molecular heterogeneity, aggressive clinical behavior, and limited therapeutic options, with treatment resistance remaining a primary driver of poor patient outcomes and clinical stagnation. Despite extensive transcriptomic profiling, the absence of integrative frameworks that effectively link molecular dysregulation with clinical survival and deterministic predictive modeling continues to hinder translational progress. In this study, we present a high-fidelity systems-level framework integrating multi-cohort transcriptomics across four independent datasets—GSE12777, GSE76540, GSE103091, and GSE103115—to elucidate the transcriptomic determinants of cisplatin resistance. Principal component analysis consistently demonstrated robust, reproducible separation between therapy-sensitive and resistant phenotypes, enabling the identification of a core 138-gene consensus signature. Subsequent Protein-Protein Interaction (PPI) network topology, analyzed via the Maximal Clique Centrality algorithm, prioritized a 10-gene hub network that identifies regulators of glycogen metabolism—specifically GYS1 and GYS2—as central survival nodes driving the resistant state. Clinical validation on an independent TCGA cohort confirmed these hubs as definitive prognostic markers, where elevated *GYS1* expression serves as a significant driver of poor overall survival ($p = 0.0085$), while *GYS2* demonstrated a protective clinical effect ($p = 0.02$). To assess translational potential, we benchmarked multiple machine learning architectures, where the LightGBM classifier achieved an unprecedented, absolute Accuracy of 1.0 and a ROC-AUC of 1.0. Model interpretability using high-resolution feature attribution (SHAP) further highlighted the dominant contribution of the *GYS1/2* metabolic axis to these predictive decisions, effectively bridging the gap between computational precision and molecular pathology. Collectively, this integrative analysis provides a biologically grounded, zero-error predictive pipeline that offers a transformative path toward precision oncology, enabling the identification of resistant patients before treatment initiation and sparing them from the toxicity of ineffective chemotherapy.

Keywords*: Triple-negative breast cancer, transcriptomics, drug resistance, protein–protein interaction network, survival analysis, machine learning, biomarker discovery, precision oncology*

PP-23

Biodegradable Polymeric Nanoparticles Inhibit TDP-43 Aggregation: Implications for ALS Therapy

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Abstract: TDP-43 is a nucleic acid–binding protein with important roles in RNA and protein synthesis, mRNA processing, and splicing. Dysfunction of TDP-43 has been associated with neurodegenerative diseases (ND), most importantly amyotrophic lateral sclerosis (ALS), in which TDP-43 misfolded aggregates accumulate within the central nervous system. Such aggregation leads to cellular homeostasis disruption and contributes to the onset and progression of ND. ALS, the most common motor neuron disease which leads to gradual loss of voluntary muscle function, frequently leads to death within a few years. Current therapeutic approaches, mostly palliative, offer only symptomatic temporary alleviation without affecting the causal TDP-43 aggregation. This situation clearly indicates an urgent need for novel therapeutic strategies, particularly in view of the growing aging populations and associated increases in the prevalence of neurodegenerative diseases. Traditional approaches have almost uniformly failed in clinical trials for ND, partly because of poor solubility, low bioavailability, and inability of the compounds tested so far to cross the blood brain barrier (BBB). Nanoparticles have recently emerged as promising therapeutics for ND treatment. Here we study the anti-amyloidogenic activity of two types of FDA-approved biodegradable polymeric nanoparticles, Chitosan and PLGA (poly lactic-co-glycolic acid). This study explores the effect of Chitosan, PLGA, and their curcumin-loaded variants on the inhibition and disaggregation of TDP-43 aggregates. A battery of spectroscopic and microscopic techniques was employed for this purpose, such as Thioflavin T (ThT) fluorescence spectroscopy, Circular Dichroism (CD) spectroscopy, Transmission electron microscopy. Collectively, our results indicate that the biodegradable nanoparticles represent a promising alternative therapeutic strategy for the treatment of amyloid-associated neurodegenerative disorders.

Keywords: *Neurodegenerative diseases, biodegradable nanoparticles, protein aggregation, Amyloid inhibition and disaggregation*

PP-24

Plant Growth-Promoting Rhizobacteria as Sustainable Modulators of Flowering and Sugar Accumulation in Sugarcane

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Abstract: Sugarcane serves as the primary raw material for bioethanol and bio-energy production. The transition from vegetative to flowering stage in sugarcane, results in post-flowering yield losses. Although chemical regulators have been used to suppress flowering and prolong the vegetative phase, their long-term use raises environmental concerns. In this study, 74 morphologically different bacterial isolates were obtained from the rhizospheric and endophytic zones of sugarcane plants collected from Pune, Maharashtra. These isolates were subjected to screening for important plant growth-promoting traits, such as the production of indole-3-acetic acid (IAA) and gibberellic acid, siderophore secretion, nitrogen fixation, and phosphate solubilization. Based on multi-trait profiling, 14 functionally significant isolates were selected for molecular identification through 16S rRNA gene sequencing and for a more detailed evaluation of phytohormone production. Ongoing studies and future trials focus on the foliar application of the selected PGPR consortia and study their influence on the expression of genes associated with flowering. This research aims to understand the pathways by which microbes can help shift the carbon flux towards fermentable sugars, with the help of targeted metabolic profiling. This work aims to focus on the potential of PGPR-based systems for modulating plant developmental pathways which can help support sugar accumulation, thereby increasing sugarcane productivity. This helps in sustainable biofuel production and bio-energy applications.

Keywords*: plant growth-promoting rhizobacteria, sugarcane, flowering regulation, carbon flux, phytohormones, bioenergy, sustainable agriculture*

PP-25

Exploration of microbial Diversity in Kitchen waste for the production of industrially important enzymes

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Abstract: Kitchen waste constitutes a nutrient-rich ecological niche harboring diverse microorganisms naturally adapted to the degradation of complex organic substrates. Harnessing such microbial resources offers sustainable solutions for waste valorization and industrial biotechnology. In the present study, kitchen waste samples collected from a college mess were investigated for microbial diversity and enzyme-producing potential. A total of fifteen distinct microbial isolates (designated Strains 1–15) were recovered using serial dilution and plating on nutrient and selective media. The isolates were characterized based on colony morphology, cellular features, and Gram staining properties. All strains were systematically screened for the production of key industrial enzymes—protease, cellulase, pectinase, and lipase—using substrate-specific agar media containing casein, carboxymethyl cellulose, pectin, and tributyrin, respectively. Primary and confirmatory screening revealed that several isolates exhibited notable extracellular enzyme activity. Notably, three strains demonstrated multi-enzyme production, highlighting their metabolic versatility. Strain 1 exhibited concurrent cellulase and lipase activity, whereas Strains 9 and 10 showed combined protease and lipase production, indicating their capacity to degrade proteins, polysaccharides, and lipids commonly present in organic waste. Although lipase activity was detected qualitatively, further optimization is required for quantitative assessment. Overall, this study highlights the bioenergy-relevant enzymatic potential of kitchen waste–derived microorganisms. The identification of multi-enzyme-producing strains provides a foundation for developing efficient microbial consortia or enzyme-based systems for enhanced substrate hydrolysis, biogas generation, and sustainable bioenergy production within a circular bioeconomy framework.

Keywords: *Kitchen waste, Bioenergy production, Hydrolytic enzymes, Microbial diversity, Sustainable bioprocesses*

PP-26

Moringa oleifera Seed Polysaccharide: Integrated Experimental and In Silico Evaluation of Antioxidant Properties.

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Abstract: Plant-derived polysaccharides are widely being studied due to their biocompatibility, biodegradability, and many biological activities. In this work, a polysaccharide extracted from *Moringa oleifera* seeds (MOS-PS) was studied to understand its extraction process, composition, and antioxidant activity using both experimental and computational methods. The polysaccharide was extracted using a hot-water extraction method and purified to obtain a water-soluble material with high carbohydrate content. Compositional analysis showed that MOS-PS is a heteropolysaccharide mainly consisting glucose and mannose units, indicating its potential as a natural bioactive polymer. The antioxidant activity of MOS-PS was tested using DPPH radical scavenging, ABTS radical cation decolorization, and hydrogen peroxide scavenging assays, the results demonstrated effective free radical scavenging capacity which increased with concentration, proving its ability to reduce reactive oxygen species. These findings conforms the antioxidant nature of the seed-derived polysaccharide. To understand its activity at molecular level, molecular docking studies were conducted using the structural model MOS-PS against proteins related to oxidative stress, the results showed good binding interactions mainly through hydrogen bonding. Molecular dynamics simulations further confirmed the stability of the polysaccharide–protein complexes with only small conformational fluctuations. Overall, this study suggests that *Moringa oleifera* seed polysaccharide is a natural antioxidant biomaterial with potential applications in functional food, pharmaceutical, and biomedical formulations.

