



WORLD CONGRESS ON Health Sciences and Technology

Transforming Health Through Research and Innovation

7-9 October 2026 | UPES, Dehradun

Souvenir



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Message from Dr. Sharad Mehra

Chairman, Hydrocarbons Education & Research Society (HERS), UPES, Dehradun

It is a pleasure to extend my greetings to the distinguished delegates, eminent academicians, researchers, healthcare professionals, industry leaders, and students participating in the World Congress on Health Sciences and Technology at UPES, Dehradun.

The healthcare landscape is undergoing a remarkable transformation, driven by the convergence of scientific discovery, technological innovation, and interdisciplinary collaboration. Developments in biotechnology, advanced diagnostics, artificial intelligence, digital health, biomedical engineering, and emerging technologies are creating new possibilities for addressing complex health challenges.

However, meaningful progress requires more than technological advancement alone. It depends on an ecosystem in which universities, research institutions, industry, healthcare professionals, and policymakers can exchange ideas and work together towards solutions that are relevant to society. Universities have a particularly important role in creating such an environment by nurturing curiosity, encouraging innovation, and preparing young minds to address challenges that transcend traditional disciplinary boundaries.

The World Congress provides a valuable platform for this exchange. I am confident that the discussions and interactions taking place here will encourage new perspectives, strengthen collaborations, and inspire research with meaningful societal impact.

I commend UPES and the School of Health Sciences and Technology for organising this important gathering and for bringing together a diverse community of professionals and researchers. I extend my best wishes to all participants and hope the Congress marks the beginning of many productive collaborations.

I wish the World Congress on Health Sciences and Technology every success and a stimulating and rewarding experience to all its participants.



Message from Dr. Ram K. Sharma

President, UPES, Dehradun

A university thrives when it creates an environment where knowledge is continuously questioned, expanded, and applied to the needs of society. The World Congress on Health Sciences and Technology reflects this very spirit by bringing together diverse areas of knowledge around one of the most important priorities of our time, the advancement of human health.

The rapid evolution of health sciences and technology is creating opportunities that were once beyond imagination. Yet, the significance of these advances lies not simply in their novelty, but in their ability to improve our understanding of disease, strengthen healthcare systems, and ultimately contribute to better human well-being.

At UPES, we believe that education must extend beyond the classroom and research beyond disciplinary boundaries. Our responsibility is to provide an environment in which students and researchers can develop the knowledge, creativity, and critical thinking required to address emerging challenges with confidence and purpose.

The Congress brings together accomplished experts alongside young researchers who represent the future of scientific discovery. Such interaction is essential for building a culture of scholarship in which ideas are exchanged freely, established perspectives are examined, and new directions for research emerge.

I congratulate the School of Health Sciences and Technology and the organising committee for bringing together this distinguished scientific gathering. I also extend my appreciation to the speakers, delegates, researchers, students, and all contributors whose participation has made this Congress possible.

I warmly welcome all participants to UPES and wish the Congress a productive exchange of ideas and a lasting contribution to the advancement of health sciences and technology.



Message from Dr. Sunil Rai

Vice Chancellor, UPES, Dehradun

The boundaries between health sciences and technology are becoming increasingly fluid. Advances in artificial intelligence, biotechnology, data science, biomedical engineering, sensing technologies, and digital healthcare are changing the way we approach research, diagnosis, treatment, and healthcare delivery.

This transformation presents enormous opportunities, but it also demands a thoughtful and evidence-driven approach. Technology must be guided by sound science and directed towards clearly defined healthcare needs. Equally important is the ability to bring together expertise from different disciplines, because many of the most significant healthcare challenges cannot be addressed through a single field of knowledge.

The World Congress on Health Sciences and Technology provides an important forum for such interaction. It brings together researchers, academicians, healthcare professionals, technologists, and students to share their work, discuss emerging developments, and explore opportunities for collaboration.

For UPES, fostering such interdisciplinary engagement is an integral part of our academic and research vision. We seek to create an environment where innovative ideas can be developed through rigorous research and where promising scientific work can progress towards meaningful applications.

I am particularly pleased to welcome young researchers and students to this Congress. Scientific progress depends on their curiosity, creativity, and willingness to explore new possibilities. I hope the interactions during the Congress provide them with opportunities to learn from established experts, challenge existing ideas, and develop collaborations that continue beyond this event.

I congratulate the organisers for their efforts in bringing together this distinguished scientific community.

May this Congress foster meaningful discussions, strengthen research collaborations, and contribute to advancing healthcare through science and technology.



Message from Prof. (Dr.) Balram Bhargava

Former Director General, Indian Council of Medical Research (ICMR), New Delhi

The true measure of health research lies not only in the knowledge it generates, but in its ability to improve health and address the needs of society.

Scientific and technological advances are opening remarkable possibilities in healthcare. From molecular diagnostics and precision medicine to biomedical technologies, artificial intelligence, genomics, and digital health, researchers today have access to tools capable of transforming the way diseases are understood, detected, and managed.

The challenge, however, is to ensure that promising discoveries successfully make the journey from research laboratories to real-world applications. This requires robust scientific evidence, appropriate validation, interdisciplinary collaboration, and an understanding of the populations and healthcare systems in which innovations will ultimately be used.

This is particularly relevant to India, where the scale and diversity of healthcare needs demand solutions that are not only scientifically sound but also accessible, affordable, and capable of meaningful implementation.

The World Congress on Health Sciences and Technology provides an important platform to consider these questions. By bringing together researchers, healthcare professionals, academicians, technologists, and young scientists, the Congress encourages dialogue across different stages of the research and innovation continuum.

I am especially pleased to see young researchers participating in this forum. Their scientific curiosity and determination will shape the direction of health research in the years ahead. I encourage them to pursue research with rigour, remain open to collaboration, and always keep the larger purpose of improving human health in view.

I congratulate UPES and the School of Health Sciences and Technology for convening this Congress and creating a platform for meaningful scientific exchange.

I extend my best wishes to all participants and hope that the discussions initiated here lead to research, collaborations, and innovations that contribute to better health outcomes for our communities.



Message from Dr. Padma Venkat

Dean, School of Health Sciences and Technology, UPES, Dehradun

It is my privilege to welcome the scientific community to the World Congress on Health Sciences and Technology, hosted by the School of Health Sciences and Technology, UPES, Dehradun.

Modern healthcare is increasingly shaped by the interaction of multiple disciplines. Questions arising from clinical practice can lead to advances in molecular biology. Discoveries in biology can inspire new diagnostic technologies. Developments in engineering and materials science can enable innovative medical devices. Computational approaches can provide new ways of understanding complex environmental and biological systems and predict health outcomes.

This interconnectedness is at the heart of contemporary health sciences and is also central to the vision of our School, which is “Leadership in Health Sciences & Technology for Planetary and Public Health”.

Scientific growth is shaped not only by experiments and publications, but also by the conversations and collaborations that emerge around them.

The World Congress brings together researchers and professionals from diverse backgrounds, creating an environment for scientific exchange that extends beyond individual disciplines. It provides an opportunity to present emerging research, discuss new methodologies, examine current challenges, and establish collaborations that can lead to meaningful advances in the field.

For our students and early-career researchers, the Congress offers an especially valuable opportunity. Engaging directly with experienced researchers and industry experts can broaden perspectives, encourage critical thinking, and inspire new research questions.

I extend my sincere appreciation to our distinguished speakers, delegates, researchers, faculty members, students, organising committee, and volunteers for their valuable contributions to this Congress.

On behalf of the School of Health Sciences and Technology, I warmly welcome you to UPES and hope that the Congress provides an intellectually stimulating platform for learning, dialogue, collaboration, scientific discovery and innovation.



Dr. Nidhi Chauhan

Professor, UPES

Organising Secretary, World Congress on Health Sciences and Technology

It gives me immense pleasure and a profound sense of privilege to welcome you to the World Congress on Health Sciences and Technology, hosted by UPES, Dehradun.

As the Organising Secretary, it has been a rewarding experience to coordinate and facilitate this significant academic gathering. The Congress represents an important milestone for UPES, bringing together the health sciences and technology community on a common platform and creating an environment for scientific exchange, collaboration, and innovation.

The response to the Congress has been truly encouraging, with more than 300 participants and over 45 delegates representing institutions from across India and around the world. The diversity of institutions, disciplines, and perspectives represented here reflects the growing importance of interdisciplinary approaches to contemporary challenges in health and technology.

The success of a Congress of this scale is made possible through collective effort. I am particularly grateful to our Supporting Partners, the Council of Scientific & Industrial Research (CSIR) and the Anusandhan National Research Foundation (ANRF), for their valuable support. I also extend my appreciation to our Knowledge Partners, the Department of Higher Education, Government of Uttarakhand, and the National Health Mission, whose association has strengthened the reach and relevance of this initiative.

Our Sponsors and Exhibitors have added another important dimension to the Congress by creating opportunities to connect scientific research with emerging technologies and real-world applications. Their participation in the workshops and exhibition activities provides our researchers and students with valuable exposure to developments beyond the academic environment.

The Congress is further strengthened by its Journal Publication Partners, including the *Indian Journal of Medical Research* and *Proceedings of the National Academy of Sciences, India, Section B: Biological Sciences*. Their association provides an important avenue for disseminating scientific knowledge and extending the impact of research presented at this Congress.

Most importantly, this Congress is about people and collaboration, researchers exchanging ideas, experts sharing experience, students discovering new possibilities, and institutions finding opportunities to work together. I hope the interactions taking place during the Congress will lead to collaborations that continue long after the event concludes.

I extend my sincere gratitude to all our distinguished speakers, delegates, participants, partners, sponsors, exhibitors, reviewers, faculty members, students, volunteers, and members of the organising team for their invaluable contributions. Each contribution has played an important role in bringing this vision to life.

It is a privilege to welcome you all to UPES, Dehradun, and to share this important milestone with the wider scientific community.

I wish you all an enriching, engaging, and memorable World Congress, and hope that the connections made here will inspire new collaborations, new ideas, and meaningful advances in health sciences and technology.

CONGRESS PROGRAMME

World Congress on Health Sciences and Technology · WCHST-2026

7 – 9 October 2026 · UPES, Dehradun

PROGRAMME AT A GLANCE

DAY	TIME	SESSION / EVENT	VENUE
DAY 1 7 October 2026	8:30 – 9:30 AM	Registration	MAC Auditorium (Adjacent)
	9:30 – 11:30 AM	Inaugural Ceremony	MAC Auditorium
	11:45 AM – 1:15 PM	Panel Discussion on Nourish to Flourish (The Wellness Blueprint: Shaping a Healthier Future)	MAC Auditorium
	2:00 – 5:10 PM	Veda to Village: Science, Policy and Practice for Holistic Wellbeing	Trust Board Room (Hubble)
	2:00 – 5:35 PM	Harnessing Habits to Heal: Evidence-Based Approaches to Wellness	MAC Auditorium
	5:00 – 6:00 PM	Poster Presentations	MAC Auditorium
	6:00 – 7:00 PM	Cultural Evening	MAC Auditorium
DAY 2 8 October 2026	9:00 AM – 1:20 PM	Tiny Tools, Big Impact: Driving Sustainable Solutions through Biotechnology	MAC Auditorium
	9:00 AM – 12:35 PM	Nourish to Flourish: Leaving No One Behind	Trust Board Room (Hubble)
	2:00 – 5:00 PM	Synapse – Students Forum for the Students, by the Students	BUZZ – 01
	2:00 – 5:30 PM	Reimagining Pharma: Next-Gen Solutions for Global Health	MAC Auditorium
	5:00 – 6:00 PM	Poster Presentations	MAC Auditorium
DAY 3 9 October 2026	9:00 AM – 12:30 PM	Advances in Biomedical Devices: Where Engineering Meets Healing	MAC Auditorium
	9:00 AM – 12:50 PM	Artificial Intelligence: The New Era of Healthcare	Trust Board Room (Hubble)
	12:30 – 1:30 PM	Poster Session	MAC Auditorium
	2:30 – 3:30 PM	Valedictory	MAC Auditorium

Sessions listed on the same day with overlapping times run in parallel in different venues. Detailed session programmes follow.

DAY 1

Wednesday, 7 October 2026

Registration & Inaugural Ceremony

Venue: MAC Auditorium

TIME	PROGRAMME	VENUE
8:30 – 9:30 AM	Registration	Venue: MAC Auditorium (Adjacent)
Inaugural Ceremony · 9:30 – 11:30 AM · MAC Auditorium		
9:30 – 9:35 AM	Arrival of Guests, Session opening and Shankhnaad	
9:35 – 9:40 AM	Welcome of dignitaries to the dais	
9:40 – 9:50 AM	Welcome address by: <i>Dr. Sunil Rai</i> , Honorable Vice Chancellor, UPES	
9:50 – 9:55 AM	Context setting by: <i>Dr. Padma Venkat</i> , Dean, School of Health Sciences and Technology, UPES	
9:55 – 10:20 AM	Special address by: <i>Dr. B.V.R.C. Purushottam</i> , IAS, Honorable Secretary, Higher Education, Govt. of Uttarakhand; Chief Electoral Officer, Govt. of Uttarakhand Address by the Guest of Honor: <i>Dr. Durgesh Pant</i> , Honorable Director General (DG), Uttarakhand Council of Science and Technology, Govt. of Uttarakhand	
10:20 – 10:40 AM	Presidential address by: <i>Dr. Soumya Swaminathan</i> , Former DG, ICMR; Former Principal Scientist, World Health Organisation (WHO)	
10:40 – 11:10 AM	Inaugural address by the Chief Guest: <i>Dr. Balram Bhargava</i> , Padma Shri; Former DG, ICMR	
11:10 – 11:15 AM	Release of the Congress e-Proceedings	
11:15 – 11:20 AM	Felicitation of dignitaries and guests	
11:20 – 11:25 AM	Vote of thanks	
11:25 – 11:30 AM	Closing announcements and group photograph	
11:30 – 11:45 AM	Tea	Venue: AB01 Quadrangle
11:45 AM – 1:15 PM	PANEL DISCUSSION - VENUE: MAC AUDITORIUM Panel Discussion on Nourish to Flourish (The Wellness Blueprint: Shaping a Healthier Future) Moderator : Dr. Nidhi Kumar - Celebrity Lead Anchor DD, AI Head Panelists 1. Dr. Jayanti Singh – Epidemiologist & Public Health Expert 2. Shri. G.C. Kandwal – Deputy Commissioner – FDA, Uttarakhand 3. Mr. Sukhwinder Singh - HOD FSSAI, UT Administration, Chandigarh 4. Ms. Rajat Shakti – Station Head Red FM 93.5 5. Ms. Roopa Soni – Nutritionist 6. Ms. Ashu Jain – PhD, IIT-D, Hybrid Athlete, Health Influencer	
1:15 – 2:00 PM	Lunch	Venue: AB01 Quadrangle

► Afternoon sessions run in parallel

Veda to Village: Science, Policy and Practice for Holistic Wellbeing

Date: 7 October 2026 | Venue: Trust Board Room (Hubble)

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
2:00 – 2:05 PM	WELCOME Welcome & Overview of the Theme	
2:05 – 2:35 PM	KEYNOTE ADDRESS Prof. Dr. G. G. Gangadharan Ayurvedacharya, Chief Physician, Ayurvedamritham Health Centre, Bengaluru	Month wise care of expectant Mother- The Ayurveda Way

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
2:35 – 2:55 PM	INVITED LECTURE Prof. N. Punniamurthy Ethnoveterinary Herbal Medicine Consultant to NDDB, TANUVAS, Tanjore	<i>Translational Research on Ethno-Veterinary Medicine for One Health: Molecular Pharmacology to Ecosystem Resilience</i>
2:55 – 3:15 PM	INVITED LECTURE Dr. Bhavna Prasher Senior Principal Scientist, CSIR-IGIB, Ministry of Science and Technology, Delhi	<i>Ayurgenomics: Integrating Traditional knowledge and Modern Genomics for precision healthcare</i>
3:15 – 4:00 PM	PANEL DISCUSSION - RELEVANCE OF AYURVEDA IN TODAY'S LIFE Moderator: Vd. Shikha Prakash, Padaav – Specialty Ayurvedic Treatment Center, Dehradun Panelists: 1. Prof. Dr. G. G. Gangadharan, Ayurvedacharya, Chief Physician, Ayurvedamritham Health Centre, Bengaluru 2. Dr. Rajeev Kurele, Uttarakhand Ayurved University 3. Dr. Bhavna Prasher, CSIR-IGIB, Ministry of Science and Technology 4. Ms. Surabhi Pandey, The Hans Foundation	
4:00 – 4:15 PM	Tea Break	Venue: Trust Board Room PFA (Hubble)
Oral Presentations · 4:15 – 5:05 PM · Venue: Trust Board Room (Hubble)		
	ORAL PRESENTATION Dr. Deepti Nagrath Himalayan Institute of Medical Science, SRHU	<i>Evaluating a Patient-Centric, Multicomponent Oral Care Framework for Improvement of Oral Health among Adults in Rural India</i>
	ORAL PRESENTATION Dr. Siyaram Pandey University of Windsor	<i>Botanical extracts with anti-cancer activity: Scientific validation, mechanism of action and their interaction with standard chemotherapy: Potential use as adjuvant to standard treatment for cancer therapy and prevention of relapse.</i>
	ORAL PRESENTATION Mr. Sathish Kumar Yenepoya (Deemed to be University)	<i>Transdermal Patch Using Biocompatible Carboxymethyl Hexanoyl Chitosan for Therapeutic delivery of Vitamin D</i>
	ORAL PRESENTATION Dr. Biswarup Basu Chittaranjan National Cancer Institute	<i>Leveraging Indian Knowledge System To Mitigate Chemotherapy and Diabetes Induced Neurotoxicity: A preclinical Study with Medicinal Phytochemicals</i>
	ORAL PRESENTATION Prof. Rashmi Malhotra AIIMS Rishikesh	<i>Altitudinal Morphological Variability in Uttarakhand: Driving Population-Specific Clinical Baselines and Healthcare Innovation</i>
5:05 – 5:10 PM	CLOSING Vote of Thanks & Closing Remarks Ms. Richa Bahuguna	
5:00 – 6:00 PM	Poster Presentations	Venue: MAC Auditorium

Harnessing Habits to Heal: Evidence-Based Approaches to Wellness

Date: 7 October 2026 | Venue: MAC Auditorium

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
2:00 – 2:20 PM	INVITED TALK (NEXTGEN WELLNESS TALKS) Dr. Alex Thomas Medical Doctor, Founder & Patron - Association of Healthcare Providers India	<i>Healing People, Healing Planet: Lifestyle Medicine for a Healthier and Climate-Resilient Future</i>
2:20 – 2:40 PM	INVITED TALK (NEXTGEN WELLNESS TALKS) Dr. Monika Pathania Additional Professor, Department of Medicine & Head, AYUSH AIIMS Rishikesh	<i>Evidence to Action: The AIIMS Rishikesh Model of Integrative Lifestyle Medicine for Scalable Chronic Disease Prevention</i>
2:40 – 3:00 PM	INVITED TALK (NEXTGEN WELLNESS TALKS) Dr. Arun Garg Founding Chair & President, Canada India Network Society (CINS), Canada	<i>You your health and the GAP- Culture</i>
3:00 – 3:15 PM	Afternoon Tea	Venue: MAC Foyer

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
3:15 – 4:00 PM	PANEL DISCUSSION EXPERTS Dr. Alex Thomas — Lifestyle medicine physician Prof. Padma Venkat — Public health expert Dr. Pranjali — Psychology Expert Dr. Monika Pathania — Lifestyle Medicine, Integrative Medicine & Holistic Wellness Expert Dr. Rai Ganguly (SoLSH) — Moderator	<i>From Hospitals to Healthy Communities: Who is Responsible for Prevention?</i>
4:00 – 4:15 PM	AUDIENCE ENGAGEMENT Activity: Audience Polls	
Oral Presentations · 4:15 – 5:30 PM Venue: Block 1 AB01 Board Room		
	ORAL PRESENTATION Dr. Anubhuti Joshi AIIMS Rishikesh	<i>Stakeholders' Perspectives on Climate-Resilient School Interventions and Child Health: A Qualitative Study from Rural Uttarakhand, India</i>
	ORAL PRESENTATION Dr. Joen Rajan Mathew All India Institute of Medical Sciences Rishikesh	<i>Prevalence and lifestyle determinants of anemia among Type-2 Diabetes Mellitus patients in a rural community of Uttarakhand, North India</i>
	ORAL PRESENTATION Dr. Anu Mahajan Symbiosis International University	<i>From Prolonged Sitting to Active Workplaces: A Systematic Review of Adiposity, Insulin Resistance, and Workplace Intervention Evidence</i>
	ORAL PRESENTATION Ms. Bhagyashree Naidu National Institute of Technology Raipur	<i>Maladaptive Daydreaming as a Habitual Coping Behavior: A Pilot Exploration of Sleep, Stress and Addiction.</i>
	ORAL PRESENTATION Ms. Tanvi Bangale National Institute of Technology	<i>Lifestyle Factors Associated with Neurocognitive Function, Mental Health, and Quality of Life in Healthy Adults</i>
	ORAL PRESENTATION Dr. Prince Tiwari IIT Roorkee	<i>From Sarcomere Regulation to Disease: Understanding the Role of Myosin IHM and MYBPC3 in cardiomyopathies</i>
	ORAL PRESENTATION Dr. Neetu Kochhar Govt Doon Medical College Dehradun	<i>Benefits of Platelet rich plasma in stress inconvenience</i>
	ORAL PRESENTATION Dr. Anusandana Mahapatra IMS & SUM Hospital	<i>Knowledge, Attitudes, and Digital Media Influence on Menstrual Health Among Adolescent Girls in Odisha: A Cross-Sectional Analysis</i>
5:30 – 5:35 PM	CLOSING Vote of Thanks & Closing Remarks	
5:00 – 6:00 PM	Poster Presentations	Venue: MAC Auditorium

Evening Programme

TIME	PROGRAMME	VENUE
6:00 – 7:00 PM	Cultural Evening	Venue: MAC Auditorium

DAY 2

Thursday, 8 October 2026

► Morning sessions run in parallel

Tiny Tools, Big Impact: Driving Sustainable Solutions through Biotechnology

Date: 8 October 2026 | Venue: MAC Auditorium

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
9:00 – 9:05 AM	WELCOME Welcome, session overview and introduction of speakers	
9:05 – 9:35 AM	KEYNOTE ADDRESS Prof. Bhushan Patwardhan National Research Professor – Ayush, Chairman, Executive Committee - National Assessment and Accreditation Council (NAAC), and Distinguished Professor - School of Health Sciences, Savitribai Phule Pune University	<i>Indian Knowledge Systems as a Source of Biomedical Innovation</i>
9:35 – 9:55 AM	INVITED TALK Dr. Chaitanya Lekshmi Indira Plaksha University, Mohali	<i>Helping Environmental Monitoring and Food Safety using Optical Reagent-less Cr(VI) Sensing</i>
9:55 – 10:15 AM	INVITED TALK Dr. Prashant Singh University of Delhi, New Delhi	<i>Sensitive and Selective Electrochemical Detection of Bosutinib Utilizing Ionic Liquid Stabilized Ti_3C_2Tx</i>
10:15 – 10:35 AM	INVITED TALK Prof. Dinesh Yadav Deen Dayal Upadhyaya Gorakhpur University	<i>Elucidating diverse role of Nuclear Factor-Y (NF-Y) transcription factor in Finger millet: Genomics and Bioinformatics intervention</i>
10:35 – 10:55 AM	INVITED TALK • ONLINE Dr. Aniruddha Chatterjee University of Otago, New Zealand, (5:55–6:15 PM NZST)	<i>Insights from cancer DNA methylome</i>
10:55 – 11:15 AM	Tea	Venue: MAC Foyer
11:15 – 11:25 AM	ORAL PRESENTATION Dr. Rohit Saluja AIIMS Bibinagar Hyderabad	<i>Driven Mast Cell Proliferation in Asthma: From Molecular Mechanisms to Therapeutic Targets</i>
11:25 – 11:35 AM	ORAL PRESENTATION Dr. Ashutosh Sharma BHR FOUNDATION	<i>Altitudinal Variation in Chemical Composition and Antibacterial Activity of Rhododendron arboreum Flower Extracts from Garhwal Himalaya, India</i>
11:35 – 11:45 AM	ORAL PRESENTATION Dr. Ramandeep Kaur Chandigarh Group of colleges, Landran, Mohali	<i>Fungal bioconsortium: A sustainable tiny solution to alleviate the impact of drought stress in wheat crop</i>
11:45 – 11:55 AM	ORAL PRESENTATION Dr. Surbhi CCT-CGC Landran, Mohali	<i>Statistical Optimization of Bioactive Peptide Production from Food-Isolated Bacteria for Sustainable Applications</i>
11:55 AM – 12:05 PM	ORAL PRESENTATION Dr. Vijay Kumar Swami Rama Himalayan University	<i>Unlocking leaf-Cutter Ant-Associated Actinobacteria: A New Frontier for Anti-Tuberculosis Drug Discovery</i>
12:05 – 12:15 PM	ORAL PRESENTATION Mrs. Yashika Saini School of Life and Basic Sciences, Jaipur National University, Jaipur	<i>Discovering Nyctanthes arbor-tristis and Polyalthia longifolia's Anti-PCOS Potential: From Bioactive Compounds to Molecular Targets</i>
12:15 – 12:25 PM	ORAL PRESENTATION Ms. Nishtha Sah UPES	<i>Isolation and Assessment of fungi derived from wastewater for sustainable energy generation</i>
12:25 – 12:35 PM	ORAL PRESENTATION Mr. Pankaj Bhandari UPES	<i>Covalently Crosslinked Sodium Alginate with Linear aliphatic bifunctional alcohol: A Sustainable Route to Food Packaging</i>
12:35 – 12:55 PM	INVITED TALK • ONLINE Dr. Sahika Inal King Abdullah University of Science and Technology (KAUST)	<i>Tiny Bioelectronic Tools, Big Impact: Organic Electronics for Sustainable Biosensing and Healthcare</i>
12:55 – 1:05 PM	INDUSTRY TALK Dr. Nameet Kaur CEO, Operon Technologies	<i>Invention and Innovation: Indispensable Tools to Transform Research in the 21st Century</i>

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
1:05 – 1:20 PM	INVITED TALK Dr. Rikesh Kumar Dubey SRM Medical College Hospital and Research Centre, SRMIST, Kattankulathur, Tamil Nadu 603202, India	<i>Targeting Thrombo-Inflammation in Sickle Cell Disease: From Mechanisms to Emerging Therapies</i>
1:20 – 2:00 PM	Lunch	Venue: AB01 Quadrangle

Nourish to Flourish: Leaving No One Behind

Date: 8 October 2026 | Venue: Trust Board Room (Hubble)

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
9:00 – 9:10 AM	Welcome & Overview of the Theme - Dr. Shweta Suri	
9:10 – 9:40 AM	KEYNOTE TALK Prof. P. Girdhar Director, CFTRI, Mysuru, Karnataka	<i>Food processing and food fortification-the two critical, interconnected spokes in the wheel of global nutritional security</i>
9:40 – 10:00 AM	INVITED TALK Prof. Anuradha Dutta Prof., GBPUAT, Pantnagar, Uttarakhand	<i>Functional foods & nutraceuticals- their growing indispensability</i>
10:00 – 10:20 AM	INVITED TALK Prof. Kirtiraj Gaikwad Head, Dept. of Paper & Packaging Technology, IIT Roorkee	<i>Bio-Inspired materials for next-generation sustainable food packaging</i>
10:20 – 10:40 AM	INVITED TALK • ONLINE Dr. Ashok Pathera Scientist, CSIR-IHBT, Palampur, Himachal Pradesh	<i>3D Food Printing of Structured High-Protein Food Matrices</i>
10:40 – 11:00 AM	INVITED TALK Dr. Santosh Kumar Prof., AIIMS, Rishikesh	<i>Nutrition wellbeing & holistic health: from plate to purpose</i>
11:00 – 11:30 AM	Morning Tea / Networking	Venue: Trust Board Room PFA (Hubble)
Oral Presentations • 11:30 – 12:30 PM (Session Chairs: Prof. P. Girdhar & Dr. Santosh Kumar)		
	ORAL PRESENTATION Sharad Swarup Emery India, Gujarat (Registered Industry Delegate)	<i>Atkins Diet - Practical Hacks</i>
	ORAL PRESENTATION Bindu Naik Associate Professor, Graphic Era Deemed to be University	<i>Microwave-Assisted Green Extraction of Shorea robusta Seed Oil for Sustainable Cocoa Butter Substitution in Dark Chocolate</i>
	ORAL PRESENTATION Nidhi Nagar Assistant Professor, D.A.-V. PG College, CSJM University, Kanpur	<i>Determinants influencing Mental Well-Being: A Socio-Cultural, Socio-Economic and Technological Perspective</i>
	ORAL PRESENTATION Dr. Amarpal Singh National Forensic Science Laboratory, Delhi	<i>Beyond Nutrition: Chemical Profiling and Safety Assessment of Commercial Buckwheat Flour for Pesticide and Heavy Metal Contamination</i>
12:30 – 12:35 PM	Concluding remarks and session closure- Ms. Trishali Chauhan	
12:35 – 2:00 PM	Lunch	Venue: AB01 Quadrangle

► Afternoon sessions run in parallel

Synapse – Students Forum for the Students, by the Students

Date: 8 October 2026 | Time: 2:00 – 5:00 PM

TIME	PROGRAMME	VENUE
2:00 – 5:00 PM	STUDENTS FORUM Synapse – Students Forum For the students, by the students	Venue: BUZZ – 01
5:00 – 6:00 PM	Poster Presentations	Venue: MAC Auditorium

Reimagining Pharma: Next-Gen Solutions for Global Health

Date: 8 October 2026 | Venue: MAC Auditorium

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
2:00 – 2:05 PM	WELCOME ADDRESS Dean/CH-Pharma	<i>Introduction to the theme and objectives</i>
2:05 – 2:35 PM	KEYNOTE LECTURE Prof. Suresh Mittal Purdue University, USA	<i>Vaccines in the Modern Era: Triumphs, Turbulence, and Myths</i>
2:35 – 2:55 PM	INVITED LECTURE Prof. Bimalendu Roy Director, Process Chemistry and Drug Discovery, Jubilant Biosys, Delhi	<i>Route Scouting for API Commercialization: Where Medicinal Chemistry Meets Industrial Reality</i>
2:55 – 3:10 PM	Tea/Coffee Break • Networking	Venue: MAC Foyer
3:10 – 3:30 PM	INVITED LECTURE • ONLINE Prof. Amit K Mandal Professor, Department of Biological Sciences, IISER Kolkata	<i>Mapping cancer beyond microscopy: Building molecular portrait of prostate cancer and cervical cancer tissues using MALDI imaging mass spectrometry</i>
3:30 – 3:50 PM	INVITED LECTURE Prof. Swati Biswas Professor, Department of Pharmaceutical Sciences, BITS-Pilani, Hyderabad	<i>Multifunctional Nanotherapeutic Platforms for Drug Delivery and Targeting</i>
3:50 – 4:35 PM	PANEL DISCUSSION Panelists: Prof. Suresh Mittal, Prof. Bimalendu Roy, Dr. Prithipal Singh / Dr. Mukesh Session chair: Prof. A K Nangia	<i>Breaking Bottlenecks: Challenges and Opportunities from Drug Discovery to Commercialization</i>
4:35 – 4:45 PM	ORAL PRESENTATION Mr. Saptak Chatterjee DIT University, Dehradun	<i>Novel Nanoethosomal Delivery of Dabigatran Etxilate Mesylate for enhanced Antithrombotic activity</i>
4:45 – 4:55 PM	ORAL PRESENTATION Ms. Tashi Palmo CSIR-IIIM Jammu	<i>Reimagining the fight against AMR with beddomeilactone derived molecule targeting drug-resistant Staphylococcus aureus</i>
4:55 – 5:05 PM	ORAL PRESENTATION Ms. Uma Chaudhry Bhaskaracharya College of Applied Sciences, University of Delhi	<i>Repurposing Nitrofurazone Against Drug-Resistant Neisseria gonorrhoeae: Targeting Glutamate Racemase at Two Functional Sites</i>
5:05 – 5:15 PM	ORAL PRESENTATION Mr. Chayanta Sen Sister Nivedita University, Kolkata	<i>Closing the Active-Learning Loop: Physics driven Generative RL for De Novo KRAS G12C Inhibitor Discovery</i>
5:15 – 5:25 PM	ORAL PRESENTATION Dr. Raghu Solanki IIT- Gandhinagar	<i>Engineering DNA tetrahedron nanocarriers for targeted glioblastoma treatment</i>
5:25 – 5:30 PM	CLOSING REMARKS Dr. Anand / Dr. Utsab Debnath	<i>Key takeaways and acknowledgements</i>
5:00 – 6:00 PM	Poster Presentations	Venue: MAC Auditorium