Keywords: *Moringa oleifera, Seed polysaccharide, Structural characterization, Antioxidant activity, Molecular docking, Molecular dynamics simulation, Natural biomaterials*

PP-27

Development of Organ on Chip model using microfluidics for cancer diagnosis

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Abstract: 'Organ on Chip' models or more specifically, 'Tissue on Chip' models are designed to create a more physiologically relevant three-dimensional (3D) in-vitro model as compared to two-dimensional (2D) cell culture. Such models have a wide range of applications including study of diseases, drug testing and diagnostics. They also help understand how organs work and reduce animal testing. Furthermore, nanoparticles such as quantum dots conjugated with relevant biomarkers have great potential for use in bioimaging of such models. Numerous studies on 3D in-vitro cell culture and Organ on Chip models have been conducted in recent years. In this study a PDMS scaffold-based model is presented. A grooved PDMS scaffold can enable the growth of HepG2 cells in a 3D manner. The moulds for such scaffolds were prepared on Fusion 360 software and 3D printed. Furthermore, quantum dots were synthesized using green synthesis methods to be utilised for characterisation. This study focuses on the development of a 3D cell culture model for cancer cell imaging and diagnostics.

Keywords: *Organ on Chip models, 3D cell culture, HepG2, Quantum Dots*

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PP-28

Co-culturing yeast and filamentous fungi: An integrated waste valorization approach for environmental sustainability and bioenergy

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Abstract: Interest in biofuels produced using renewable biological resources has increased due to the growing need for sustainable energy. A fermentation-based method was used in this study to assess ethanol production from agricultural waste. The focus was on the use of consortium of filamentous fungi and yeast for biodegradation of husk and simultaneous production of bioethanol. Four yeast strains isolated from different agrowaste were screened for the compatibility against filamentous fungi. The fungi showed inhibitory activity of yeast strain Y2 and Y4 after 7 days of co-incubation. Strain Y1 and Y3 were compatible with the filamentous fungi. Fermentation of husk was carried out for 7 days in a fermenter using the microbial consortium. Ethanol formation was detected using gas chromatography. Chromatographic profile showed a single, noticeable peak with a retention period that closely matched the ethanol standard, indicating a successful fermentative conversion to ethanol. Overall, the study highlights biological fermentation's potential as a practical method for producing bioethanol, highlighting its importance in frameworks for the circular bioeconomy and the development of sustainable biofuels.

Keywords: *Microbial consortium, dual culture assay, agricultural waste, fermentation, bioethanol, sustainability*

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PP-29

Smart Contact Lens Technologies for Ocular Diagnostics

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Abstract: In our study, we are examining a new approach to creating contact lenses using PDMS with quantum dots prepared from Sappan wood extract to deliver drugs directly to the eye. We selected Sappan wood because of its availability and its ability to offer an environmentally friendly means to synthesize quantum dots. The synthesized nanoparticles have a high fluorescence ability and can be easily functionalized depending on their intended purposes. The design of the lenses with microfluidic channels was able to offer a better means to control quantum dots size and distribution within the material. The PDMS substrate is useful in designing eyes due to its permeability to oxygen and its flexibility and transparency. A patient can wear these contact lenses without any vision problems. The quantum dots do not affect one's sight because they are not visible to the eyes and can be traced through fluorescence methods. The problem with current treatments for the eyes is that patients forget to put drops into their eyes or the drops are washed away immediately. The potential solution to these problems could be the sustained delivery of the drug. This would benefit patients suffering from glaucoma or an eye infection. The microfluidic integration provides an accurate manner in which a controlled amount of a drug can be loaded and released. The usage of the fluorescence property of a quantum dot provides a possible manner in which tracking of therapeutic agents within an eye non-invasively can be achieved. Based on the findings obtained from this study, a future focus on innovative ophthalmic drug delivery is established. The inclusion of sustainable nanomaterials, microfluidic integration, and a biocompatible polymer provides an indication of a positive future in dealing with a number of eye issues.

Keywords: *Ophthalmic drug delivery, PDMS contact lenses, Quantum dots, Microfluidic integration, Sustainable nanomaterials, Controlled drug release, Fluorescence tracking*

PP-30

Development of a Low-Cost Temperature-Controlled Microheater for Lab-on-Chip Platforms

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Abstract: This study presents a temperature-regulated microheater specifically engineered for biomedical and microfluidic applications employing silicone polymers such as PDMS. The main objective is to build an affordable, reliable, and easily controllable heating system that can provide uniform thermal conditions for on-chip experiments and material synthesis. The device integrates an intricate nichrome wire network patterned onto a glass substrate to ensure uniform heat distribution and reliable operation. A closed-loop feedback system, composed of a thermocouple interfaced with a MAX6675 temperature sensor and controlled via an Arduino Uno microcontroller, maintains precise temperature stability across a wide operating range of 50°C – 200°C. Experimental characterization and stimulation confirmed uniform heating within ±1°C over different set points, with rapid response and low power consumption. The PDMS microfluidic layer is directly bonded to the heating surface, achieving efficient thermal transfer and consistent temperature conditions across microchannels. This configuration enables real-time, repeatable synthesis of nano-materials such as carbon quantum dots, while substantially reducing energy usage and operational costs. The compact, cost-effective, and portable architecture makes the system suitable for lab-on-chip devices, materials research, and biological experimentation. By combining micro-assembly methods with affordable electronic control, this work delivers a scalable and adaptable thermal platform that enhances process reproducibility and broadens access to precision temperature control in biomedical research.

Keywords: *PDMS microfluidics, on-glass microheater, nichrome wire, thermocouple feedback, MAX6675, Arduino Uno control, Carbon quantum-dot synthesis, low-cost portable platform*

PP-31

Identification of Conserved T-Cell Exhaustion Biomarkers in Lung and Breast Cancer through Integrated Transcriptomic Analysis

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Abstract: Breast cancer is the most common cancer among women, while lung cancer remains one of the leading causes of cancer-related deaths worldwide. One of the major challenges in cancer treatment is T-cell exhaustion, a condition in which T cells gradually lose their ability to eliminate tumor cells after prolonged antigen exposure within an immunosuppressive tumor microenvironment. This affects patient responses to targeted and immune therapies, while the underlying conserved mechanisms remain unclear. In this study, we aimed to identify conserved biomarkers associated with T-cell exhaustion in breast and lung cancer. We analyzed eight publicly available microarray datasets from the Gene Expression Omnibus (GEO), including four lung cancer datasets (GSE10072, GSE18842, GSE19804, GSE32863) and four breast cancer datasets (GSE10780, GSE42568, GSE65194, GSE70947). Differentially expressed genes between tumor and normal groups were identified. T-cell exhaustion scores were calculated using single-sample gene set enrichment analysis (ssGSEA), and gene modules associated with these scores were identified using Weighted Gene Co-expression Network Analysis (WGCNA). Key genes were further prioritized using the Maximal Clique Centrality (MCC) method, and biological pathways were explored through functional enrichment analysis. Survival analysis was performed to evaluate their clinical relevance and identify potential therapeutic candidates. We applied Random Forest and LASSO to identify key genes linked to disease progression followed by evaluating their diagnostic potential using ROC analysis. This study provides insight into shared molecular mechanisms of T-cell exhaustion in lung and breast cancers and highlights immune-related biomarkers that may support future immunotherapy-based research and treatment strategies.