DAY 3 Friday, 9 October 2026

► Morning sessions run in parallel

Advances in Biomedical Devices: Where Engineering Meets Healing

Date: 9 October 2026 | Venue: MAC Auditorium

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
9:00 – 9:30 AM	KEYNOTE TALK Prof. N.K. Ganguly Former DG, ICMR, India	<i>Microbiome science, Health, and Emerging AI-Driven Approaches</i>
Invited Talks • Session Chair: Prof. N.K. Ganguly		
9:30 – 9:50 AM	INVITED TALK Dr. Monalisa Mukherjee Amity University Uttar Pradesh, India	<i>Biogenic Carbon Quantum Dots as Neoteric Inducers for Directing Chondrogenic Differentiation</i>

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
9:50 – 10:10 AM	INVITED TALK Dr. Rajesh CSIR-NPL, New Delhi, India	P-type Carbon Quantum Dots decorated rGO hybrid Field-Effect Transistor for Tumor Biomarker Detection
10:10 – 10:30 AM	INVITED TALK Dr. Vinita Hooda MD University, Rohtak, India	Smart Nano-Solutions for Sustainable Crop Production
10:30 – 10:45 AM	Morning Tea / Networking	Venue: MAC Foyer
Invited Talks • Session Chair: Prof. N.K. Ganguly		
10:45 – 11:05 AM	INVITED TALK Prof. K. Sudhakara Prasad Yenepoya University, India	Innovative Devices and Materials for Biomedical Applications – From Bench to Bedside
Oral Presentations • Session Chair: Dr. Monalisa Mukherjee, Dr. Rajesh		
TIME	PARALLEL PRESENTATION – A	PARALLEL PRESENTATION – B
11:05 – 11:15 AM	ORAL PRESENTATION Dr. Amit Kumar Yadav IIT Gandhinagar <i>Aptasensor with Spatially Expanded Bioreceptor Architecture Using DNA Nanotetrahedra for Nanoscale-Controlled Electrochemical Detection of Interleukin-6</i>	ORAL PRESENTATION Mr. Arvind Kumar Prajapati Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum <i>Assessment of Hydroxyapatite Coating Mechanical Integrity in a Novel Pedicle Screw Design</i>
11:15 – 11:25 AM	ORAL PRESENTATION Dr. Ayshathil Bushra Yenepoya deemed to be university <i>Development of a Portable Wearable Sweat Glucose Monitoring Device Based on a Non-Enzymatic Paper Field-Effect Transistor Sensor</i>	ORAL PRESENTATION Dr. Juhi Singh Department of Bioengineering, Indian Institute of Science <i>Self-crosslinking chondroitin sulfate-poly(L-lysine) hydrogels as glutaraldehyde-free injectable cartilage mimics</i>
11:25 – 11:35 AM	ORAL PRESENTATION Dr. Keshaw Ram Aadil Govt. Digvijay Autonomous PG College, Rajnandgaon, Chhattisgarh <i>Keratin based conductive nanofiber scaffold for advanced tissue engineering application</i>	ORAL PRESENTATION Dr. Manali Datta Amity University Rajasthan <i>Biosensor Design for Prognosis and Diagnosis of Chronic Kidney Disease</i>
11:35 – 11:45 AM	ORAL PRESENTATION Ms. Naina Jain Thapar Institute of Engineering and Technology <i>Development of Gelatin-CMC Biopolymeric Scaffolds for Transdermal Delivery of Mupirocin: A Replacement for the Traditional Ointment Approach</i>	ORAL PRESENTATION Ms. Neha Pari SASTRA Deemed University <i>Next Generation Molecularly Imprinted Polypyrrole Sensor for Point of care Electrochemical sensing of Estradiol</i>
11:45 – 11:55 AM	ORAL PRESENTATION Dr. Vishal Mago AIIMS <i>A comparative study of management of wound with hyperbaric oxygen therapy along with ionic silver dressings in Burn and Plastic surgery Department in AIIMS Rishikesh</i>	ORAL PRESENTATION Prof. Sachin Kumar B IIT Delhi <i>Regenerating Cartilage using Bioenergetics Hydrogel</i>
11:55 – 12:05 PM	ORAL PRESENTATION Dr. Arun Kant Singh Academy of Scientific and Innovative Research (AcSIR) <i>Liquid crystal based optical aptasensor for the detection of tumor biomarker</i>	ORAL PRESENTATION Ms. Bani Preet Kaur AMITY UNIVERSITY NOIDA <i>Carbon Quantum Dot-Hydrogel Nanocomposite For Chondrogenic Differentiation Induction in Mesenchymal Stem Cells</i>
12:05 – 12:30 PM	INVITED TALK • ONLINE Prof. Can Dincer Technical University of Munich, Germany	Signal-Amplifying Biohybrid Material Circuits for CRISPR/Cas-Based Single-Stranded RNA Detection
12:30 – 1:30 PM	Poster Session	Venue: MAC Auditorium
1:30 – 2:30 PM	Lunch	Venue: AB01 Quadrangle

Artificial Intelligence: The New Era of Healthcare

Date: 9 October 2026 | Venue: Trust Board Room (Hubble)

TIME	PROGRAMME / SPEAKER	TITLE OF TALK
9:00 – 9:30 AM	KEYNOTE Dr. P.G. Diwakar Former Distinguished Scientist, ISRO Director, Centre for Sustainability, Chanakya University	<i>Space technology based Applications for Health-GIS</i>
9:30 – 9:50 AM	INVITED TALK Prof. Prashanth N. Suravajhala Systems Genomics Lab, Department of Biosciences, Manipal University Jaipur, India	<i>Ethics in the age of Genomics and AI: Case studies</i>
9:50 – 10:10 AM	INVITED TALK • ONLINE Mr. Mohit Mittal AI First Chief Architect, Forbes Tech Council, USA	<i>Architecting the AI-First Healthcare Revolution: From Generative AI to Agentic Intelligence</i>
10:10 – 10:30 AM	INVITED TALK Dr. Akash Pati AIIMS Bhubaneswar, India	<i>What Surgeons Need from Artificial Intelligence</i>
10:30 – 11:00 AM	Morning Tea / Networking	Venue: Trust Board Room PFA (Hubble)
11:00 – 11:45 AM	PANEL DISCUSSION Panelists: Dr. P.G. Diwakar (Chairperson) · Ajay Tukroo · Dr. Pradeep Kumar Singh · Prof. Prashanth N. Suravajhala	<i>The Future of Human Health between Progress and Ethics</i>
11:45 – 11:55 AM	ORAL PRESENTATION Mr. Devendra Bhavsar JK Lakshmi Pat University	<i>Smart Health: An AI-Powered Multi-Disease Prediction and Assistance System</i>
11:55 – 12:05 PM	ORAL PRESENTATION Dr. Jairam Meena Indian Institute of Technology (Banaras Hindu University), Varanasi	<i>Artificial Intelligence inspired serotype independent multi-epitope vaccine for Streptococcus pneumoniae</i>
12:05 – 12:15 PM	ORAL PRESENTATION Dr. Joen Rajan Mathew All India Institute of Medical Sciences Rishikesh	<i>Idea to Reality: An AI-Assisted Framework Enabling Clinicians to Independently Build Longitudinal Public Health Monitoring Systems</i>
12:15 – 12:25 PM	ORAL PRESENTATION Dr. Sumit Sharma Sai Institute of Medical Sciences	<i>Machine Learning Algorithms for Predicting Micronutrient Deficiency Risk: A Systematic Review and Nutrient-Specific Meta-analysis</i>
12:25 – 12:35 PM	ORAL PRESENTATION Mr. Vijay Kumar National Institute of Technology Raipur	<i>Impact of Educational Attainment on Cognitive Performance in Leprosy</i>
12:35 – 12:45 PM	ORAL PRESENTATION Ms. Chahat Hemvati Nandan Bahuguna Garhwal (A Central) University Srinagar, Uttarakhand	<i>Deploying the Drug Repurposing strategy for the Identification of Selective COX-2 Inhibitors for use as Anti-inflammatory and Anti-cancer Agents</i>
12:45 – 12:50 PM	WRAP-UP Session Chair Wrap-up & Transition to Lunch	
12:30 – 1:30 PM	Poster Session	Venue: MAC Auditorium
1:00 – 2:30 PM	Lunch	Venue: AB01 Quadrangle

Closing

TIME	PROGRAMME	VENUE
2:30 – 3:30 PM	Valedictory	Venue: MAC Auditorium

Session 1

Veda to Village: Science, Policy and Practice for Holistic Wellbeing

Evaluating a Patient-Centric, Multicomponent Oral Care Framework for Improvement of Oral Health among Adults in Rural India

Deepti Nagrath¹, Jayanti Semwal², Rajeev Mohan Kaushik^{3*}

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Abstract

Background: Traditional single-disease frameworks frequently isolate oral care from systemic health management. To address widespread oral-systemic multimorbidity in rural Dehradun, an integrative, multicomponent oral care framework was introduced to bridge biomedical, behavioural, and social health strategies.

Methods: Phase II of this study utilized a quasi-experimental design among adults aged 30–50 years. Participants were divided into a control group receiving standard dental advice (night brushing) and an intervention group receiving a dynamically adaptive, patient-centric package. This multicomponent package featured a daily holistic regimen of a locally sourced, standardized nutraceutical supplement (10 mg turmeric/curcumin in 100 ml water), a culturally tailored educational calendar module for behaviour change communication, and structured family-supported compliance monitoring. Clinical indices (gingivitis and halitosis) and metabolic parameters (blood pressure and blood glucose) were evaluated at baseline, 3 months, and 6 months.

Results: The patient-centric oral care model produced statistically significant short-term improvements in oral health indicators within the intervention arm compared to the control group over the 6-month follow-up period ($p < 0.05$). The intervention group demonstrated significantly enhanced periodontal and symptomatic outcomes, notably marked reductions in gingivitis and halitosis status ($p < 0.05$).

Conclusions: The study demonstrates that a standardized turmeric-curcumin nutraceutical solution serves as a highly feasible, culturally resonant, and therapeutically effective cornerstone for improving short-term oral health outcomes in low-resource settings. Integrating familiar, local remedies like turmeric into structured behavioural frameworks offers a powerful, scalable strategy for driving community compliance and embedding basic dental preventive care into primary healthcare systems.

Keywords: Ayurveda, Oral-systemic health, Patient-centric oral care, Gingivitis, Halitosis, Quasi-experimental study, Low-resource settings

Botanical Extracts with Anticancer Activity: Scientific Validation, Mechanism of Action and Their Interaction with Standard Chemotherapy: Potential Use as Adjuvant to Standard Treatment for Cancer Therapy and Prevention of Relapse.

Siyaram Pandey* and Rian Grassi

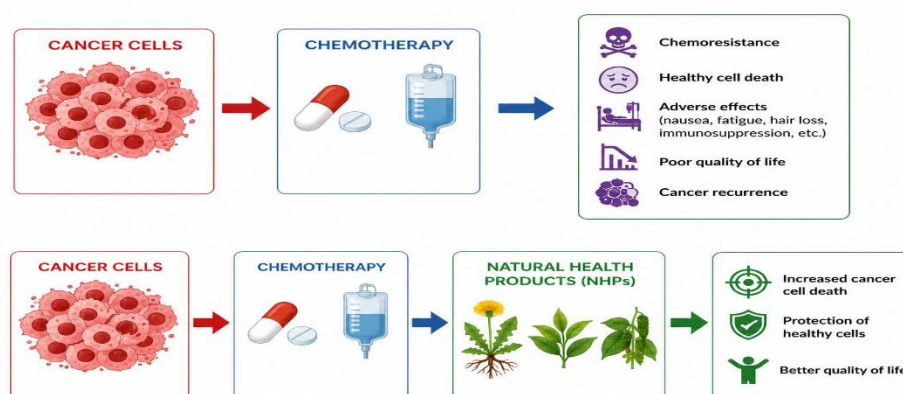
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Abstract

Metastatic and aggressive cancers are extremely resistant to current chemotherapeutics including adjuvant therapies with multiple compounds which cause severe adverse effects. We have observed that total plant extracts from dandelion root, lemongrass, long pepper, and fresh tea leaves have very selective toxicity to cancer cells and do not affect non-cancerous cells. These extracts are well-tolerated, and safe to be given as supplements over a long period of time. We have provided scientific validation of these extracts for their anti-cancerous effects as well as proof of positive interaction with standard chemotherapeutic regimens. It is essential to evaluate efficacy of these extracts as potential supplementary materials to improve quality of life and increase overall survival of cancer patients. We have investigated dandelion root, fresh tea leaves and long pepper extracts for their anticancer efficacy, mechanism, and interaction with standard chemotherapies in 2D, 3D cell culture models and xenograft of human cancer cell in mice. We showed that these Natural Health Products are effective in targeting oxidative and mitochondrial vulnerabilities of cancer cells. We have shown positive interaction of these NHPs with standard chemo. Interestingly, they are also effective in inducing cell death in cancer stem cells. These results could lead to the development of safe and effective treatment alongside standard chemo regimens as supplements for cancer patients.

Graphical Abstract



Keywords: Natural Health Products, Apoptosis, Cancer, NHP-Drug interaction, mitochondrial depolarization and oxidative stress

References:

1. Wear et al. *Advances in Complementary and Alternative Medicine (ACAM)* 2026, Vol. 9, Issue 3 page 1037-1051.
2. Ruvinov et al. *Integrative Cancer Therapy* 2019, Vol 18, page 1-13.
3. Ovadje et al *Oncotarget*, 2016, Vol. 7, Issue 45 page 73080-73100

Transdermal Patch Using Biocompatible Carboxymethyl Hexanoyl Chitosan for Therapeutic delivery of Vitamin D

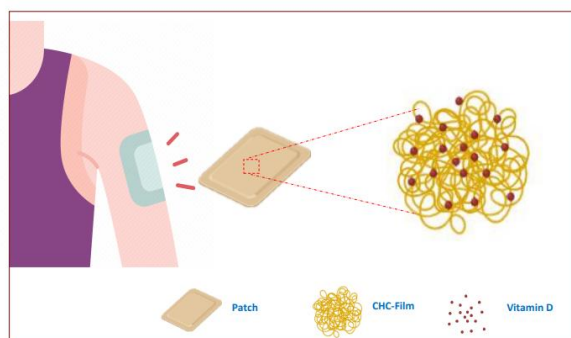
Sathish Kumar M, K. Sudhakara Prasad*

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Abstract

Vitamin D deficiency is a widespread health issue affecting millions globally, leading to various health problems such as weakened bones, impaired immune function, and increased risk of chronic diseases. Traditional methods of addressing this deficiency, such as oral supplements, often face challenges related to absorption and patient compliance. Herein, a novel transdermal patch designed to deliver Vitamin D efficiently through the skin. The patch utilizes biocompatible carboxymethyl hexanoyl chitosan (CHC) to enhance permeation and ensure effective delivery of the active form of vitamin D. The invitro studies are carried out with HaCaT cell lines includes cytotoxicity testing, permeation studies, and bioavailability assessments. In addition, skin permeation studies and delivery studies are performed with artificial membranes. The results demonstrate that the as developed dermal patch have the potential to provide an effective and convenient solution for managing vitamin D deficiency, offering improved patient compliance and enhanced therapeutic outcomes.



Scheme 1 - Preparation of Vitamin D3 loaded CHC based Transdermal patch

Keywords: Vitamin D deficiency, Transdermal patch, Carboxymethyl hexanoyl chitosan, Drug delivery.

References:

1. R. M. Donnelly, T. R. R. Singh, D. A. Woolfson, *Journal of Controlled Release*, 2011, 153 (3), 208.
2. J. W. Lee, H. J. Jung, *Biomaterials Science*, 2019, 7(2), 431.
3. B.N. Kumara, N.G. Gurudatt, K.S. Prasad, *Carbohydrate Polymer Technologies and Applications*, 2023, 6, 100401.

Leveraging Indian Knowledge System To Mitigate Chemotherapy and Diabetes Induced Neurotoxicity: A preclinical Study on Indian Plant-Derived Bioactives

Biswarup Basu*, Pratiti Bhattacharjee, Souvik Das, Sharmistha Roy Chowdhury

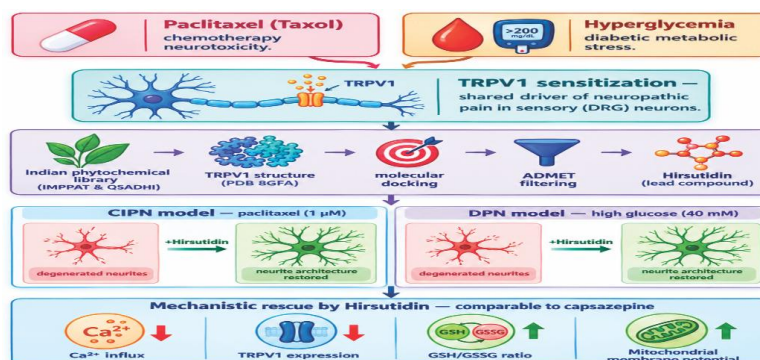
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Abstract

Background: Chemotherapy-induced peripheral neuropathy (CIPN) and diabetic peripheral neuropathy (DPN) are neurotoxic complications in majority of therapy undergoing cancer patients as well as diabetes- metabolic syndrome affected population respectively, characterised by pain, numbness, and sensorimotor deficits. Present clinical option Gabapentin offer only symptomatic relief and approved synthetic drugs are often associated with adverse effects. Objective: Nociceptive TRPV1 channel modulates calcium influx, oxidative stress, and neuroinflammatory responses when associated with nerve damage induced pain and we aim to identify bioactive compounds from Indian medicinal plants modulating TRPV1 activity-validated in preclinical CIPN or DPN models. Methods: An *in-silico* screening of Indian phytochemical libraries was conducted against TRPV1 using molecular docking and molecular dynamics simulations. Top candidates were evaluated for ADMET activity *in silico* and *in vitro* using SH-SY5Y neuronal cells post Chemotherapy or Glucose treatment. Experimental endpoints included measurement of neurite outgrowth, ROS generation, immunocytochemical analysis of cytoskeleton proteins compared to the TRPV1 antagonist drug Capsazepine and Gabapentin. Results: Phytochemicals identified as top TRPV1-binding compounds *in silico*, demonstrating stable interactions with pharmacologically favourable ADMET profile, were tested *in vitro*. Few showed significantly promoted neurite outgrowth, reduced ROS generation, post treatment in DPN/CIPN models. Finally, effect of lead candidate Hirsutidin was corroborated with TRPV1 pathway indicating targeted neuroprotective efficacy. Conclusion: Indian phytochemicals represent safe and promising TRPV1-targeting candidate(s) capable of mitigating chemotherapy or diabetes incurred neuronal injury, requiring *in vivo* & translational development for neuropathy.

Graphical Abstract :



Keywords: Chemotherapy-induced peripheral neuropathy (CIPN); Diabetic peripheral neuropathy (DPN); Transient receptor potential cation channel subfamily V member 1 (TRPV1); Capsazepine; Gabapentin; Neurotoxicity; Phytopharmaceuticals; *In Silico*; *In Vitro*

References:

1. Zajączkowska, Renata et al. *International journal of molecular sciences* .20 (2019) 1451-22
2. Gunthorpe MJ, Szallasi A. *Curr Pharm Des.*;14(2008):32-41

Altitudinal Morphological Variability in Uttarakhand: Driving Population-Specific Clinical Baselines and Healthcare Innovation

Rashmi Malhotra¹, Jayanti Pant², Bhamini Sharma³, Srikant S⁴, Mukesh Singla⁵, Manu Malhotra⁶, Latika Mohan^{7*}

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Abstract

Human morphological variations arise from complex interactions between genetic lineage, environmental pressures, and altitudinal adaptation. In mountainous states like Uttarakhand, marked ecological gradients impose unique physiological and anatomical demands on indigenous communities. This comparative cross-sectional study maps the somatometric, craniofacial, nasal, and auricular traits of 325 adult participants across four ethnically distinct populations: the Jaunsari (n=200), Panwars of Dharali (n=69), Dunda Valley Low Lander Bhutias (n=32), and Harshil Valley High Lander Bhutias (n=24).

While stature remained statistically uniform across the cohorts, high-altitude populations demonstrated a significantly higher BMI ($p < 0.05$) alongside expanded craniofacial and nasal dimensions, reflecting distinct respiratory and thermoregulatory adaptations to hypoxic terrains. Pronounced sexual dimorphism was evident, with males exhibiting greater head, bizygomatic, and auricular breadths, whereas female cohorts demonstrated highly population-specific morphological sensitivity across nearly all parameters.

From a clinical and public health perspective, these variations reveal a critical limitation in contemporary healthcare delivery: universal diagnostic baselines and generalized medical device designs fail to account for altitudinal physiology. Representing AIIMS Rishikesh, this plenary address presents these findings as a foundational blueprint for developing population-specific clinical standards, localized metabolic risk assessments, and targeted healthcare solutions engineered precisely for Himalayan populations.

Keywords: Anthropometry; Craniofacial Morphology; Altitude Adaptation; Clinical Baselines; AIIMS Rishikesh; Healthcare Innovation.

Session 2

Harnessing Habits to Heal: Evidence-Based Approaches to Wellness

Stakeholders' Perspectives on Climate-Resilient School Interventions and Child Health: A Qualitative Study from Rural Uttarakhand, India

Vartika Saxena^{1*}, Anubhuti Joshi², Joen Rajan Mathew³

^{1,2,3} Department of Community Medicine, All India Institute of Medical Sciences (AIIMS) Rishikesh, Rishikesh, 249203, Uttarakhand, India

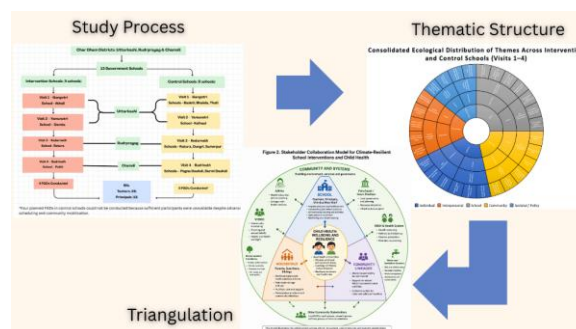
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Abstract

Climate change increasingly threatens children's health, education & wellbeing by disrupting water, sanitation and hygiene, particularly in climate-vulnerable mountain regions. In 2024 alone, climate-related hazards disrupted education for at least 242 million children worldwide, highlighting urgent need for climate-resilient school systems¹. Despite increasing investment in climate-resilient schools, little qualitative evidence exists on how these interventions are perceived by stakeholders or influence resilience beyond school settings, particularly in Indian Himalayan Region. An embedded comparative qualitative descriptive study conducted within a mixed-methods quasi-experimental evaluation across 13 government schools (4 intervention, 9 control) in three climate-vulnerable districts of Uttarakhand, India (April–December 2025). Data generated through 9 focus group discussions involving 90 community stakeholders and 39 key informant interviews with teachers (n=26) and principals (n=13). A hybrid deductive–inductive framework analysis was undertaken and interpreted using the Social Ecological Model². Four interconnected themes emerged: schools as islands of resilience and health promotion; children as agents of intergenerational behaviour change; schools as catalysts for environmental stewardship; and persistent structural vulnerabilities shaping child health. Compared with control schools, intervention schools were more frequently perceived as supportive environments that reinforced hygiene practices, strengthened school-to-home transfer of healthy behaviours, enhanced student confidence, and promoted environmental responsibility. However, water insecurity, menstrual hygiene gaps, environmental degradation, and limited preventive health services remained important barriers. Climate-resilient schools were perceived as community resilience hubs extending beyond hygiene promotion by strengthening behavioural, environmental and community resilience. Sustained impact will require integrated investments in resilient WASH systems, menstrual health, preventive health services, and multisectoral collaboration, particularly in climate-vulnerable regions^{3,4}.

Keywords: Climate resilience; School health; Water, sanitation and hygiene (WASH); Child health; Community resilience; One Health; Qualitative research; Social Ecological Model.

Graphical Abstract



References:

1. United Nations Children's Fund (UNICEF). *Learning interrupted: Global snapshot of climate-related school disruptions in 2024*. New York: UNICEF; 2025.
2. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q*. 1988;15(4):351-77.
3. World Health Organization, United Nations Children's Fund (UNICEF). *Progress on drinking water, sanitation and hygiene in schools 2015-2023: Special focus on menstrual health*. Geneva: World Health Organization; 2024.
4. Wester P, Mishra A, Mukherji A, Shrestha AB, editors. *The Hindu Kush Himalaya assessment: Mountains, climate change, sustainability and people*. Cham (Switzerland): Springer Nature; 2019.

Prevalence and lifestyle determinants of anemia among Type-2 Diabetes Mellitus patients in a rural community of Uttarakhand, North India

Joen Rajan Mathew^{1*}, Anubhuti Joshi¹, Vartika Saxena¹

¹ Department of Community Medicine, All India Institute of Medical Sciences (AIIMS) Rishikesh, Uttarakhand, India

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Abstract

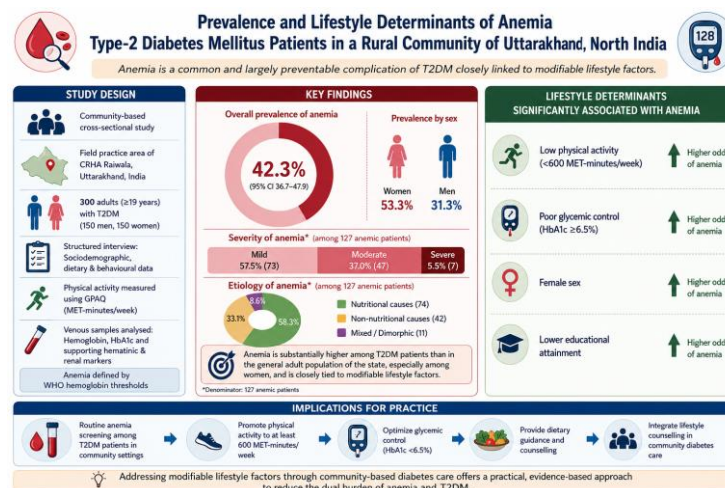
Anemia is the commonest hematological complication of Type-2 Diabetes Mellitus (T2DM), yet community-level data from northern India are scarce and its lifestyle determinants remain under-explored. As diabetes is fundamentally a disorder of metabolic health, understanding how modifiable habits relate to anemia in this population is central to lifestyle-based prevention. We conducted a community-based cross-sectional study among 300 adults (≥ 19 years, equal numbers of men and women) with T2DM in the field practice area of the Center for Rural Health AIIMS (CRHA) Raiwala, Uttarakhand. Participants underwent a structured interview capturing sociodemographic, dietary, and behavioural information; physical activity was quantified using the Global Physical Activity Questionnaire (MET-minutes/week), and venous samples were analysed for hemoglobin, HbA1c, and supporting hematinic and renal markers. Anemia was defined by WHO hemoglobin thresholds. The overall prevalence of anemia was 42.3% (95% CI 36.7–47.9), substantially higher than in the general adult population of the state, and markedly greater among women (53.3%) than men (31.3%). Most anemia was mild-to-moderate in severity, and nutritional causes predominated over non-nutritional ones. On analysis, anemia was significantly associated with several modifiable, lifestyle-relevant factors- notably low physical activity (<600 MET-minutes/week) and poor glycemic control (HbA1c $\geq 6.5\%$) alongside female sex and lower educational attainment. These findings position anemia as a frequent, largely preventable comorbidity of T2DM that is closely tied to modifiable habits. Embedding routine anemia screening and lifestyle counselling-physical activity promotion, glycemic optimisation, and dietary guidance within community diabetes care offers a practical, evidence-based avenue to reduce this dual burden.

Keywords: Anemia; Type-2 Diabetes Mellitus; Physical activity; Glycemic control; Lifestyle medicine; Community health; Uttarakhand

References:

- [1] H. Mazumder et al, PLoS ONE 18 (2023) e0285336.
- [2] M. Faghri-Ganji et al, Biomedical and Environmental Sciences 37 (2024) 96–107.

Graphical Abstract



AI declaration: Artificial intelligence (OpenAI ChatGPT, GPT-5.5/DALL-E) was used solely to assist in the design of the graphical abstract. All scientific content, data, interpretation, and final approval were provided by the authors.

From Prolonged Sitting to Active Workplaces: A Systematic Review of Adiposity, Insulin Resistance, and Workplace Intervention Evidence

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* Corresponding Author: Formulation Scientist, Nutralytics Edtech LLP, Pune

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Abstract

Background: Prolonged occupational sitting may also lead to increased central adiposity and decreased insulin sensitivity, even when body weight, fasting glucose, or HbA1c is within the normal range. Strategies such as sit–stand desks, walking breaks, and short exercises have been studied in the workplace for their effects on reducing sedentary exposure and metabolic risk.

Objective: To summarize the evidence on the relationship between occupational sitting and obesity and insulin resistance, assessing the metabolic impact of laborious movement interventions in the workplace.

Methodology: Databases such as PubMed/MEDLINE, Scopus, Web of Science, Embase, and Google Scholar were searched from January 2017 to July 2026 with search terms “occupational sitting,” “workplace sedentary behaviour,” “office workers,” “obesity,” “waist circumference,” “fasting insulin,” “HOMA-IR,” “sit–stand desk,” “walking breaks” and “micro-exercise.” A total of 1056 articles were retrieved, out of which 175 articles were left after removing duplicates and meeting the eligibility criteria. Sixteen studies were included because they measured occupational sitting directly or assessed workplace sitting-reduction interventions and reported adiposity or insulin-related outcomes. Due to methodological heterogeneity, results were narratively synthesized.

Results: The review consisted of 4 cross-sectional studies, 1 prospective study, and 11 intervention or experimental studies. Occupational sitting was more consistently associated with central adiposity than with BMI. One extra hour of work-a-day sitting in the office was associated with a 0.45-cm greater waist circumference (95% CI: 0.09–0.80). Consistency in BMI and longitudinal changes in weight were inconsistent. During 24 weeks of a sit–stand intervention, fasting insulin decreased from 16.4 ± 7.1 to 12.4 ± 5.2 μ IU/mL, along with improvement in HOMA-IR, despite small alterations in fasting glucose or HbA1c. Hourly micro-exercise breaks reduced HOMA-IR by -0.42 (95% CI: -0.55 to -0.29) and waist circumference by 2.1 cm. Active movement generally produced greater metabolic benefits than standing alone.

Conclusion: Occupational sitting is associated with central adiposity and decreased insulin sensitivity. Waist circumference, fasting insulin, and HOMA-IR could be more powerful markers of metabolic changes than BMI or HbA1c. Having frequent breaks from movement work at work seems to do the best.

Keywords: Insulin resistance, adiposity, Corporate, exercise, movement

Maladaptive Daydreaming as a Habitual Coping Behavior: A Pilot Exploration of Sleep, Stress and Addiction.

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Abstract

Background: Maladaptive Daydreaming characterized as excessive daydreaming. Previous research has shown relation with addiction.

Method: The aim is to find the content, function, duration and theme of maladaptive daydreaming. 90 psychiatric patients with inclusion criteria of insight grade 3 or above; schizophrenia, depression, dysthymia, atypical depression, bipolar disorder, and anxiety were included. Patients were screened using the NIMHANS screening tool for psychiatric patients. MDS-16 above 40%, then advance to SCIMD, as confirmed by a psychiatrist. Later, the Immersive Daydreaming Content Checklist, Daydreaming Contents and functions questionnaire, and proposed diagnostic criteria for Daydreaming Disorder (Maladaptive Daydreaming) were analyzed.

Results: The results were analyzed in SPSS for the immersive daydreaming content checklist. They were more involved in past and future imagination, with frequencies of 100%, real-life scenarios at 83.3%, and Wish Fulfilment at 83.3%. The storyline type consists of both long continuous stories and short separate stories, with 50% long continuous stories, 33.3% short stories, and 16.7% short separate stories. With a repeated pattern of recurring dreams, 33.3%. Sometimes repeat with changes with 66.7%. The most frequent dreams involved imagining changes to past stories. Prevalence is that it occupies 37.5% of waking hours, which can exceed up to 60%. Social Inference ($r=.51$) and sleep disruption($r=.42$).

Conclusion: These preliminary findings suggest that MD may function as a habitual, difficult-to-moderate coping behavior with cross-cutting relevance to sleep health, stress regulation, and behavior-change frameworks.

Limitations: A large sample size is required to establish the data.

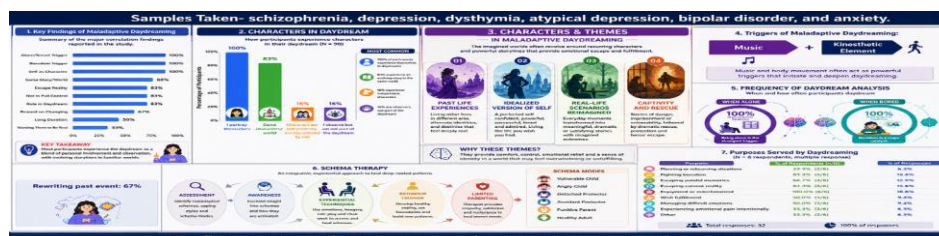


Figure 1: Graphical Abstract representing the study of Maladaptive Daydreaming and Schema Therapy

Keywords: Maladaptive Daydreaming, Immersive Daydreaming Content checklist, Addiction, Coping-behavior.