Keywords: *T cell exhaustion, Microarray, Lung cancer, Breast cancer, Biomarkers*

PP-32

Genomic and Functional Profiling of *Roseburia intestinalis* as a Next-Generation Probiotic

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Abstract: *Roseburia intestinalis,* a strictly anaerobic gut bacterium, is increasingly recognized as a promising next-generation probiotic with potential health benefits. In this study, comprehensive genome analysis and in vitro characterization were performed to evaluate the probiotic potential, safety, and gut adaptability of R. intestinalis. The draft genome was assembled de novo into 128 contigs, totaling 4.25 Mb with a GC content of 42.2%. Comparative BRIG analysis revealed unique genomic regions distinguishing this strain from other R. intestinalis isolates. Genome mining identified genes associated with probiotic traits, including acid (F1-F0 ATPases) and bile tolerance (chologlycine hydrolase), adhesion (LPXTG-type Sortase A and GroEL), and biosynthesis of vitamins, amino acids, and enzymes essential for host metabolism. Bacteriocin-related gene clusters suggested potential disease-preventing activity. Safety assessment using ResFinder, CARD, PlasmidFinder, VirulenceFinder, PathogenFinder, confirmed the absence of plasmid-borne Antibiotic resistance, virulence, or pathogenicity determinants. In vitro assays demonstrated optimal growth at 37°C and neutral pH, tolerance to low-salt conditions (0–2% NaCl), and survival in simulated acid and bile concentrations, reflecting adaptation to gut-like environments. Higher cell surface hydrophobicity and Auto-aggregation highlighted the strong adhesion potential of RS1. The presence of adhesion-related and metabolic genes, coupled with resilience under gastrointestinal stress conditions, underscores its suitability for human gut colonization. This study provides critical genomic and functional evidence supporting the development of RS1as a next-generation probiotic, offering potential applications in promoting gut health and preventing disease.

Keywords: *Roseburia intestinalis, Whole genome analysis, Next-generation probiotic, GIT tolerance, adhesion, disease-preventing activity*

PP-33

In-Silico Optimization of Metabolic Fluxes for Enhanced Bioenergy Production

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Abstract: Bioenergy production using microorganisms has gained significant attention as a sustainable alternative to energy systems based on fossil fuels. Optimization of microbial metabolic pathways is essential to improve energy yield while maintaining cellular growth and viability. In the present study, genome-scale metabolic modeling combined with flux balance analysis (FBA) is employed to analyze and optimize the metabolic parameters associated with bioenergy production. The genome-scale metabolic models (GEMs) of two bacteria are analyzed under defined environmental and physiological constraints to simulate cellular metabolism. *Escherichia coli* is a well-explored bacterium and is known to be a possible source of bioethanol production. *Geobacter sulfurreducens* is a model electroactive bacterium capable of bioenergy production, which can be studied for bio-hydrogen production. In this current study, GEMs of both *E. coli* and *G. sulfurreducens* will be manually curated. Then, the FBA analyses will be carried out to optimize the metabolic flux distributions for various conditions, especially with biomass growth rate selected as the primary objective function to assess the model's feasibility and predictive accuracy. Key metabolic parameters such as substrate uptake rates, energy generation pathways, and energy-related fluxes will be systematically optimized initially using OptFlux. Constraint-based simulations will be carried out to study the effect of varying growth conditions on biomass formation and bioenergy related metabolic fluxes using COBRApy. The expected outcome of this study is the identification of key metabolic pathways and flux distributions that influence bioenergy production while maintaining cellular growth. The optimized metabolic profiles are anticipated to provide insights into metabolic efficiency and potential targets for metabolic engineering. Overall, this work aims to demonstrate the applicability of FBA as a robust *in-silico* approach for understanding and optimizing microbial bioenergy production.

Keywords: *Bioenergy, Genome Scale Metabolic Model, Flux Balance Analysis, Biomass growth, Bio-hydrogen production*

PP-34

Akkermansia muciniphila as a Next generation probiotic: Genomic Insights and Probiotic potential

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Abstract: *Akkermansia muciniphila,* a promising candidate for next-generation probiotics, is a prevalent symbiont in the gastrointestinal tracts of humans and animals. Herein, we present a comprehensive pan-genomic characterization of *A. muciniphila* strain AM1 to delineate the genetic underpinnings of its probiotic functionality. The genome comprises a single circular chromosome of 2.84 Mb with a mean G+C content of 55.6 mol%, encompassing 2,901 protein-coding sequences (CDS) and 55 RNA genes.ANI and dDDH metrics affirmed its taxonomic affiliation, whereas BRIG comparisons highlighted strain-specific gaps and divergences relative to reference *A. muciniphila* genomes. Functional annotation identified determinants of acid tolerance, including the F_1F_0-ATPase proton pump and Na^+/H^+ antiporters for pH homeostasis, alongside a sodium-bile acid symporter conferring bile salt resistance. Genes essential for exopolysaccharide (EPS) biosynthesis were abundant, while superoxide dismutase (MnSOD) and the thioredoxin-thioredoxin reductase system support robust antioxidant defenses against reactive oxygen species. BAGEL4 analysis unveiled a sactipeptide-class bacteriocin biosynthetic cluster. Biosynthetic gene clusters for folate (vitamin B_9), tryptophan, and leucine were mined, complemented by extracellular hydrolases such as β-galactosidase and proteases that enhance nutritional versatility. The absence of antibiotic resistance genes, plasmids, virulence factors, or toxin-encoding sequences substantiates the Generally Recognized as Safe (GRAS) status of AM1. These genomic insights establish *A. muciniphila* AM1 as a potential therapeutic candidate, warranting rigorous validation via in vitro and in vivo studies.

Keywords: *Akkermansia muciniphila, next-generation probiotic, Genome, Functional annotation, GIT tolerance, folate biosynthesis, GRAS*

PP-35

Synthesis of Carbon Quantum Dots-based Nano-Systems for Healthcare Applications

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Abstract: Compared to traditional nanoparticles, quantum dots offer significant advantages including size-dependent quantum confinement effects that produce tunable and highly stable fluorescence emissions. This leads to narrower emission spectra, superior brightness, and enhanced resistance to photobleaching, key benefits over conventional fluorescent nanoparticles. Additionally, CQDs exhibit excellent biocompatibility, water solubility, and facile surface functionalization, enabling targeted biomedical applications. Nitrogen-doped carbon quantum dots (N-CQDs) were synthesized using a bottom-up chemical approach facilitated by constant high temperature using convection-grill mode. This method enables rapid, uniform heating, ensuring controlled nucleation and growth of quantum dots with precise size regulation. Reaction parameters including time and precursor concentration were optimized to achieve a narrow size distribution with 100% population centered around the following range 3-10 nm, crucial for consistent optical and chemical behavior. In biomedical contexts, especially for cell internalization studies, CQDs' ultra-small size (~10 nm) and surface chemistry allow efficient cellular uptake with minimal toxicity. Their strong fluorescence provides high-resolution imaging and real-time tracking of cellular processes, making them powerful tools for bioimaging, biosensing, and drug delivery monitoring. Nitrogen doping further enhances CQD photoluminescence and interaction with biological environments, expanding their utility in diagnostics and therapeutic applications.

This study demonstrates that microwave oven-assisted synthesis of N-CQDs with optimized parameters is a rapid approach to produce highly uniform and functional nanomaterials. The resulting CQDs offer superior advantages over typical nanoparticles, supporting their growing relevance in nanobiotechnology and clinical research, particularly for intracellular imaging and targeted therapeutics.

Keywords: *Carbon Quantum Dot synthesis, nanobiotechnology, Photo-luminescence, bioimaging, drug delivery system*

PP-36

Development of Biodegradable Nanomaterials-based Drug Delivery System from Fish Skin for Healthcare Applications

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Abstract: The growing demand for sustainable and biocompatible wound care materials has driven the exploration of alternative biomaterials such as marine collagen to replace mammalian sources. In this study, collagen was extracted from tilapia fish skin and processed into porous patches through lyophilization. The protein content was quantified using the Bradford assay, while FTIR spectroscopy confirmed the preservation of the collagen's triple-helical structure through characteristic amide peaks. Chitosan-mediated silver nanoparticles (ChAgNPs) were synthesized using chitosan as both reducing and stabilizing agent and characterized by UV–Visible spectroscopy, which showed a surface plasmon resonance peak at 421–426 nm, indicating long-term stability of approximately one year. Particle size distribution and colloidal stability were evaluated using dynamic light scattering and zeta potential analysis, respectively. The antimicrobial efficacy of ChAgNPs was demonstrated through disc diffusion assays, showing clear zones of inhibition against *Staphylococcus aureus* and *Escherichia coli*. In vitro scratch assays using AGS cells revealed enhanced cell migration in the presence of collagen, indicating improved wound healing potential. MTT cytotoxicity assays confirmed good biocompatibility at optimized concentrations, although higher nanoparticle doses led to aggregation and reduced cell viability, highlighting the importance of dosage optimization. Additionally, a hemolytic assay performed using the extracted collagen demonstrated minimal to no red blood cell lysis, indicating excellent blood compatibility and supporting the safe use of the material for wound healing applications. Overall, the regenerative properties of marine collagen, together with the broad-spectrum antimicrobial activity of ChAgNPs, highlight their potential as biodegradable and eco-friendly components for advanced wound care strategies.

Keywords: *Marine Collagen, Silver Nanoparticles, Lyophilized Patch, Wound Dressing, FTIR Analysis, Antimicrobial Assay*

PP-37

Phytoremediation of textile wastewater by plant (*Ophiopogon japonicus*) (Mondo grass) and its root associated bacteria

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Abstract: Textile dye wastewater, especially from azo dyes like Direct Red 80, is a major environmental concern due to its intense colour, toxicity, and persistence. This study explores a combined phytoremediation–microbial strategy using *Ophiopogon japonicus* (Mondo grass) and dye-degrading bacteria to treat Direct Red 80-contaminated wastewater. Bacterial strains were isolated from roots zone of *Ophiopogon japonicus* and introduced into the plant rhizosphere to enhance degradation. Treatment performance was evaluated through UV–Vis spectrophotometry, which showed significant absorbance reduction, indicating effective colour removal. FTIR analysis confirmed structural breakdown of the dye and formation of degradation products. The integrated system exhibited notably higher efficiency than using plants alone, demonstrating a strong synergistic effect. A small-scale reactor setup further validated the feasibility of this approach for practical wastewater treatment applications. Overall, this plant–microbe system provides a low-cost, sustainable, and eco-friendly solution for textile dye remediation, with potential for scale-up in industrial settings.

Keywords: *Phytoremediation, Dyes, Textile wastewater, Rhizosphere bacteria, Reactor*

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PP-38

Millet Formulations and Their Potential Role in Modulating Low-Grade Inflammation Through Gut Microbiome Interactions

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Abstract: Low-grade inflammation represents a persistent and subtle physiological state associated with modern dietary patterns, metabolic stress, and lifestyle factors. Because it develops gradually and often lacks clear clinical symptoms or easily measurable biomarkers, individuals typically remain unaware of its presence until it contributes to chronic health complications. In such contexts, preventive nutritional strategies become crucial for maintaining gut-mediated immune balance and mitigating the progression of inflammation before it manifests clinically. Millets have emerged as promising components of such preventive approaches due to their rich content of dietary fiber, prebiotics, polyphenols, and other bioactive compounds known to influence gut microbial ecology. The present preliminary study examines how different millet formulations-including germinated, and fermented forms-may vary in their potential to support anti-inflammatory pathways. These processed forms are hypothesized to differ in their metabolic outputs, including short-chain fatty acids (SCFAs) and probiotic growth–promoting components, which are central to gut microbiome health and barrier integrity. Early assessments, such as pH reduction and indicative SCFA trends, suggest that processing methods may enhance beneficial biochemical attributes in millet formulations. By comparing these formulations, this work seeks to characterize how processing-driven biochemical changes in millets may relate to mechanisms associated with gut microbiota activity and inflammatory regulation. This conceptual framework highlights the potential of millet formulations as promising functional food candidates capable of supporting gut health and influencing low-grade inflammatory processes commonly linked with contemporary lifestyles.

Keywords: *Millet formulations, Low-grade inflammation, Gut microbiota, Prebiotics, Short-chain fatty acids (SCFAs), Fermentation and germination, Functional foods, Microbiome-mediated regulation*

PP-39

Exploring Nirmali seeds (*Strychnos Potatorum*) Powder as Natural Coagulant for Treatment of Textile Wastewater

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Abstract: Conventional methods of textile wastewater treatment include the use of chemical coagulants which eventually lead to secondary pollution. Thus, a need for more cleaner and eco-friendly approach was to be explored. Investigation of the potential of Nirmali seeds (*Strychnos Potatorum*) was then considered, a natural coagulant for treatment of textile dye wastewater. Natural coagulants although traditionally known for exhibiting the property of water purification their role in dye removal remains less explored. Our study evaluated Nirmali seed powder's coagulant efficiency to remove the textile dyes under experimentally controlled conditions. The experiments conducted included the seed powder being treated with dye solutions of different concentrations of coagulant, at varying levels of pH, settling time, temperature etc. The OD was then calculated and % Dye removal was interpreted using the formula. The results exhibited that the chosen coagulant showed significant dye removal capability especially at alkaline pH, maximum removal being at pH 10 **(**~88.3%**)**, followed by pH 8 **(**~87.5%**)**, and pH 7 (~86.8%). The lowest removal occurred at pH 6 (~63.6%). The visuals also support the result by showing enhanced flocculation at higher pH. The above findings thus help support Nirmali as a green alternative coagulant to conventional chemical coagulants. This experiment thus illustrates the use of natural coagulant being a promising and feasible alternative to already existing chemical coagulants in dye removal in textile wastewater. However further work of optimizing the process is an important perspective that is required for scalability. Our future aim with this project includes assessing more parameters like temperature and transforming the seed powder to a bio-nanoparticle which will enhance surface area and adsorption capacity of this coagulant.

Keywords: *Natural Coagulants, Dyes, Textile wastewater. Nirmali seeds, Physical treatment*

PP-40

Biodegradable Polymeric-Lipid Nanoparticles for Modulation of Amyloid Protein Aggregation in Neurodegenerative Disorders

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Abstract: Neurodegenerative disorders, such as Alzheimer's and Parkinson's are driven by the aggregation of misfolded proteins that cause neuronal toxicity and progressive loss of its function. This study aims at developing and characterizing biodegradable PLGA nanoparticles for possible therapeutic use in inhibiting or reversing protein aggregation. PLGA are polymeric core matrix of nanoparticle-carrier system that loads the Curcumin as drug molecule. Curcumin drug candidate has anti-amyloid, antioxidant, anti-inflammatory and Neurogenesis properties. Phospholipid used are DOTAP and DPPC to give a lipid like outer layer for interaction. These formulations were then optimized to enhance their biocompatibility, stability, and drug loading efficiency. Bovain Serum Albumin [BSA] was used as a model protein to induce amyloid-like aggregates, which represent distinct aggregation stages such as soluble oligomers, protofibrils, and insoluble fibrils, to simulate neurodegenerative aggregation processes. The prepared nanoparticles were applied at two different stages: preincubation with aggregation, to assess their possible inhibition of aggregation; and post incubation with the aggregated forms, to study their potential to disaggregate. This comparative analysis of each nanoparticle type will enable us to identify active formulations able to interfere with either amyloid growth or fibril disassembly. The focus of this work will be to explain how biodegradable nanoparticles can modulate pathological protein aggregation and provide a basis for developing active nanotherapeutic methods for curing neurodegenerative disorders.

Keywords: *Neurodegenerative diseases, biodegradable nanoparticles, protein aggregation, Amyloid inhibition and disaggregation*

PP-41

Horizontal Continuous Flow Hydroponic Phytoreactor for Removal of Textile Dye from Wastewater by using Plant *Nephrolepis cordifolia*

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Abstract: A horizontal continuous flow hydroponic reactor system is particularly well-suited for phytoremediation when using robust plant species like *Nephrolepis cordifolia*. In such systems, a continuous flow of textile dye is targeted for phytoremediation through horizontal channels. Thus, plant roots are suspended in these channels, directly interacting with the pollutants to maximize root oxygenation and ensure sons tent exposure of plant roots. Textile dyes, particularly azo dyes like Direct Red 80, are persistent organic pollutants that severely impact aquatic ecosystems and public health, as they are recalcitrant to conventional treatment and can be carcinogenic or mutagenic. Using *Nephrolepis cordifolia* in such a system demonstrates strong adaptability to hydroponic systems and shows potential in up taking and metabolizing Direct Red 80 from water due to its extensive root system and resilience to stress. A horizontal continuous flow hydroponic reactor harnesses efficient fluid management, maximized root exposure, system scalability, and reduces chemical input, making it ideal for sustainable phytoremediation of industrial textile dye-laden effluents.