References:

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Lifestyle Factors Associated with Neurocognitive Function, Mental Health, and Quality of Life in Healthy Adults

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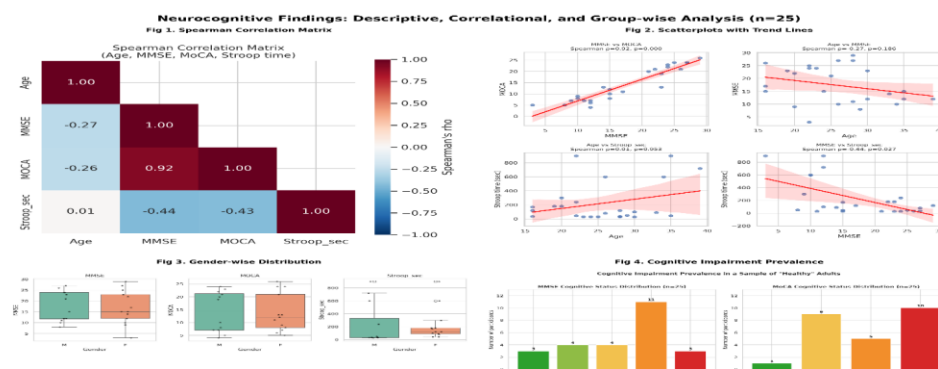
Abstract

Background: Attention, memory, executive function, and cognitive flexibility are crucial for academic success, occupational functioning, and functional independence, and are vital contributors to neurocognitive and psychological well-being. Technological progress and urbanization have increased sedentary behavior, irregular sleep, and screen time among adults. Although physical activity (PA) and screen time (ST) have been widely studied, limited evidence has examined their combined relationship with routine structure and its association with neurocognitive function, mental health, and quality of life among healthy adults, particularly in India.

Methodology: Cross sectional study at a hospital and college, the study population was healthy adult ages 16-40 years. Structured and validated questionnaires were used to assess PA, ST and routine regularity, with standardized Mini Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) used to assess neurocognitive function.

Results: 25 adults were assessed. 72% scored below-normal on MMSE, 96% on MoCA, showing neurocognitive function is affected — likely from lifestyle factors like sedentary behavior, screen time, and irregular routines. MMSE-MoCA correlated strongly ($p=0.920$, $p<0.001$), and both linked significantly to slower Stroop performance ($p=0.027$, $p=0.031$), confirming genuine impairment.

Conclusion: The study concludes that MMSE and MoCA scores were low among the sampled healthy adults, indicating affected neurocognitive function. A majority of participants scored below normal cutoffs on both tests, suggesting cognitive impairment is present even in individuals presumed to be healthy, highlighting a need for wider screening.



Keywords: Physical Activity, Screen Time, Daily Routine Structure, Neurocognitive Function; Mental Health; Quality of Life; Healthy Adults

References:

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From Sarcomere Regulation to Disease: Understanding the Role of Myosin IHM and MYBPC3 in Cardiomyopathies

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Abstract

Hypertrophic cardiomyopathy (HCM) is a genetic disorder where the contractile proteins, such as myosin motor, do not perform their regular function, which leads to hypercontractility of heart muscles and impaired diastole. This causes abnormal heartbeats (arrhythmias) and abnormal heart function, which can eventually lead to sudden cardiac arrest in affected people. In myosin filaments, the myosin forms a conformation called the interacting heads motif (IHM), which regulates the number of myosin heads available to interact with actin to produce force. It has been suggested that HCM mutations in myosin may increase the number of available heads by disrupting the IHM head interactions, thus leading to hypercontractility and impaired diastole of the disease. Cardiac myosin-binding protein C (MyBPC3) regulates cardiac contractility by controlling myosin head dynamics in the thick filament C-zone through interactions with myosin and actin.

Mutations in MYBPC3 are a leading cause of cardiomyopathy, particularly in Indian and South Asian populations, where a 25-base pair deletion ($\Delta 25\text{bp}$) is highly prevalent. MYBPC3 deficiency destabilizes the IHM, shifting myosin heads toward active states, increasing cross-bridge cycling, and driving hypercontractility, which is a hallmark of hypertrophic cardiomyopathy (HCM). Thus, impaired C-protein-mediated control of IHM stability provides a unifying mechanism for cardiomyopathy and highlights therapeutic strategies targeting myosin regulation.

Benefits of Platelet Rich Plasma in Stress Urinary Incontinence

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Abstract

The prevalence of incontinence is very common in middle and old aged women due to inadequate anatomical supports and hypermobile urethra. This study was done in a series of 15 patients who were treated with platelet-rich plasma by paraurethral injection in women with a diagnosis of stress urinary incontinence (SUI) respectively in the Department of Obstetrics and Gynaecology, Government Doon Medical College, Dehradun with good results. Platelet-rich plasma is a valuable tool in the management of SUI as it is autologous, safe, free from side effects, and cost-effective.

Key words: stress incontinence, platelet rich plasma, paraurethral

Knowledge, Attitudes, and Digital Media Influence on Menstrual Health Among Adolescent Girls in Odisha: A Cross-Sectional Analysis

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Abstract

Background: Menstrual health is a key component of adolescent well-being, yet myths, stigma, and limited awareness persist among Indian adolescents despite gains reported in National Family Health Survey-5 (NFHS-5), with digital media emerging as an underexplored influence on menstrual knowledge in Odisha.

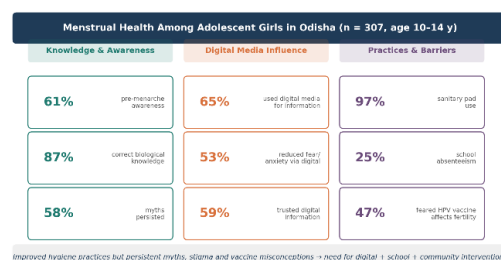
Objective: To assess menstrual knowledge, hygiene practices, digital media influence, cultural perceptions, and vaccination-related myths among adolescent girls in Odisha.

Methods: A cross-sectional observational study was conducted among 307 adolescent girls (10–14 years) attending a tertiary care hospital OPD in Odisha, using a structured interviewer-administered questionnaire; data were analyzed in SPSS v27 using descriptive statistics, chi-square/Fisher's exact test, t-test/ANOVA, and multivariable logistic regression ($p < 0.05$ significant).

Results: Mean age at menarche was 12.4 years; pre-menarche awareness was 61% and correct biological knowledge 87%, though myths persisted in 58%. Digital platforms were used by 65% for menstrual information, and 53% reported reduced fear/anxiety through digital media. Sanitary pad use was high (97%), but school absenteeism (25%) and cultural restrictions (religious avoidance 78%, food restrictions 45%) persisted, and 47% believed HPV vaccination could affect fertility or menstruation.

Conclusion: Despite improved hygiene practices and knowledge compared with NFHS-4/5 benchmarks, persistent myths, psychosocial fear, and HPV vaccine misconceptions reflect a knowledge–attitude gap. Digital media offers a promising avenue for education and emotional support, and integrated digital, school-, and community-based interventions strengthening the Rashtriya Kishor Swasthya Karyakram are warranted for comprehensive adolescent menstrual and reproductive health, including cervical cancer prevention.

Graphical Abstract



Keywords: Menstrual health; Adolescent girls; Menstrual hygiene; Digital media; HPV vaccination; Cultural taboos; Odisha

References:

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Session 3

Nourish to Flourish: Leaving No One Behind

Diet Hacks for Health Boost & “Fighting Fit”- ness:

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Abstract

Diet and nutritional practices play an important role in maintaining health, vitality, and physical and mental well-being throughout life. This perspective summarizes personal experiences with dietary modification, supplementation, fermented foods, sprouts, and meal sequencing, while also considering their potential relationships with digestion, metabolism, and healthy ageing. A high-protein, low-carbohydrate dietary approach, inspired by the Atkins diet, was personally associated with perceived improvements in energy, mental freshness, and general well-being. Foods including cheese, pineapple, tomato, skinned urad sprouts, and dates were incorporated in different phases, with varying perceived benefits.

Particular emphasis is placed on vitamin B12 and vitamin D, nutrients important for normal physiological functions and commonly obtained through diet, supplementation, and, in the case of vitamin D, sunlight-mediated synthesis. The potential value of sprouts as sources of nutrients and enzymes and of fermented preparations such as kefir and kombucha is also discussed from an experiential perspective. Fermentation was explored as a means of modifying foods such as leafy vegetables and almonds and potentially improving their digestibility.

The dietary approach further emphasizes controlling refined carbohydrate intake, adequately preparing foods containing antinutritional compounds, and sequencing meals by consuming fibre-rich foods first, followed by protein and fats and carbohydrates later. The overall perspective advocates individualized dietary planning, particularly during ageing, while recognizing that nutritional requirements and responses vary considerably among individuals. Personal dietary experiences should therefore be interpreted cautiously and complemented by evidence-based nutritional guidance, appropriate biochemical assessment, and consultation with qualified healthcare professionals.

Keywords: Healthy ageing; high-protein diet; low-carbohydrate diet; dietary modification; sprouts; fermented foods; kefir; vitamin B12; vitamin D; gut health; metabolism; meal sequencing; nutritional wellness.

Microwave-Assisted Green Extraction of *Shorea robusta* Seed Oil and Its Application as a Sustainable Cocoa Butter Alternative in Dark Chocolate

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Abstract

The global chocolate industry is increasingly seeking sustainable alternatives to cocoa butter due to fluctuations in cocoa production and supply. The extraction of *Shorea robusta* (Sal) seed oil was optimized in this study by response surface methodology (RSM)-based microwave-assisted extraction (MAE). The potential of Sal seed oil as an alternative to cocoa butter in dark chocolate was assessed. The optimized extraction conditions were 879 W microwave power, 38.81 min extraction time, and a seed-to-solvent ratio of 1:18.86 (w/v; 10 g seed powder:188.64 mL n-hexane), to obtain $21.28 \pm 0.68\%$ oil. The extracted oil had low moisture (0.35%), density (0.873 g/mL), peroxide (1.12 meq O₂/kg), and acid (2.54 mg KOH/g) values, and a fatty acid profile dominated by stearic (43.37%) and oleic (40.81%) acids. Differential scanning calorimetry showed a melting profile resembling that of cocoa butter. Dark chocolates made with 5% Sal oil substitution exhibited physicochemical, textural, and thermal properties similar to the cocoa butter control, while maintaining desirable storage stability over one month, with minimal changes in peroxide value, free fatty acid content, water activity, and bloom development. The MAE was more efficient than the previously optimised conventional solvent extraction process, with 9% less solvent required per gram of oil recovered and 84.5% reduction in total extraction time. Overall, the RSM-optimized MAE process provides an efficient and relatively greener approach for the recovery of high-quality Sal seed oil and supports its potential as a sustainable alternative to cocoa butter in dark chocolate formulations within currently permitted substitution levels.

Keywords: *Shorea robusta*, oil, cocoa butter alternative, chocolates, storage stability

Determinants influencing Mental Well-Being: A Socio-Cultural, Socio-Economic and Technological Perspective

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Abstract

Background: Mental well-being is identified as a core dimension of human well-being as well as a critical barrier to effective psychiatric care across different cultural contexts. It is widely recognized as not a single simple feeling but a psychological state, shaped by a combination of different emotions operating at individual, social, and environmental levels. As per the World Health Organization (WHO), mental well-being is defined as "a state of well-being in which an individual realizes their abilities, can cope with the normal stresses of life, can work productively, and is able to make a contribution to their community". The definition lays emphasis on the fact that merely the absence of mental disabilities or disorders does not imply mental well-being, but it is more comprehensive in nature. It can be envisioned as an integral part of health and is interpreted in terms of various socioeconomic, biological, and environmental factors. There is an imperative need for the promotion, protection, and restoration of mental health as a vital concern for individuals, communities, and societies worldwide (WHO, 2022).

Objectives: The study aims to examine the role of socio-cultural structures, socio-economic realities, lifestyle, and technological environments in influencing the mental well-being of academic community members.

Research gap: This study addresses the lack of integrated research examining how socio-cultural, socio-economic, lifestyle, and technological factors simultaneously influence mental well-being, along with bridging the gap between the multidimensional understanding of positive mental functioning and pathology-oriented perspectives.

Material and Methods: The study adopts a descriptive cross-sectional research design based on primary data collection using a structured questionnaire administered via Google Forms. A 7-point Likert scale was used for capturing respondents' perspectives on mental well-being determinants. A total of 116 responses procured through an online survey were analyzed using appropriate statistical techniques. The responses showing agreement, neutral, and disagreement categories were analyzed to get mean scores, percentage distributions, and ranks for the assessment of the relative influence of factors on mental well-being.

Results: The findings depict that lifestyle factors showed the strongest positive association with mental well-being with the highest level of agreement (75.86%), followed by psychological factors (70.40%) and social support factors (68.79%). Technological (63.94%) and work/academic factors (64.66%) showed moderate levels of association, indicating their considerable but comparatively lesser influence. Besides, the results show that financial conditions and economic stress remain notable concerns affecting respondents' mental well-being. Among demographic characteristics, employment status exhibited the highest variation in well-being scores (Range = 1.976), indicating a comparatively stronger influence. Gender demonstrated minimal variation (Range = 0.018), suggesting a limited differential effect on well-being within the sample.

Conclusion: This study provides a structured comparative assessment of determinants influencing mental well-being using composite mean ranking and standardized indexing techniques. The findings underscore the importance of targeting behavioral practices, psychosocial environments, and employment-related stability in mental health promotion strategies.

Keywords: Mental Well-being, socio-cultural factors, socio-economic factors, lifestyle factor, technological factor.

Session 4

Tiny Tools, Big Impact: Driving Sustainable Solutions through Biotechnology

Elucidating Diverse Role of Nuclear Factor-Y (NF-Y) Transcription Factor in Finger Millet: Genomics and Bioinformatics Intervention

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Abstract

Plant regulatory functions, particularly stress and development, are being investigated by using whole genome sequences. NF-Y transcription factors are heterotrimeric complexes found in nearly all eukaryotes. A sturdy crop, finger millet (*Eleusine coracana* (L.) Gaertn), may contain transcriptomic factors related to its tolerance of abiotic stresses. Thus, in our lab, we have performed genome-wide identification and characterization of NF-Y transcription factors. Further, it was examined whether ABA-dependent or ABA-independent mechanisms regulate NF-Y expression. Finger millet harbors 59 EcNF-Y genes that may provide valuable insights into responses to drought and salinity stress. Furthermore, finger millet PYL receptor proteins interact with transcription factors in response to abiotic stress. Two finger millet genotypes, PES400 (tolerant to dehydration and salt stress) and VR708 (sensitive to dehydration and salt stress), were analyzed for the gene expression profiles of the EcNF-Y genes. According to qRT-PCR expression analysis, six EcNF-Y genes are associated with tolerance to both dehydration and salinity stress, including *EcNF-YA1*, *EcNF-YA5*, *EcNF-YA16*, *EcNF-YB6*, *EcNF-YB10*, and *EcNF-YC2*. Several stress responses may be influenced by these genes. A number of NF-Y transcription factors in finger millet have been characterized and shown to have tolerance-related properties that can be applied to other crop improvement programs as well.

IL-33 Driven Mast Cell Proliferation in Asthma: From Molecular Mechanisms to Therapeutic Targets

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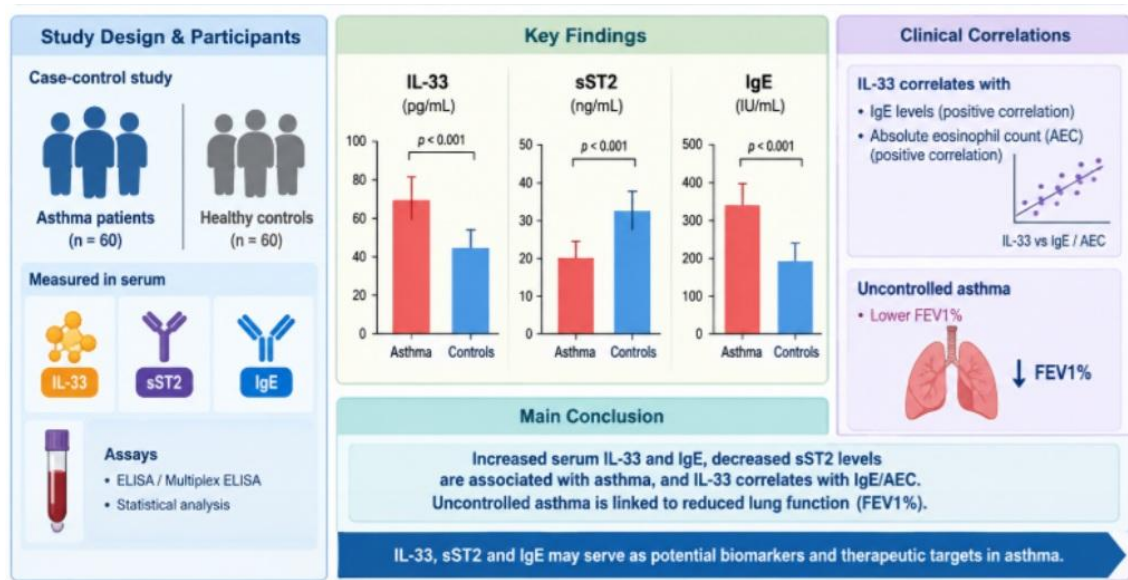
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Abstract

Asthma is a chronic inflammatory airway disease involving multiple immune mediators, including interleukins. Interleukin-33 (IL-33), a member of the IL-1 cytokine family, is an emerging mediator in asthma that exerts its biological effects through its receptor suppression of tumorigenicity 2 (ST2). This study aimed to evaluate serum levels of IL-33, soluble ST2 (sST2), and immunoglobulin E (IgE) in asthmatic patients and healthy controls and to investigate their association with forced expiratory volume in one second (FEV₁%) and absolute eosinophil count (AEC). Both asthmatic patients and healthy subjects were enrolled in the study. Serum IL-33, sST2, and IgE levels were measured, and asthmatic patients were further categorized into allergic and non-allergic groups based on serum IgE levels. Statistical analyses were performed using GraphPad Prism version 8. Asthmatic patients showed significantly elevated serum IL-33 and IgE levels compared with healthy controls, whereas sST2 levels were significantly reduced. FEV₁% was lower among patients with uncontrolled asthma. Furthermore, serum IL-33 levels showed a significant positive correlation with IgE levels. A significant association between IL-33 and AEC was also observed in patients with allergic asthma. These findings demonstrate an altered IL-33/ST2 axis in asthma and support the potential clinical relevance of IL-33 and sST2 as inflammatory biomarkers. The IL-33/ST2 pathway may also represent a potential therapeutic target in allergic asthma and other inflammatory airway diseases.