Keywords: *Hydroponic Reactor, Phytoremediation, Textile dyes, Horizontal Continuous flow, Nephrolepis Cordifolia*

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Novel Polystyrene degrading bacteria from the gut of *Corcyra cephalonica* (Stainton, 1886) gut

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Abstract: Polystyrene (PS) is a ubiquitous plastic waste that is highly resistant to biodegradation and is widely used in many industries. The present study focused on the isolation and identification of PS-degrading bacteria from the gut of *Corcyra cephalonica* (Stainton, 1886) and on evaluating the degrading efficiency of the isolated strains. The total viable count (TVC) was found to be 3.2*10 6 CFU g -1. Primary screening for PS biodegradation was performed using clear zone method, which resulted in the selection of two efficient isolates AG1 and AG2. Molecular identification of the PS degrading isolates was carried out using 16S rRNA technique. Phylogenetic analysis revealed that strain AG1 showed 99.791% sequence similarity with *Bacillus thuringiensis* (KT206229), while strain AG2 showed 99.719% similarity with *Bacillus haynesii* (NR_157609.1). Both isolates demonstrated significant PS degradation, with weight losses of 8.75 ± 1.0% and 7.53 ± 0.81%, respectively. Among them, *B. thuringenesis* strain AG1 exhibited the highest PS degradation efficiency. This potent isolate was further evaluated using the weight loss method, scanning electron microscopy (SEM), and Fourier transform infrared spectroscopy (FTIR). SEM analysis showed the formation of pits, cracks and surface erosion on PS films, indicating biodegradation by *B. thuringenesis* AG1. FTIR analysis revealed the appearance of absorption peaks corresponding to carbonyl and other functional groups, suggesting oxidative degradation and microbial modification of PS surface. Overall, the study provides novel insights into the identification of Bacillus spp. from the insect gut and highlights their potential role in polystyrene degradation.

Keywords: *Polystyrene biodegradation, Insect gut microbiota, Bacillus thuringiensis, Corcyra cephalonica, Plastic-degrading bacteria, SEM analysis, FTIR analysis*

PP-43

Synergistic effect of chemotherapy and electromagnetic radiations on cancer cells

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Abstract: Cancer is one of the leading causes of deaths across the globe. Current treatments, such as chemotherapy and radiotherapy, often damage normal cells and exhibit limited selectivity. Because of these limitations, electromagnetic fields have been studied as a supportive approach in cancer treatment. Previous studies have reported that high magnetic field intensity or long exposure time affects cancer but they also affect normal cells. This research focuses on understanding how electromagnetic fields influence cancer cells while minimizing harm to normal cells. Studies have shown that electromagnetic fields can induce biological changes, such as increased reactive oxygen species production, membrane disruption, and apoptosis in cancer cells. In this research, we analyzed in vitro cancer cell studies that used a Helmholtz coil to generate a static, uniform magnetic field. Magnetic field intensities of less than 1 mT and shorter exposure durations were emphasized to reduce the effects on normal cells. In addition, the combined use of low-intensity magnetic fields and the chemotherapy drug doxorubicin was reviewed to evaluate whether this combination enhances cancer cell sensitivity.

Keywords: *Cancer, Chemotherapy, Static magnetic field, Helmholtz coil, Magnetism, Doxorubicin*

PP-44

Computational drug repurposing approach to obtain potential anti-HEV molecules

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Abstract: Hepatitis E virus (HEV), responsible for acute viral hepatitis, is endemic in Central Asia, Africa and Central America with severity especially high in pregnant women. Side effects of off-label therapies and lack of effective antivirals warrant exploring the existing drugs for anti-HEV activity through drug repurposing. Transcriptome analysis of infected cells to that of control cells allows identifying changes in the gene expression pattern after acquiring disease to get potential drug candidates which would reverse the effect. The study compared these patterns and identified a few potential anti-HEV molecules using a computational drug repurposing approach. Gene mapping of available wet-lab RNA seq data resulted in successful mapping of about 49 to 89 % of genes on the reference genome. 203 up-regulated and 311 downregulated genes were obtained. Total 85 drugs (which reverse the altered DEG pattern) were obtained from cMAP using top 150 up and downregulated genes. 15 drugs were finalised by eliminating drugs having low scores, and those without any known animal and cell line toxicity values. Two DEGs, LGALS9 and NRC2 were obtained with associated potential drug candidates and GO (pathway) terms. LGALS9 coding for galectin 1 and galectin 9 protein products affect biological pathways crucial for viral entry in host cell (GO:0046598) and also responsible for regulation of CD4-positive, CD25-positive, alpha-beta regulatory T cell differentiation involved in immune response (GO:0032832). These dictated the identification of the following molecules of high anti-HEV potential: Mercaptoethanol; Thiodigalactoside; 1, 4-Dithiothreitol; Artenimol; (R)-1-Para-Nitro-Phenyl-2-Azido-ethanol.

Keywords: *Hepatitis E virus, Transcriptome, RNA seq, cMAP, DEG*

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Hydrogel Bandages for Burn Wounds

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Abstract: The management and healing of burn injuries have a notable impact on patients and global health from both social and economic perspectives. This burden primarily arises from the negative effects of infections, including secondary infections, extended recovery periods, and the associated treatment expenses. However, traditional bandages used for this type of injury exhibit several limitations. The dry dressings currently available in the market do not promote healing as effectively, while also increase pain by sticking to the wound, and are prone to secondary infections. Hydrogels, typically made from biopolymers and having the ability to swell in water by absorption, have been suggested as potential solutions to this due to their capacity to maintain a moist healing environment. Their swelling properties allows them to absorb wound exudate, change their shape according to the wound, and be modified to include active ingredients, such as growth factors and antibacterial agents. The use of organic, biodegradable hydrogel made from cellulose, infused with an antimicrobial drug and CeO2 nanoparticles, has been proposed as an innovative approach for these treatments. Characterization of the synthesized hydrogel using FT-IR, P-XRD, and contact angle analysis was conducted through experimental studies, thereby demonstrating the advantages of organic, biodegradable hydrogels as an effective option for treating and healing burn injuries. This investigation led to the precise optimization of these hydrogels for wound healing applications.

Keywords: *Wound Healing, Biocompatible, Hydrogels, Antimicrobial, Nanoparticles*

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Green-Synthesized CeO_2–Au Nanoparticles for Multifunctional Wound Healing

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Abstract: Gold–cerium oxide (Au–CeO_2) hybrid nanoparticles were synthesized using a green, plant-mediated approach and are proposed as a potential multifunctional platform for wound healing applications. Cerium oxide nanoparticles were prepared via a Moringa extract–assisted synthesis and subsequently decorated with gold nanoparticles to obtain a redox-active hybrid system. The synthesized Au–CeO_2 nanoparticles are expected to combine the antioxidant properties of CeO_2, arising from reversible Ce^{3+}/Ce^{4+} redox cycling, with the antimicrobial and pro-regenerative characteristics of gold nanoparticles. The synthesized cerium oxide and gold–cerium oxide hybrid nanoparticles were characterized using Fourier transform infrared spectroscopy (FTIR), ultraviolet–visible (UV–Vis) spectroscopy, dynamic light scattering (DLS), and zeta potential analysis to evaluate their physicochemical properties, the characterization, results demonstrate successful nanoparticle synthesis with stable and favorable physicochemical properties. Compared to conventional and silver-based wound dressings, the Au–CeO_2 system is anticipated to offer multifunctional therapeutic activity with reduced cytotoxicity, highlighting its potential as an advanced material for next-generation wound healing applications.

Keywords: *Gold–cerium oxide hybrid nanoparticle, Green synthesis, Reactive oxygen species (ROS), Antimicrobial, Nanoparticle characterization*

PP-47

Synthesis and Characterization of CeO_2 Nanoparticles for Potential Antimicrobial Applications

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Abstract: Cerium oxide nanoparticles (CeO_2 NPs) represent a promising class of antimicrobial agents for biomedical applications due to their antioxidant, non-cytotoxic, biocompatible, and antimicrobial properties. In this study, we synthesised CeO_2 NPs via a scalable, low-temperature hydrothermal method (70°C, 4 hours) using cerium nitrate hexahydrate and sodium hydroxide precursors, offering an energy-efficient alternative to conventional high- temperature synthesis routes. Comprehensive physicochemical characterization confirmed successful nanoparticle formation and stability. Dynamic Light Scattering revealed monodisperse colloidal aggregates with excellent stability (Z-average: 214.3 nm, PDI: 0.03), while UV-Vis spectroscopy validated nanoscale CeO_2 formation through characteristic blue-shifted absorption at 312 nm. Fourier Transform Infrared spectroscopy confirmed Ce-O bonding with minimal nitrate contamination, demonstrating high purification efficiency. Scanning Electron Microscope and X-Ray Diffraction studies were also used to characterise the nanoparticles. The synthesised NPs were subsequently tested for antimicrobial activity against two critical pathogens using a Surface Challenge Test. This test also validated the adherence of NPs of non-porous surface of glass. Antimicrobial results indicated promising activity against the Gram-negative bacterium, Escherichia coli, achieving a 4 Log reduction at 0.1 mg/mL. However, activity against the Gram-positive Staphylococcus Aureus was negligible ($R \approx 0.4$), indicating a structure-dependent mechanism of NPs. Furthermore, an in-vitro cytotoxicity assessment using the MTT assay was initiated on HepG2 liver cells to establish a safety margin and assess the biocompatibility of NPs. This research validates the synthesis route and highlights the selective antibacterial potential of CeO2 NPs for translational surface applications.

Keywords: *Cerium oxide nanoparticles (CeO_2 NPs), Hydrothermal synthesis, Gram- negative bacteria, Surface challenge test, Biocompatibility, Dynamic Light Scattering*

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Fermentation of wheat straw hydrolysate by yeast strains for bioethanol production

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Abstract: Wheat straw, an abundant lignocellulosic biomass, represents a promising renewable feedstock for sustainable bioethanol production. In this study, wheat straw was subjected to an optimized pretreatment process to enhance cellulose accessibility, followed by detoxification and fermentation using selected indigenous yeast isolates. The present study aimed at revival of isolated yeast strain and these yeast stains were investigated macroscopically and microscopically to identify them for cellular morphology. The fermentation ability of screened yeasts was tested to produce bioethanol. Based on screening experiments, four isolates mainly P1, P2, W1, and B1 demonstrated improved glucose utilization efficiency during fermentation. Among these, isolate B1 exhibited significantly higher ethanol productivity compared to P2 and W1, while no significant differences were observed among P1, P2, and W1. The results indicate that isolates B1, P2, and W1 possess promising fermentation potential and warrant further optimization and process development for their application in large-scale industrial bioethanol production. This study highlights the feasibility of integrating wheat straw vaporization with tailored microbial fermentation to advance cost-effective, second-generation bioethanol technologies.

Keywords: *Wheat straw, yeast strain, fermentation, bioethanol, pretreatment*

PP-49

Fabrication of Benchtop Microfluidic Devices with On-chip Reservoirs for Automated Fluid Flow

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Abstract: Microfluidic devices are often associated with cleanroom infrastructure and expensive fabrication steps, but many useful structures can actually be created with simple tools available in most labs. In this work, we explored a set of practical, low-cost, cleanroom-free methods that rely on everyday 3D printing and common solvents to fabricate functional microchannels and integrated fluid reservoirs. Three complementary benchtop-friendly strategies were studied: using 3D printed ABS sacrificial scaffolds, replica molding using (SLA) resin moulds, and polymethyl methacrylate (PMMA) patterning via solvent-assisted embossing and chemical bonding. Using all three methods, identical channel geometries were fabricated and evaluated across surface morphology, dimensional fidelity, wettability, optical transparency and fabrication throughput. Small, on chip reservoirs were incorporated through passive pumping mechanisms that allowed the chip to move liquids on its own, without the need for external syringe pumps or complex control hardware. These demonstrations show that a simple, cleanroom-free setup can still support the rapid development of microfluidic systems suited for basic assays, and small-scale research. The comparative data provides a practical approach in selection of fabrication methods for rapid prototyping in proof-of-concept in the development of lab-on-chip devices.

***Keywords*:** *3D printing, Lab-on-chip, Microfabrication, Passive pumping, Replica molding, Sacrificial scaffolds,Solvent embossing*

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PP-50

Deep Learning-Based Early Prediction of Lung and Breast Cancer from CT Imaging

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Abstract: Early detection of cancer is essential for improving survival rates and reducing treatment complexity, particularly in the case of lung and breast cancer, which continue to pose major global health challenges. Traditional diagnostic approaches depend largely on manual evaluation of medical images, which can be time-intensive and subject to human error. To overcome these limitations, this project proposes an automated deep learning–based system for early cancer prediction using medical imaging data. The proposed framework employs advanced convolutional neural network (CNN) architectures, specifically ResNet and DenseNet, to analyze lung and breast CT scan images. These models enable automatic and effective feature extraction from complex medical images. ResNet utilizes residual connections to facilitate the training of deep networks and improve learning stability, while DenseNet enhances feature propagation and reuse through dense layer connectivity. Together, these architectures improve classification performance by capturing subtle patterns associated with cancerous and non-cancerous tissues. The system follows an end-to-end learning approach, minimizing the need for manual feature engineering and reducing dependency on expert intervention. Data preprocessing and optimization techniques are applied to improve robustness and generalization. Experimental evaluation demonstrates that the proposed method achieves accurate and reliable predictions for both lung and breast cancer detection. This study highlights the potential of deep learning techniques to support early diagnosis, increase awareness, and assist clinicians in timely decision-making, ultimately contributing to more accessible, efficient, and reliable cancer diagnostic solutions.

Keywords: *Early Cancer Detection, Deep Learning, Convolutional Neural Networks (CNN), Medical Imaging, ResNet and DenseNet*

PP-51

To assess the synergistic potential of DHA, EPA and chemotherapy drugs on Breast cancer

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Abstract: Drug resistance is a major hurdle in the battle against cancer, making chemotherapy treatments often ineffective. To improve the effectiveness of chemotherapy, various natural molecules that can enhance chemotherapy ability are been studied globally. One of the potent molecule is Docosahexaenoic acid (DHA), a Polyunsaturated Fatty acid (PUFA) found in marine fish, which has been shown to enhance the cytotoxicity of various anti-cancer drugs in vitro and in vivo. Though the combined use of DHA along with chemotherapy drugs have demonstrated promising preliminary results in clinical trials, there is still a need to discover the exact mechanism of action of DHA. As the biological pathways involved in the chemosensitization of chemoresistant MDA-MB-231 cells are still not entirely explored, in this study, we are aiming to investigate whether DHA co-treatment could enhance the ability of the chemotherapy drug doxorubicin to inhibit the growth and invasion of MDA-MB-231 breast cancer cells that had become resistant to the drug.

Keywords: *Breast cancer, chemoresistance, natural bioactive compound, docosahexaenoic acid, chemosensitization, drug accumulation, apoptosis*

PP-52

WGCNA-Based Co-expression Network Analysis with Functional Enrichment

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Abstract: Myotonic dystrophy type 1 (DM1) is a complex neuromuscular disorder marked by widespread disturbances in gene expression, particularly within skeletal muscle. Understanding how genes act in a coordinated manner is essential for unravelling the molecular basis of this disease. In this study, we applied Weighted Gene Co-expression Network Analysis (WGCNA) to the publicly available transcriptomic dataset GSE86356, consisting of skeletal muscle samples from individuals with DM1 and healthy controls, to capture disease-associated gene interaction patterns. After comprehensive data preprocessing and outlier removal using hierarchical clustering and principal component analysis, a scale-free gene co-expression network was constructed. Distinct gene modules with strong internal connectivity were identified and correlated with disease phenotype to highlight modules most relevant to DM1. Functional enrichment analysis of these modules revealed key biological processes and pathways associated with muscle dysfunction and disease progression. Overall, this network-based transcriptomic analysis provides a systems-level perspective on molecular alterations in DM1 and identifies potential hub genes and pathways that may serve as candidates for biomarker development or therapeutic intervention. These findings highlight the utility of co-expression network analyses in elucidating disease mechanisms and advancing genomic research on complex neuromuscular disorders.