Graphical Abstract



Keywords: Interleukin-33 (IL-33), Mast cells, Asthma, sST2, IgE,

Altitudinal Variation in Chemical Composition and Antibacterial Activity of *Rhododendron arboreum* Flower Extracts from Garhwal Himalaya, India

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Abstract

Rhododendron arboreum is a medicinally and economically important Himalayan tree species whose various parts are used traditionally to treat several ailments. This study determined the chemical composition of petroleum ether extracts of *R. arboreum* flowers collected from three sites of differing altitude in the Garhwal Himalaya – Kharpatiya Khal (1900 m), Ghimtoli (2200 m) and Kanakchauri (2800 m) – and evaluated their antibacterial activity. Extracts were analysed by gas chromatography–mass spectrometry (GC–MS), and antibacterial activity was assessed against three Gram-positive (*Streptococcus*, *Staphylococcus aureus*, *Bacillus cereus*) and three Gram-negative (*Escherichia coli*, *Salmonella* sp., *Pseudomonas aeruginosa*) bacterial strains using the agar well diffusion method. GC–MS analysis identified 19 compounds in total across the three sites, dominated by long-chain alcohols, alkanes and a phthalate ester, with the number and identity of compounds differing markedly by site (5 compounds at Kharpatiya Khal versus 11 at Kanakchauri). All three extracts inhibited *Streptococcus* and *Salmonella*, with the extract from the lowest-altitude site (Kharpatiya Khal) showing the greatest overall antibacterial activity (zone of inhibition up to 1.1 cm), while none of the extracts inhibited *Staphylococcus aureus* or *Bacillus cereus*. These results indicate that both the phytochemical profile and the antibacterial potential of *R. arboreum* flowers vary with altitude, most likely reflecting differences in soil properties, temperature and UV exposure across the altitudinal gradient.

Keywords: GC–MS; *Rhododendron arboreum*; antibacterial activity; altitudinal variation; Garhwal Himalaya; agar well diffusion.

Fungal bioconsortium: A sustainable tiny solution to Alleviate the Impact of Drought Stress in Wheat Crop

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Abstract

The present work is based on the hypothesis that the fungal endomycobiome of *Triticum aestivum* L. (wheat) is a potential player in plant growth and fitness by performing an array of physiological roles, from adapting to abiotic stresses to stimulating plant growth. A total of 145 culturable endophytic fungal isolates were recovered from the different parts, viz. roots, internode, leaves, and spikes) collected from different growth stages of wheat (variety PBW 725) plants. Based on statistical analysis, 10 potent isolates viz., #TAKR-1a, #2TAKR-6a, #3TAKR-1a, #4TKI-3a, #5TAKL 3a, #6TAKR-1a, #7TAKL-1b, #8TAKS-3a, #9TAKL-4a, and #9TAKR-1b exhibited more than 70% growth on agar plates, more than 30% induction in wet biomass and more than 50% increase in dry biomass in the presence of drought stress (20% PEG 6000). These 10 potent drought-tolerant endophytic fungi were used to analyze their various plant growth promoter properties and antioxidant activities.

Hence, based on the PGP attributes and antioxidant potential, fungal isolates #5TAKL-3a and #8TAKS-3a were further selected for further bioinoculant studies through pot trials. Based on morphological characters and multi-locus phylogenetic analysis of the nuclear rDNA internal transcribed spacer region (ITS1-5.8S-ITS2 = ITS), β -tubulin (TUB 2), and RNA polymerase II second largest subunit (RPB2) genes, two potent fungal isolates #5TAKL-3a and #8TAKS-3a were identified as *Penicillium citrinum* and *Talaromyces purpureogenus*, respectively.

Penicillium citrinum, *Talaromyces purpureogenus*, and their bio-consortium (1:1) were encapsulated using sodium alginate and carboxymethyl cellulose (Alg-CMC) and transferred into the pots containing sterile soil and wheat seeds were allowed to grow in pots under normal conditions. Results indicate that the prepared bio-consortium of fungal isolates (1:1) showed maximum potential to enhance the growth of wheat plants under normal and drought conditions, as compared to the control (culture untreated), as well as encapsulated individual culture (*Penicillium citrinum* and *Talaromyces purpureogenus*) treated wheat plants. The findings of this study generate ample interest to extend this research to the next level by using a bio-consortium of potent fungal endophytes that have broad applicability across disciplines.

Keywords: Wheat, Endophytic fungi, PEG 6000, Drought stress, Fungal bioconsortium

Statistical Optimization of Bioactive Peptide Production from Food-Isolated Bacteria for Sustainable Applications

Surbhi

CCT-CGC Landran

Abstract

Introduction: Bioactive peptides — short protein fragments with antibacterial, antibiofilm, and antioxidant properties — are conventionally derived through enzymatic hydrolysis of dietary proteins. This study explores microbial innovation as a sustainable alternative: bacterial strains isolated from fermented foods that naturally secrete such peptides during growth, offering a low-cost route to functional biomolecules aligned with circular bioeconomy principles.

Methodology: Bacterial isolates were obtained from various fermented foods and screened for proteolytic activity using skim milk agar and casein hydrolysis assays. High-activity strains were cultured under optimized conditions for peptide secretion. Cell-free supernatants were partially purified by ammonium sulfate precipitation and dialysis, and peptides were characterized for antioxidant activity (DPPH assay), antimicrobial action against *E. coli* and *S. aureus*, and molecular weight profile (SDS-PAGE).

Results: Production was optimized using Response Surface Methodology (Box-Behnken design), varying carbon source, nitrogen source, and inoculum size (5% v/v), yielding 10 g/L peptide (ANOVA, $p < 0.05$). Structural analysis identified the peptide as a cationic, thermostable lipopeptide with a critical micelle concentration of 1000 mg/L, exhibiting emulsification activity against vegetable oils and antibiofilm efficacy against Gram-positive and Gram-negative pathogens. Stable cell morphology and consistent growth under optimized conditions indicate scalability of the bioprocess.

Conclusion: Food-derived bacterial isolates represent a promising, sustainable microbial resource for producing multifunctional bioactive peptides with applications spanning food preservation, nutraceuticals, and pharmaceuticals — directly supporting the theme of microbial innovation for food and sustainable systems.

Keywords: Bioactive peptides, food-isolated bacteria, sustainability, antibiofilm, RSM optimization, circular bioeconomy.

Unlocking Leaf-Cutter Ant-Associated Actinobacteria: A New Frontier for Anti-Tuberculosis Drug Discovery

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Abstract

Background: The global rise of antimicrobial resistance (AMR) and drug-resistant tuberculosis (TB) has driven the urgent need for new antimicrobial scaffolds with novel mechanisms of action. Actinobacteria are a great source of clinically important antibiotics, but conventional screening usually recovers well-characterized populations from previously established taxa and ignores rare microorganisms from unknown ecological contexts.

Objectives: In this study, we explored leaf-cutter ants and their microhabitats in Uttarakhand, India, as a new source of rare actinobacteria that might lead to anti-tuberculosis drug discovery in the future.

Methods: Actinobacteria were isolated from 23 samples and 22 isolates were identified using polyphasic taxonomy. Antimicrobial potential was first investigated using an agar plug assay. Bioactive isolates were further studied by whole-genome sequencing and biosynthetic gene cluster (BGC) mining using antiSMASH, PRISM and BAGEL. To establish a connection between genomic biosynthetic potential and metabolite production, high-resolution HRMS/MS profiling was performed to characterize the chemical diversity of bioactive isolates and identify potential bioactive secondary metabolites.

Results: Seven isolates (35%) showed significant anti-tuberculosis activity. The active isolates were mostly *Streptomyces*, but *Nocardiopsis*, *Cellulomonas*, *Arthrobacter*, and *Nocardia* were also recovered. Polyphasic characterization and whole-genome sequencing showed that some isolates have characteristics that suggest new *Streptomyces* taxa are present. Genome mining revealed a variety of biosynthetic gene clusters associated with polyketides, non-ribosomal peptides and other specialized metabolites. HRMS/MS profiling further demonstrated substantial chemical diversity and identified some probable secondary metabolites that may correspond to predicted biosynthetic potential, providing further evidence for the production of structurally diverse bioactive compounds.

Conclusion: Leaf-cutter ant-associated actinobacteria appear to be a promising and largely unstudied source of antimicrobial natural products. Integrating ecological bioprospecting, antimicrobial screening, full-genome sequencing, BGC mining and HRMS/MS-based metabolite profiling in combination provides a powerful discovery pipeline for linking microbial genomes with their chemical outputs. This innovative approach offers a pathway to new anti-tuberculosis scaffolds and drug-resistant *M. tuberculosis* therapeutic candidates.

Keywords: Antimicrobial resistance; tuberculosis; *Mycobacterium tuberculosis*; leaf-cutter ants; actinobacteria; *Streptomyces*; HRMS/MS; metabolomics; biosynthetic gene clusters; genome mining; natural products; drug discovery.

Discovering *Nyctanthes arbor-tristis* and *Polyalthia longifolia*'s Anti-PCOS Potential: From Bioactive Compounds to Molecular Targets

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Abstract

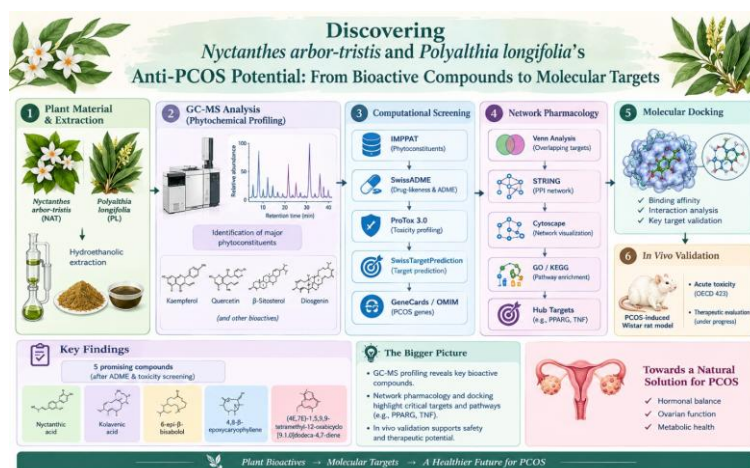
Polycystic ovary syndrome (PCOS) is a complicated reproductive and metabolic illness marked by hormonal imbalance, ovarian dysfunction, and metabolic abnormalities. The multifactorial nature of PCOS, as well as the limitations of current treatments, have prompted researchers to investigate plant-derived bioactive chemicals as prospective therapeutic possibilities. The current work uses both in-silico and in-vivo methods to examine the medicinal potential of *Nyctanthes arbor-tristis* and *Polyalthia longifolia*.

Hydroethanolic extracts of *N. arbor-tristis* and *P. longifolia* were produced and their phytoconstituents were screened using a systematic computational approach. Candidate compounds were examined for drug-likeness and pharmacokinetic characteristics using SwissADME, followed by toxicity profiling with ProTox 3.0. Potential protein targets were identified using SwissTargetPrediction and linked to PCOS-associated genes from GeneCards and OMIM. Protein-protein interaction, functional enrichment, and pathway analysis were then carried out utilizing the STRING, Cytoscape, DAVID, Gene Ontology, and KEGG databases. Molecular docking was used to further test selected drugs against important PCOS-associated therapeutic targets. The experimental validation began with an OECD 423 acute toxicity assessment, followed by an in-vivo PCOS-induced Wistar rat model.

Five phytoconstituents with acceptable pharmacokinetic and toxicological profiles were found using computational screening: nyctanthic acid, kolavenic acid, 6-epi- β -bisabolol, 4,8- β -epoxycaryophyllene, and (4E,7E)-1,5,9,9-tetramethyl-12-oxabicyclo[9.1.0]dodeca-4,7-diene. Molecular docking revealed that the shortlisted drugs interacted favorably with major PCOS-related targets. The acute toxicity evaluation revealed good preliminary safety at the examined dose.

The combined findings support *N. arbor-tristis* and *P. longifolia* as prospective sources of bioactive chemicals and give a molecular framework for further investigation in PCOS treatment.

Graphical Abstract



Keywords: Polycystic ovary syndrome; *Nyctanthes arbor-tristis*; *Polyalthia longifolia*; Network pharmacology; Molecular docking, Acute Toxicity Analysis

Isolation and Assessment of Fungi Derived from Wastewater for Sustainable Energy Generation

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Abstract

Urbanization has intensified the demand for different sustainable energy-generating solutions. One promising approach is the treatment of wastewater using electrochemical setups. A microbial fuel cell (MFC), an electrochemical setup, can be highly effective for wastewater treatment as it simultaneously generates bioelectricity. This study focuses on the isolation, characterization, and evaluation of electrogenic fungal species from wastewater samples (WWS) collected from the Uttarakhand region. Using the potentiostat, an electrochemical workstation, we screened a total of 70 different fungal isolates and identified 10 distinct fungal strains as potent current generators. Morphological characterization of these strains revealed several fungal structures, including hyphae and spores. The most potent fungi were further analyzed based on Polymerase Chain Reaction (PCR) amplification and genomic sequencing of the internal transcribed spacer (ITS) region. The obtained sequences were subjected to Basic Local Alignment Search Tool (BLAST) analysis, and the corresponding fungal isolates were assigned genus names after comparison with representative sequences available in GeneBank. ITS sequencing for the top three potent fungi revealed their highest resemblance to *Aspergillus flavus* (99.09%), *Diaporthe caryae* isolate KM 19 (96.18%), and *Montagnula donacina* (100.00%). Among these, the strain closely related to *Aspergillus flavus* demonstrated the highest current output. This isolate has been successfully submitted to the National Center for Biotechnology Information (NCBI) database under the accession number PX226319. The selected strain will be integrated into a dual-chambered microbial fuel cell (DC-MFC) system to evaluate its bioelectric performance under optimized conditions. Overall, this research established a foundation for identifying the potent fungal strains from local microbial communities present in wastewater for sustainable energy production.