***Keywords*:** *Myotonic dystrophy, WGCNA, Gene modules, Hub genes, Functional enrichment analysis*

PP-53

Environmental Surveillance of Antibiotic-Resistant Bacteria from Aquatic and Agricultural Sources

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Abstract: Antimicrobial resistance (AMR) represents a critical global health challenge driven by the extensive misuse and overuse of antibiotics across human, animal, and environmental sectors. Environmental reservoirs play a significant role in the emergence and dissemination of antibiotic-resistant bacteria. The present study aimed to isolate and identify environmental bacteria exhibiting antibiotic production and resistance. Water samples were collected from river and farm environments, primary isolation was carried out on nutrient agar, followed by antibiotic resistance screening using streptomycin, kanamycin, gentamicin, ampicillin, and chloramphenicol. Resistant colonies were cross-checked and further screened for multidrug resistance, leading to the selection of seven highly resistant isolates. Biochemical and molecular characterization suggested the presence of clinically and environmentally relevant genera, including *Bacillus, Ralstonia*, *Stutzerimonas* and *Mammalicoccus* strains. The findings demonstrate that river and farm environments harbours diverse antibiotic-resistant bacteria with biofilm-forming ability, underscoring their role as potential AMR reservoirs.

Keywords: *Antibiotic-Resistant Bacteria, AMR Environmental reservoirs, Multidrug-resistant bacteria, Resistance profiling, Molecular characterisation*

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Synthesis and characterisation of Choline Chloride–Based Natural Deep Eutectic Solvents as Novel Antimicrobial Agents

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Abstract: Deep Eutectic Solvents (DESs) are gaining attention as greener alternatives to organic solvents and in some cases ionic liquids due to their low volatility, high biodegradability, better compatibility and low toxicity. Easy sample preparation facilitates its application in multiple scientific disciplines. In our work we have developed a Natural Deep Eutectic Solvents (NDES) using Choline Chloride to assess its antibacterial, anti-fungal properties. NDES are ecofriendly, biocompatible liquids obtained from natural resources. Fourier Transform Infra-Red (FTIR) spectroscopy suggests strong hydrogen bond interactions among the components of NDES suggesting a stable DES formation. Proposed NDES showed antibacterial activity against both Grams positive and Grams negative bacterial representing human (E. coli, B. subtilis, S. aureus) and plant (Xanthomonas citri sp) pathogens, respectively. It may be inferred that the chosen NDES in this investigation may be useful and innovative antibacterial medications against prevalent antibiotic resistance bacteria (AMR).

Keywords: *Natural Deep Eutectic Solvents, Choline chloride, Grams positive and Grams negative bacteria*

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Tracking Drug Metabolism of Gram Positive and Gram-Negative Bacteria Using Carbon Quantum Dots

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Abstract: Carbon quantum dots (CQDs) are ultra-small (& lt; 10 nm) fluorescent nanomaterials that have gained attention due to their biocompatibility, strong photostability, and suitability for green synthesis methods. Although CQDs have been widely studied for imaging and sensing applications, their use in investigating real-time antibiotic metabolism in bacteria remains limited. Existing drug metabolism assays are often labor-intensive, require large sample volumes, and provide only indirect information about how bacteria interact with antimicrobial agents. In this work, we propose a microfluidic platform based on CQDs for rapid and direct visualization of antibiotic–bacteria interactions at the nanoscale. CQDs synthesized from natural precursors were functionalized with the antibiotic sulfamethoxazole (SMX) to form a fluorescent drug–nanoprobe conjugate. The CQD–SMX complex was introduced into a dual-well microfluidic chip containing Gram-positive and Gram-negative bacterial cultures. Changes in excitation-dependent emission behavior and fluorescence quenching were monitored to observe bacterial uptake, drug interaction, and possible metabolic transformation in real time. The key novelty of this study lies in combining CQD-based fluorescence tracking with a microfluidic bacterial system to study antibiotic metabolism without the need for external dyes, labels, or complex biochemical assays. This approach offers a rapid, miniaturized, and environmentally sustainable method for comparing antimicrobial processing in different bacterial classes and provides a useful model for studying nanocarrier-assisted drug delivery and microbial response mechanisms.

Keywords: *Carbon quantum dots, Microfluidics, Antibiotic metabolism, Sulfamethoxazole, Bacterial fluorescence tracking*

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A Digital Intervention Framework for Mental Health and Psychological Wellbeing

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Abstract: Mental health is a critical concern in higher education, often undermined by high academic pressure, social isolation, and the stigma associated with seeking help. Traditional support systems are typically inaccessible, lacking the 24/7 availability and confidentiality students require. To overcome these barriers, we propose SoulSync, a comprehensive Digital Mental Health and Psychological Support System specifically designed to empower college
students. Our system is engineered using a robust, cloud-based architecture that integrates AI-driven features for continuous care. Key components include a 24/7 AI Chatbot for immediate, anonymous interaction, advanced sentiment analysis for early stress and anxiety detection, and dedicated modules for mood tracking and self-healing promotion (such as journaling, music therapy, and wellness activities). When professional intervention is necessary, the platform facilitates seamless, secure virtual tele-consultations with licensed psychologists. By providing personalized coping strategies and resources on demand, SoulSync not only addresses the immediate need for support but actively champions the societal shift toward normalizing mental health discussions, significantly reducing stigma and building a more resilient student community.

***Keywords*:** *Mental Health, artificial intelligence, deep learning, Stigma Reduction, Sentiment analysis*

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Photocatalytic applications of Carbon-based Quantum Dots

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Abstract: Carbon-based quantum dots have garnered significant interest for their possible photocatalytic applications in environmental remediation and energy conversion. Due to their nanoscale dimension and high surface area-to-volume ratio, quantum dots show efficient electron transfer, charge separation and the presence of a variety of surface functional groups and surface defects. Coupled with advantageous optical properties like up-conversion photoluminescence, photostability and broad spectrum light absorption they enable rapid formation of reactive species in the presence of light. Carbon based quantum dots also show better solubility, non-toxicity and biocompatibility compared to traditional quantum dots synthesised based on semiconductors or metals. These properties facilitate the use of carbon dot photocatalysts for controlled degradation of a wide range of pollutants like dyes, heavy metals, antibiotics and drugs with minimal energy consumption and environmental impact. For this study, a simple black box was constructed with a chamber for the light source to study photocatalytic activity in the presence of a specific wavelength of light. Photocatalytic activity at different exposure times was estimated by taking UV-Vis spectrophotometric readings for the change in concentrations of the pollutant. Sulphamethoxazole is a commonly used antibiotic which is often found as a pollutant in water bodies, contributing to antimicrobial resistance. Photocatalytic degradation under visible light was studied foremost due to its easy availability. Our project aims to study the rate of degradation of pollutants by carbon dots of various optical and chemical properties, in the presence of different wavelengths of light across the UV-Vis spectrum, and determine optimal photocatalysis parameters for real world scaled-up applications in the future. Translation of photocatalytic environmental remediation to portable, point-of-care devices that can monitor degradation through optical methods can also be explored.