Keywords: microgens; electrogens; wastewater; myco electrogenic; MFC

Covalently Crosslinked Sodium Alginate with Linear Aliphatic Bifunctional Alcohol: A Sustainable Route to Food Packaging

Pankaj Bhandari¹, Shefali Arora^{1*}, Sukanya Chhetri¹, Akash Dhiman¹, Versha Parcha², Parteek Prasher¹

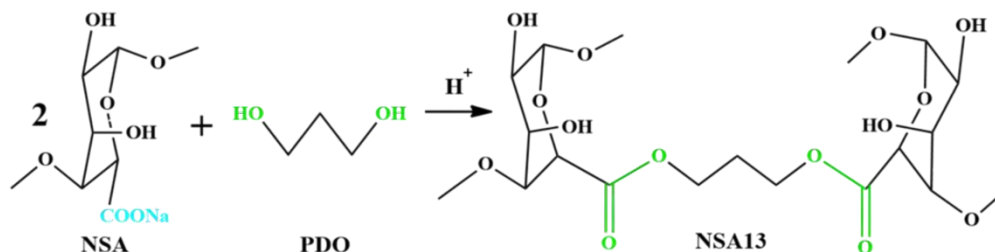
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Abstract

Sodium alginate is a non-toxic natural polysaccharide derived from brown seaweed, recognised for its plastic-like transparency and inherent oxygen barrier qualities, rendering it ideal for food packaging applications. Nonetheless, its restricted effectiveness against moisture, biodegradability under microbial influence, and high solubility in water limit its application in food packaging. Strengthening the physicochemical stability of alginate-based films via environmentally sustainable covalent modification is a novel strategy for carbohydrate materials. This research examines the ester crosslinking of sodium alginate (NSA) with bio-derived 1,3-propanediol (PDO) under acid as a catalyst under varying reaction times of 1 to 3 days. Moreover, the ester bond was monitored using FTIR over 5 days span for optimising the reaction time. The establishment of integration of PDO was validated through techniques such as FTIR, XRD, DSC, TGA, and ¹H-NMR. Surface morphology was analysed through SEM and AFM. The modified film (NSA-P) exhibited significantly reduced swelling power and water solubility in hot water, with an increased contact angle from 14.7 to 76.7 (an increase of 81%) in hydrophobicity. Furthermore, a notable water vapour transmission rate (WVTR) for NSA-P, as determined by ASTM F1249, was 156.91 g/m².24h at 90% humidity. The microbial susceptibility to the degradation effects of NSA-P film against both Gram-positive and Gram-negative bacteria, as well as various fungal strains, confirms the potential for food packaging and biomedical applications.



Keywords: Sodium alginate, propanediol, covalent crosslinking, wetting constant, food packaging

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Session 5

Reimagining Pharma: Next-Gen Solutions for Global Health

Vaccines in the Modern Era: Triumphs, Turbulence, and Myths

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Abstract

Vaccines have reshaped the trajectory of global health, eliminating or controlling many of the world's most devastating infectious diseases. The modern era has ushered in unprecedented scientific advances from genomic-guided antigen design to versatile platforms such as adenoviral vectors, mRNA technologies, and recombinant protein systems. These innovations have enabled rapid responses to emerging pathogens, improved safety profiles, and expanded opportunities for inducing durable, cross-protective immunity.

Despite these scientific triumphs, the vaccine ecosystem has become increasingly turbulent. Political polarization, erosion of public trust, and widespread misinformation have complicated vaccine deployment and acceptance. Global disparities in manufacturing capacity, regulatory infrastructure, and distribution logistics further challenge equitable access, particularly during pandemics and high-consequence outbreaks. These pressures highlight the need for sustained investment in preparedness, transparent communication, and evidence-based policy.

Persistent myths, ranging from misconceptions about immune mechanisms to exaggerated concerns about adverse effects, continue to influence public perception. Amplified by digital media, these narratives obscure the overwhelming evidence supporting vaccine safety and effectiveness. Addressing them requires not only scientific clarity but also an understanding of the sociocultural forces that shape belief systems.

This talk examines the intersection of scientific innovation, societal turbulence, and enduring myths to illuminate the path forward for resilient, trusted, and equitable vaccination strategies in an era of rapidly evolving infectious threats.

Novel Nanoethosomal Delivery of Dabigatran Etxilate Mesylate for Enhanced Antithrombotic Activity

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Abstract

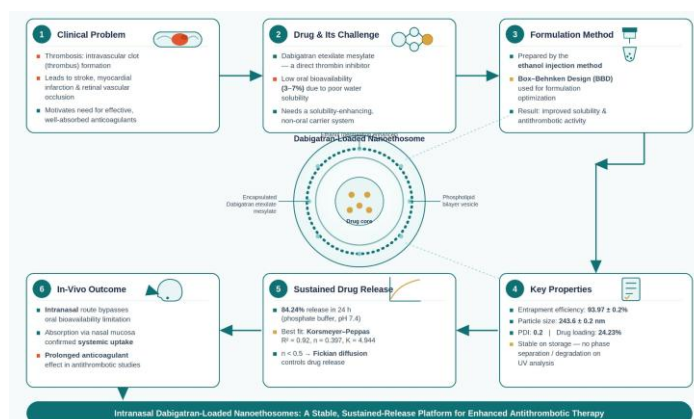
Thrombosis is a condition for formation of intravascular blood clot (thrombus) which often result in dangerous clinical consequences like retinal vascular occlusion, ischemic stroke, and myocardial infarction. Substantial research on thrombotic mechanisms and treatment approaches provided the basis for the current research. Dabigatran etexilate mesylate, a direct thrombin inhibitor, was selected because of its demonstrated antithrombotic efficacy. The drug is having low oral bioavailability (3-7 %) due to poor water solubility. In the current work novel formulation of dabigatran etexilate mesylate as nanoethosomes using the ethanol injection method was selected which revealed a good solubility and enhanced antithrombotic activity.

The box behnken design tool was used for optimization of formulations. The optimised responses were $93.97\% \pm 0.2$ for drug entrapment efficiency, 0.2 for PDI, 243.6 ± 0.2 nm for particle size, and 24.23% for drug loading and stability profile in which no physical sign of separation after UV analysis no degradation absorbed, which showed stability, and sustained release profile, indicating its potential for systemic absorption through the nasal mucosa. *In-vitro* drug release of dabigatran etexilate mesylate loaded nanoethosomes in phosphate buffer of pH 7.4 gave a release profile of 84.24% drug release over 24 hours. The *in-vitro* drug release kinetics for nanoethosomes showed a correlation coefficient (R^2) of 0.92, a release exponent (n) of 0.397, and a release rate constant (K) of 4.944 which was best suited to the Korsmeyer–Peppas model. The n value (< 0.5) in this model demonstrated the Fickian diffusion process, suggesting that diffusion was the main mechanism controlling the drug release from the nanoethosomes vesicles. The model's suitability for understanding Dabigatran's release behavior from the nano-carrier system is further supported by the strong R^2 value.

In vivo antithrombotic studies indicated that intranasal delivery dabigatran loaded nanoethosomes prolongs the anticoagulant effect, potentially offering efficient therapeutic approach for managing thrombotic conditions.

Key Words - Anticoagulant, Thrombosis, Dabigatran etexilate mesylate, Nanoethosomes, Sustained Release.

Graphical Abstract



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Reimagining the Fight Against AMR with Beddomeilactone Derived Molecule Targeting Drug-Resistant *Staphylococcus aureus*

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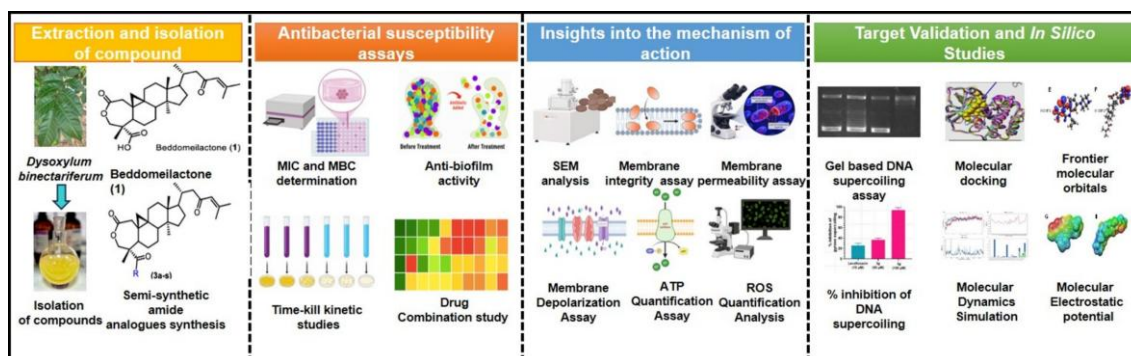
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Abstract

Antimicrobial resistance (AMR) is a major global health threat, creating an urgent need for antibacterial agents with novel chemical scaffolds and mechanisms of action. Natural products provide a rich source of potential antibacterial leads due to their structural diversity. In this study, we explored cycloartane triterpenoid-derived beddomeilactone amides from *Dysoxylum binectariferum* against *Staphylococcus aureus* and methicillin-resistant *S. aureus* (MRSA). A primary screening of 23 semi-synthesized beddomeilactone amide at a concentration of 50 µg/mL led to the identification of two active molecules (3g and 3s) against *S. aureus*. Further, a dose-dependent broth microdilution assay revealed 3g molecule as the most potent hit, exhibiting MICs of 5.7 µg/mL and 6.3 µg/mL against *S. aureus* and MRSA, respectively, indicating the critical role of the piperazine moiety in enhancing antibacterial activity. The potent molecule 3g exhibited bactericidal and bacteriostatic effects along with synergistic potential against *S. aureus* and MRSA, respectively. To elucidate its cellular effects, scanning electron microscopy and membrane-targeting assays were performed, revealing pronounced morphological alterations and membrane perturbation after treatment with 3g. Further investigation revealed that 3g also inhibited DNA gyrase-mediated DNA supercoiling by >90% at 100 µM. Molecular docking and molecular dynamics simulations supported stable interaction of 3g with DNA gyrase. Collectively, these findings identify 3g as a promising plant-derived antibacterial lead associated with pronounced membrane perturbations, while its DNA gyrase inhibitory activity suggests DNA gyrase as a putative intracellular target.

Keywords: Antimicrobial resistance (AMR), Beddomeilactone amide, DNA gyrase, *Dysoxylum binectariferum*, MRSA



Repurposing Nitrofurazone Against Drug-Resistant *Neisseria gonorrhoeae*: Targeting Glutamate Racemase at Two Functional Sites

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Abstract

Objective: The global emergence of antibiotic-resistant *Neisseria gonorrhoeae* (Ng) has substantially compromised available therapeutic options, necessitating the identification of novel drug targets and alternative therapeutic strategies. This study aimed to evaluate *N. gonorrhoeae* glutamate racemase (NgGR), a moonlighting enzyme involved in D-glutamate biosynthesis, cell wall integrity, and regulatory functions, as a potential therapeutic target and to identify inhibitors capable of targeting its catalytic and regulatory functions.

Methodology: A structure-based drug discovery strategy integrating structural modelling, molecular docking, and molecular dynamics (MD) simulations was employed to screen FDA-approved, natural-product, and Traditional Chinese Medicine compound libraries. Three candidate compounds—Agarocycbyne C (M1), Ficifuranone A (M2), and Nitrofurazone (M3)—were identified based on their predicted binding at the canonical catalytic site and the DNA gyrase-interacting allosteric interface of NgGR. Experimental validation was performed using *in vitro* racemization, bacterial cell viability, and isothermal titration calorimetry (ITC) assays.

Key Findings: All three compounds demonstrated favourable interactions with NgGR at both functional sites. Nitrofurazone exhibited the most promising dual-site inhibitory profile, with predicted disruption of both NgGR catalytic activity and its interaction with DNA gyrase. Experimental assays confirmed concentration-dependent inhibition of NgGR and significant reduction in *N. gonorrhoeae* survival. The antibacterial effect of Nitrofurazone was further enhanced in combination with ciprofloxacin. ITC confirmed high-affinity binding of Nitrofurazone to NgGR.

Significance:

This study provides the first evidence supporting dual-site inhibition of NgGR and establishes its potential as an alternative therapeutic target against drug-resistant *N. gonorrhoeae*. The identification of Nitrofurazone, an FDA-approved compound, as a dual-site NgGR inhibitor highlights a promising drug-repurposing strategy and provides a foundation for developing novel therapeutic approaches against drug-resistant gonorrhoea.

Keywords: *Neisseria gonorrhoeae*; Antimicrobial resistance; Glutamate racemase; Dual-site inhibitor; Nitrofurazone

Closing the Active-Learning Loop: Physics-Driven Generative RL for *De Novo* KRAS G12C Inhibitor Discovery

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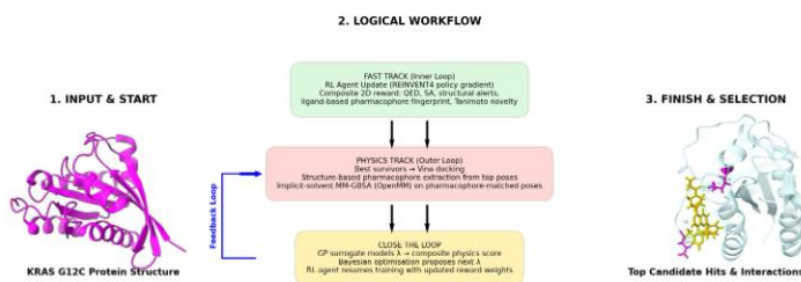
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Abstract

KRAS is one of the most frequently mutated oncogenes in human cancers; the mutation G12C is common in non-small-cell lung and colorectal cancer. Targeting it remains challenging due to its shallow pocket, hence the necessity to explore novel chemical scaffolds [1]. Generative reinforcement learning (RL) can explore vast chemical space; however, current workflows rely mostly on 2D-descriptor rewards or molecular docking scores, leading to poor binding predictions to generate suboptimal molecules. This workflow introduces a multilayered active learning approach with the introduction of physics-based methods in different steps to improve the generation of more accurate molecules in a stepwise manner. REINVENT 4 is fine-tuned with curated KRAS G12C bioactive inhibitors to bias the model towards a validated chemical space [2]. The RL scoring system then operates on a fast, effective ligand-based multiple-objective reward function that includes QED, SA, toxicity alerts, pharmacophore features, and chemical novelty to encourage diverse drug-like molecules through scaffold hopping. In this inner loop; the generated molecules go through a post hoc cascade: Vina scoring, structure-based pharmacophore feature extraction, and implicit-solvent MMGBSA of top candidates. These components are used in an external Bayesian optimisation loop, iteratively updating weights of the inner reward loop to enrich molecule generation towards higher geometric complementarity, structural novelty, and favourable energy values. After convergence, the final molecule generation is comprehensively profiled—assessed with QED, SA, SMARTS, Tanimoto diversity, and t-SNE projection—and undergoes physics-based validation, giving this work the best of both worlds; it seamlessly integrates generative AI with established drug discovery protocols to produce unique molecules for further wet lab validation.

Graphical Abstract

Closing the Active-Learning Loop: Physics-Driven Generative RL for *De Novo* KRAS G12C Inhibitor Discovery



Keywords: KRAS G12C Inhibitors, Generative RL; Scaffold Hopping; Bayesian Optimisation; Pharmacophore-Guided Generation; MM-GBSA.

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Engineering DNA Tetrahedron Nanocarriers for Targeted Glioblastoma Treatment

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Abstract

Glioblastoma multiforme (GBM) is a highly aggressive WHO grade IV primary brain malignancy characterized by extensive cellular heterogeneity, invasive growth, frequent recurrence, and poor therapeutic outcomes. Effective treatment is further hindered by the blood–brain barrier (BBB), which restricts the delivery of therapeutic agents to the tumor. Temozolomide (TMZ), the current standard-of-care chemotherapeutic agent, provides limited clinical benefit owing to inadequate tumor selectivity, systemic adverse effects, and the emergence of therapeutic resistance. In this study, we investigated tetrahedral DNA nanostructures (TDNs) as a programmable and biocompatible platform for TMZ delivery to GBM cells. To enhance tumor targeting, TDNs were functionalized with hyaluronic acid (HA), generating HA@TMZ-TDNs capable of exploiting CD44-mediated cellular recognition and uptake. The engineered nanostructures exhibited well-defined tetrahedral morphology, uniform nanoscale dimensions, structural stability, and efficient TMZ loading. *In vitro* evaluation in U87MG and LN229 GBM cell models demonstrated enhanced intracellular accumulation and greater cytotoxic efficacy of HA@TMZ-TDNs compared with free TMZ. These findings were supported by confocal fluorescence imaging and cell viability analysis. Importantly, HA@TMZ-TDNs also demonstrated improved penetration and therapeutic activity in a three-dimensional GBM spheroid model, resulting in enhanced suppression of spheroid growth and viability. Overall, the findings demonstrate that HA-functionalized TDNs can serve as an adaptable nanoplatform for targeted TMZ delivery and may help address key limitations associated with conventional GBM chemotherapy. This study highlights the potential of DNA nanotechnology for developing targeted and biologically responsive nanomedicine strategies for the treatment of GBM.

Keywords: Glioblastoma, Temozolomide, DNA nanocages, Targeted cancer therapy

Session 6

Advances in Biomedical Devices: Where Engineering Meets Healing

Biogenic Carbon Quantum Dots as Neoteric Inducers for Directing Chondrogenic Differentiation

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Abstract

Background:

Mesenchymal stem cells (MSCs) are central to regenerative medicine owing to their self-renewal capacity, multilineage differentiation potential, and ability to restore tissue function. Their differentiation into osteocytes, adipocytes, chondrocytes, neuroblasts, and fibroblasts enables therapeutic applications in bone and muscle repair, wound healing, and neurodegenerative disorders. However, clinical translation of MSC-based therapies is limited by challenges such as noninvasive administration with long-term cell tracking and the lack of biocompatible, cost-effective, and eco-friendly strategies for lineage-specific differentiation. Furthermore, efficient stem cell differentiation, migration, and in situ imaging remain essential for regenerative success.