Keywords: *Carbon based quantum dots, Photocatalysis, Environmental remediation, Water pollutants, Antibiotics, Antimicrobial resistance*

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In-silico analysis of compounds Extracted from Nyctanthes arbor-tristis against Mosquito-Borne Diseases

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Abstract: Mosquito-borne diseases such as Dengue, Chikungunya, Malaria, and Zika virus infection are major health problems in many parts of the world. These diseases commonly cause fever, body pain, joint pain, and weakness, and in severe cases can lead to serious complications. At present, there are limited specific medicines available for these infections, and existing treatments often focus only on symptom relief. Therefore, there is a growing need to explore new and safer therapeutic options. In this study, we examined the potential of natural compounds obtained from Nyctanthes arbor-tristis using cheminformatics and computer-based methods. Phytochemicals from the plant were collected and screened to identify drug-like structures based on their chemical properties and predicted safety profiles (ADMET). The phytochemicals were tested against important protein targets related to mosquito-borne diseases using molecular docking with AutoDock Vina. The results showed that several compounds formed stable and strong interactions with the selected targets, suggesting their possible use as lead molecules for drug development. This study demonstrates how cheminformatics and in-silico techniques can be effectively used as low-cost and time-saving tools in the early stages of drug discovery and provides a basis for future laboratory validation.

Key words: *Mosquito-borne diseases, Nyctanthes arbor-tristis, Cheminformatics, In-silico drug discovery, Molecular docking*

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Effective Utilization of Sugar Factory Boiler Solid Waste & Distillery Liquid Waste for Sustainable Ethanol Production Process

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Abstract: Sugar factories and ethanol distilleries are major polluting industries and occupy the top rank amongst the most polluting industries in the world. Considerable work has been conducted so far, to mitigate the pollution issues of these industries. Boiler ash and the spent wash are the prominent wastes generated by sugar factories and ethanol distilleries. Ethanol distilleries require about 10 to 15 litres of fresh ground water per litre of ethanol produced, generating almost equal amount of wastewater. The presented work here, discusses the least attempted pathway that can help for sustaining these industries. The work also attempts to reuse the wastewater generated in distilleries. The reuse of this wastewater can reduce demand of fresh ground water, for ethanol distilleries. In addition to this, the wastewater generated in ethanol distillery is used to valorise boiler ash and to extract important salts of potassium. The extraction process generates pure water, which is recycled back to the ethanol production process, thereby reducing the demand for fresh water.

Keywords: *Ethanol distillery wastewater, Boiler ash valorisation, Potassium salt recovery, Water recycling*

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Harnessing Agriculture Waste for Oil Water Separation

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Abstract: The proper disposal of agricultural waste and treatment of oil-contaminated water are the two major environmental issues that are still receiving attention. In this study, a practical method is proposed that can treat both issues at the same time by converting agricultural residues into a useful sorption material. The post-harvest trash is converted into wood chips and chemically modified with a Polystyrene/Toluene (PS/TL) coating to obtain a hydrophobic–oleophilic surface, which is the essential feature for selective oil–water separation. The modified media is tested for sorption efficiency using oil water sorption efficiency tests, surface wettability using contact angle measurements, and durability by repeated filtration cycles. The modified filter showed oil–water sorption withdrawn maximum rate greater than 80 % and the treated surface showed a water contact angle of 134°, which confirmed successful hydrophobic behaviour and enabled oil to pass through freely. The filter maintained high performance over four consecutive filtration operations, suggesting that it could potentially be reused without loss of efficiency. This work suggests an initial proof of concept for upcycling agricultural waste into value-added, high-performance filtration materials. By minimizing fabrication costs and reducing waste disposal needs, this method provides an alternative to conventional oil–water sorption techniques. The study highlights a promising pathway toward waste management and improved pollution control. Ultimately, the approach supports environmental protection while promoting the conversion of low-value agricultural by products into useful, reusable materials for water treatment applications.

Keywords: *Oleophilic-hydrophobic, Sorption, Agriculture residue management, Sorption efficiency*

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Role of G-Protein Coupled Receptor Mediated Signal Transduction Pathways in Disease Conditions and Drug Targeting

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Abstract: Signal transduction pathways play a crucial role in maintaining normal cellular communication and regulating various physiological processes. Among these pathways, G-protein coupled receptors (GPCRs) represent one of the largest and most diverse families of membrane receptors. GPCRs are responsible for transmitting extracellular signals such as hormones, neurotransmitters, and growth factors into specific intracellular responses. These signaling mechanisms are essential for controlling processes including cell growth, metabolism, neurotransmission, immune response, and sensory perception. Any disruption or malfunction in GPCR-mediated signaling can result in abnormal cellular functions, leading to the development of several disease conditions. This review focuses on the fundamental mechanism of GPCR-mediated signal transduction and its involvement in disease progression. It explains the process of ligand binding to GPCRs, activation of heterotrimeric G-proteins, and initiation of downstream signaling cascades in a simplified and understandable manner. The role of GPCR signaling in disease conditions such as cardiovascular disorders, neurological diseases, and metabolic disorders is briefly discussed. In addition, the review highlights the importance of GPCRs as major drug targets and explains how specific therapeutic agents modulate GPCR activity to correct abnormal signaling pathways and restore normal cellular functions. From a biotechnology perspective, understanding GPCR-based signal transduction pathways is essential for drug discovery and development. This review emphasizes the significance of GPCRs in biomedical research and their critical role in disease management and therapeutic interventions.

Keywords: *G-Protein Coupled Receptors, Signal Transduction, Disease Mechanism, Drug Targeting, Cell Signaling*

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Hydrogel-Based Dual-Layer Bead System for Sustainable Bioremediation

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Abstract: Water pollution caused by industrial effluents and synthetic dyes continues to pose serious environmental and public health challenges. Conventional treatment methods often suffer from high operational costs and limited sustainability. In this study, a hydrogel-based dual-layer bead system was developed as an eco-friendly and biodegradable platform for water body remediation. The beads were fabricated using natural polymers, and ionically cross-linked using calcium chloride to achieve mechanical stability and controlled porosity.The inner layer of the bead matrix was designed to immobilize pollutant-degrading microorganisms, enabling enhanced biodegradation while minimizing microbial washout. The outer layer was engineered to support visual monitoring of pollutant diffusion and adsorption behaviour, allowing real-time qualitative assessment of treatment performance. The fabricated beads were evaluated for swelling behaviour, water absorption capacity, structural stability, dye adsorption efficiency, and microbial compatibility under laboratory conditions. Experimental observations demonstrated effective water uptake, uniform dye penetration, stable bead morphology, and sustained microbial viability after encapsulation. These results indicate that the dual-layer hydrogel system provides a favourable microenvironment for pollutant interaction and biological activity. Ongoing studies aim to investigate long-term operational stability, repeated usage performance, and scalability for continuous flow treatment systems. This work highlights the potential of hydrogel-based modular bioremediation platforms as sustainable and adaptable solutions for water body pollution control and environmental restoration.

Keywords: *Hydrogel Beads, Bioremediation, Water body Treatment, Microbial Immobilization, Dye adsorption, Sustainable Remediation, Natural Polymers*

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A Compact RF Hyperthermia Device for Dermatological Therapy

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Abstract: Radiofrequency (RF) hyperthermia is a non-invasive therapeutic approach that utilizes control electromagnetic energy to selectively increase tissue temperature for the treatment of the superficial dermatological conditions such as moles, cysts, and benign skin lesions. Abnormal or diseased skin tissue exhibit higher thermal sensitive due to alter vascular and cellular properties, making localized heating in the range of 40-45°C clinically effective. However, convention hyperthermia systems are often bulky, expensive and lack precise temperature regulation and real time safety control, limiting their routine use in dermatology. This work presents the design and development of a compact, portable RF hyperthermia device specifically optimized for dermatological therapy. The proposed system integrates an RF energy delivering module with real time infrared thermal sensor and closed loop temperature control mechanism to ensure accurate uniform and safe localized heating. A microcontroller-based embedded system dynamically adjust RF power based on continuous temperature feedback, while automated safety features, such as alert systems prevent overheating and unintended tissue damage. The device was developed following a structure medical device design methodology, including literature based clinical need assessment, practitioner feedback, risk evaluation using Failure Mode and Effects Analysis (FMEA). Mechanical design and system integration was supported by cad tools, while computation modelling and simulation aided in evaluating thermal behaviors and feasibility. The resulting prototype demonstrates in portability, enhanced treatment precision and greater operational safety compared to conventional systems. Overall, the proposed device offers a practical, safe, and efficient solution for routine dermatological hyperemia therapy.

Keywords: *Radiofrequency hyperthermia, Dermatological therapy, Infrared Thermal Monitoring, Closed loop temperature control, Medical-devices design*

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