In this context, materiobiology has increasingly explored carbon-based nanomaterials as modulators of MSC fate. Graphene quantum dots and carbon dots regulate osteogenic and adipogenic differentiation through pathways including BMP, TGF- β , MAPK, Wnt, and Notch, while enabling intrinsic optical tracking. Nevertheless, carbon-mediated chondrogenesis without exogenous growth factors remains underexplored.

Herein, we report biogenic carbon quantum dots (CQDs) synthesized from garlic peel waste as multifunctional nanomachines that direct chondrogenesis, enhance MSC migration, and enable simultaneous cell tracking. These eco-friendly CQDs exhibit strong photoluminescence, mitochondrial localization, and reactive oxygen species-mediated signaling, enabling growth factor-free chondrogenic differentiation and rapid wound closure. This waste-to-resource strategy highlights biogenic CQDs as promising chondrogenic inducers for regenerative medicine.

Materials and Methods:

Garlic peel agrowaste was collected from vegetable vendors in Uttar Pradesh, India, and used for carbon quantum dot (CQD) synthesis. All animal studies were approved by the Institutional Animal Ethics Committee (CPCSEA/AIP/2015/03/005) and conducted according to CPCSEA guidelines. Immortalized human feeder fibroblast (IHF) cells were obtained from Prof. Anis Feki (Geneva University Hospital, Switzerland). Human Wharton's jelly-derived mesenchymal stem cells (hWJ-MSCs) were cultured in low-glucose DMEM supplemented with fetal bovine serum and antibiotics following ICSCR approval (ICSCR/114/20(o)).

CQDs were synthesized via a hydrothermal process using garlic peel powder at 180 °C for 4 h and purified thereafter. Structural and optical characterization was performed using XRD, TEM/HRTEM, AFM, FTIR, XPS, Raman spectroscopy, UV-vis, photoluminescence, and TCSPC.

Cytocompatibility, cellular uptake, ROS generation, migration, stemness, and chondrogenic differentiation were evaluated using standard cell-based assays, flow cytometry, microscopy, qRT-PCR, and histology. Hemocompatibility and histocompatibility were assessed in Wistar rats. Statistical analysis was performed using ANOVA.

Results, Discussion and Conclusions:

Biogenic carbon quantum dots (CQDs) were successfully synthesized from garlic peel agrowaste via a hydrothermal route, yielding uniformly dispersed, spherical nanoparticles with an average size of ~5–6 nm. Structural and chemical characterization confirmed their polycrystalline carbon framework enriched

with oxygen-, nitrogen-, and sulfur-containing functional groups, imparting excellent aqueous dispersibility and excitation-dependent photoluminescence. These optical properties enabled efficient intracellular imaging of human Wharton's jelly-derived mesenchymal stem cells (hWJ-MSCs) without compromising cell viability.

Cytocompatibility studies demonstrated that CQDs were well tolerated by both immortalized human fibroblasts and hWJ-MSCs at biologically relevant concentrations, while preserving MSC surface markers and stemness-associated gene expression. Notably, CQD internalization led to controlled intracellular reactive oxygen species (ROS) generation, which played a pivotal signaling role rather than inducing oxidative stress. This ROS modulation significantly enhanced MSC migration, as evidenced by accelerated wound closure in scratch assays.

Most importantly, CQDs robustly directed chondrogenic differentiation of hWJ-MSCs in the absence of conventional growth factors. Enhanced deposition of sulfated glycosaminoglycans and collagen, along with upregulated expression of key chondrogenic markers (COL II, COL X, and ACAN), confirmed effective lineage commitment comparable to chemically induced controls. Histological analyses further corroborated mature cartilage-like extracellular matrix formation.

In conclusion, garlic peel-derived CQDs function as a multifunctional, biocompatible nanoplatform capable of simultaneous stem cell imaging, migration enhancement, and growth factor-free chondrogenic induction. This waste-to-wealth strategy offers a sustainable and translationally promising approach in materiobiology and regenerative medicine, addressing critical limitations associated with conventional differentiation cues.

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Aptasensor with Spatially Expanded Bioreceptor Architecture Using DNA Nanotetrahedra for Nanoscale-Controlled Electrochemical Detection of Interleukin-6

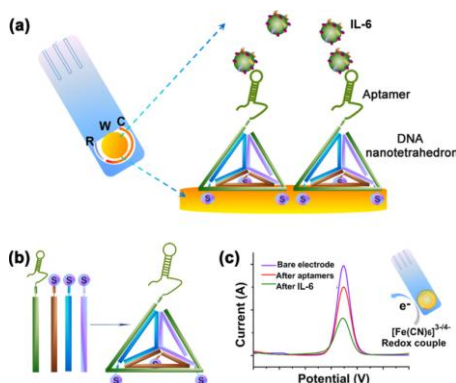
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Abstract

Surface-confined aptamers often suffer from reduced recognition efficiency because uncontrolled probe orientation, molecular crowding, steric hindrance, and electrode-probe interactions can restrict target accessibility and aptamer conformational freedom [1]. DNA tetrahedra provide a rigid and programmable three-dimensional scaffold that spatially separates recognition elements from the electrode while enabling controlled probe spacing, upright orientation, and improved target accessibility [2-3]. Here, we exploit this concept as a device-engineering strategy by treating tetrahedral anchoring valency as a tunable nanoscale parameter for interfacial bioreceptor organization. Four tetrahedral DNA nanostructure configurations carrying an interleukin-6 (IL-6) aptamer at the apex and differing in the number of thiolated anchoring vertices were assembled and evaluated on gold screen-printed electrodes. Electrochemical impedance spectroscopy was used to determine how progressive control of electrode attachment influences charge-transfer resistance and target-induced interfacial modulation. Among the tested architectures, the tripodally anchored aptamer-TDN produced the most pronounced interfacial response, with a baseline charge-transfer resistance of approximately 9011 Ω and the largest change after IL-6 recognition, indicating improved structural presentation and target accessibility. Under optimized conditions, the platform displayed a linear response from 0.0001 to 0.001 pg/mL, with a detection limit of 5.71 ag/mL and a quantification limit of 19 ag/mL. The sensor also discriminated IL-6 from IL-8, TNF- α , and C-reactive protein and retained analytical performance in artificial serum. These findings demonstrate that DNA nanotetrahedra can function not only as probe carriers but also as programmable interfacial engineering elements. Rational control of nanoscale anchoring geometry enables accessible, ordered, and sensitive bioreceptor interfaces for advanced biomedical devices.

Graphical Abstract



Keywords: Tetrahedral DNA nanostructure; Aptasensor; Interleukin-6; Interfacial bioengineering; Electrochemical biosensing

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Assessment of Hydroxyapatite Coating Mechanical Integrity in a Novel Pedicle Screw Design

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Abstract

Background

Pedicle screw loosening is still a major concern in spinal fixation. It is strongly influenced by the mechanical strength at the screw-bone interface. Hydroxyapatite (HAp) coatings have been reported to promote osseointegration. However, poor coating adhesion strength may weaken the mechanical integrity of the coating during screw insertion. This study evaluated the effect of plasma-sprayed HAp coating thickness on the mechanical integrity of a novel pedicle screw.

Methods

A novel pedicle screw was developed by considering the different mechanical properties of the cortical and cancellous bone. Finite element analysis combined with a design of experiments (DoE) approach was used to optimize screw geometry. The optimized design was then experimentally validated and showed higher pull-out strength than the control screw. A high-quality HAp coating was applied to the novel screws using plasma spraying, and three coating thicknesses were evaluated. Fresh pig cadaveric vertebrae were used for the screw insertion tests. The pedicle screw trajectory was determined using a previously established method and confirmed by X-ray imaging. The screws were inserted at 3 rpm using a Torsion Test System, and both Insertion and removal torque were recorded. The coating integrity and delamination were determined using a Leica digital microscope and inbuilt image-analysis software.

Results

The results show that HAp coating thickness affects coating integrity during insertion. Coating thickness more than 100 μm showed large patches of delamination, whereas 80 μm coating thickness showed less delamination. The results also indicate that an increase in coating thickness was associated with a higher likelihood of coating failure. Therefore, an optimal coating thickness should be selected for pedicle screws for coating stability under clinically relevant loading conditions.

Conclusion

HAp coating thickness is an important factor in maintaining coating integrity during screw insertion. An optimal coating thickness may reduce the risk of coating delamination. Combining an appropriate coating thickness with optimized screw geometry may improve the mechanical performance of the screw-bone interface and potentially reduce the risk of screw loosening.

Keywords: Pedicle screws; Coating integrity; HAp coating; Finite element analysis; Design of experiments

Development of a Portable Wearable Sweat Glucose Monitoring Device Based on a Non-Enzymatic Paper Field-Effect Transistor Sensor

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Abstract

Diabetes Mellitus is a chronic health condition that has affected people worldwide over the past decades, with its prevalence increasing at an alarming rate. This condition emphasises the need for inexpensive, reliable, and accessible glucose-monitoring technologies. Our study reports the development of a portable electronic system to quantify sweat glucose concentration using a cellulose paper field-effect transistor (PFET) sensing strip connected to an Arduino UNO. The sensing strip utilises a dual-metal-based silver (Ag) nanoparticle (NP)-incorporated cuprous oxide (Cu₂O) dispersed on reduced graphene oxide (Ag-Cu₂O@rGO) as the active channel material, enabling enzyme-independent glucose detection. The PFET sensor is combined with a custom-designed, low-power digital readout circuit that uses an INA219 current-sensing module to translate the sensor response into a real-time digital display via a compact, multimeter-like interface. The developed portable device was tested using clinical patient samples and demonstrated reliable glucose quantification. A PFET-based disposable glucose-sensing strip, combined with a handheld electronic reader, enables wireless monitoring and provides an inexpensive, people-friendly solution for point-of-care (PoC) continuous glucose monitoring applications. The described method demonstrates excellent analytical performance, characterised by rapid response, high sensitivity, and strong selectivity.

Index Terms- PFET, POC devices, rGO-based NC, Wearable glucose sensor

Self-Crosslinking Chondroitin Sulfate–Poly(L-lysine) Hydrogels as Glutaraldehyde-Free Injectable Cartilage Mimics

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Abstract

Injectable hydrogels are attractive for repairing focal cartilage defects because they conform to irregular lesions and can be delivered arthroscopically. Most, however, rely on small-molecule crosslinkers such as glutaraldehyde (GA), which is cytotoxic on prolonged exposure and produces densely crosslinked, brittle networks that fail under the cyclic compressive loading experienced in joints. A material that gels on its own, from components already present in cartilage, would avoid both problems. However, self-crosslinking systems must still reach cartilage-relevant stiffness without sacrificing toughness.

We address this with a two-component hydrogel built from cartilage's own building blocks: chondroitin sulfate A, oxidized to introduce aldehyde groups (CSA aldehyde), and poly(L-lysine) (PLL) as a synthetic substitute for the protein component. On mixing, aldehydes and primary amines condense instantly into Schiff base crosslinks, forming a gel without any added crosslinker, initiator, or catalyst. Properties were tuned by PLL degree of polymerization (DP 15–50) and aldehyde:amine molar ratio and benchmarked against GA-containing analogues (CSAGA-PLL).

Increasing amine content raised elasticity, with CSA-PLL storage moduli reaching ~75 kPa and ultimate compressive strengths up to ~6 MPa, approaching native articular cartilage. Adding GA increased storage modulus by nearly an order of magnitude (~500 kPa) but collapsed the yield strain and linear viscoelastic region, confirming that over-crosslinking trades toughness for stiffness. FTIR and NMR verified Schiff base formation and quantified residual polymer. Cells on preformed CSA-PLL gels remained viable at levels comparable to tissue-culture plastic, establishing self-crosslinking CSA-PLL as a GA-free injectable cartilage mimic.

Keratin Based Conductive Nanofiber Scaffold for Advanced Tissue Engineering Application

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Abstract

In the current study, keratin-based conductive nanofibers are produced using the electrospinning technique, and their potential as scaffolds for tissue engineering has been investigated. Human hair keratin was combined with poly(vinyl alcohol) (PVA) and polypyrrole (PP) in an aqueous solution. Some advanced methods were used to characterize the nanofibers. The resulting PVA-keratin-PP nanofiber was smooth, random, and had a three-dimensional network structure that mimicked a web, according to SEM assessment. The average diameter of the nanofibers was between 100 and 200 nm. FTIR study has demonstrated the presence of a hydrogen bond interaction between keratin and PVA. Dermal fibroblasts (NHDF) and mouse embryonic stem cells have been employed in in vitro cell culture investigations of the scaffold, indicating their biocompatibility and non-toxicity. Additionally, immunocytochemical research demonstrated that NHDF cells could adhere to and proliferate on scaffolds made of keratin nanofibers. Ultimately, the keratin-PVA-PP nanofiber scaffold demonstrated promise for use in a wide range of tissue engineering applications.

Keywords: Biomaterials; Keratin; Electrospinning; Nanofiber scaffolds; Tissue engineering.

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Biosensor Design for Prognosis and Diagnosis of Chronic Kidney Disease

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Abstract

Chronic kidney disease (CKD) is a growing global public health problem, affecting almost 10-16% of the world's population. Comorbidities like diabetes, hypertension, and post-COVID complications has intensified progression to CKD, creating a huge commercial market for diagnostics and therapeutics. Given its asymptomatic progression, CKD is diagnosed late, creating unmet needs in early screening and preventive care markets. This delayed detection drives substantial direct and indirect healthcare expenditures, positioning CKD as a critical area of economic concern and strategic opportunity. Standard confirmatory procedures for CKD are blood and urine analysis with ultrasound for confirmation.

The work encompasses design of electrochemical biosensor for detection of early stages of CKD. CysC and Neutrophil gelatinase-associated lipocalin (NGAL) has been established as a diagnostic and prognostic biomarker especially for the pre-clinical stages of CKD, thus presenting themselves as dependable predictors of the progression.

With the aim of designing diagnostics, a multidisciplinary methodology was utilized involving bioinformatics, biophysics, biochemistry and electrochemistry. Docking followed by molecular dynamics simulations were employed to evaluate the binding affinity and stability of ligand and target biomarkers. Subsequently, fluorescence and electrochemical techniques—square wave voltammetry, differential pulse voltammetry, cyclic voltammetry, and electrochemical impedance spectroscopy (EIS)—were systematically compared for to assess the accuracy of CysC and NGAL detection.

The sensitivity obtained is comparable with available CysC and NGAL detection methods yet cost effective and robust

Overall, we have achieved our goal of developing a specific and sensitive biosensor for detection of CKD with prolonged shelf life.

Keywords: Non- communicable disease, CKD, Diagnostic biomarker, Prognostic biomarker, Electrochemical analysis, Translational biosensing

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Development of Gelatin-CMC Biopolymeric Scaffolds for Transdermal Delivery of Mupirocin: A Replacement for the Traditional Ointment Approach

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Abstract

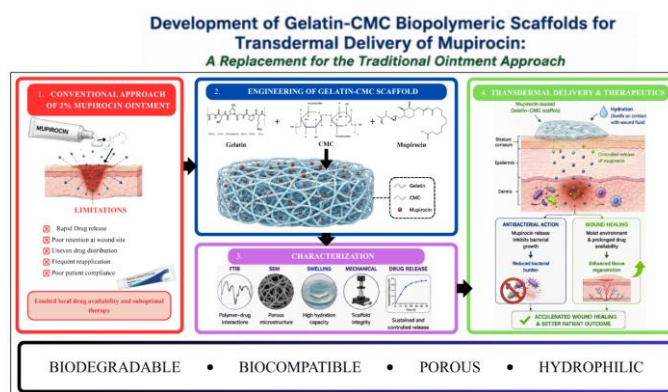
Mupirocin has long been a trusted first-line topical antibiotic for managing superficial bacterial skin infections, yet its conventional ointment formulation leaves much to be desired. Issues such as poor skin penetration, inconsistent bioavailability, and the absence of any controlled release mechanism have persisted as clinical limitations — and in an era of growing antibiotic resistance, subtherapeutic drug concentrations at the infection site are a concern that can no longer be overlooked. This study sets out to address these gaps through the development of biopolymeric scaffolds based on a Gelatin–Carboxymethyl Cellulose (CMC) complex, designed to serve as a more effective and intelligent transdermal delivery system for Mupirocin.

The scaffolds were built from the ground up by formulating Gelatin-CMC hydrogels, which were crosslinked using three different polymerising agents to identify the combination that yields the most structurally stable and mechanically robust hydrogel matrix. These optimised hydrogels were then converted into porous, biocompatible scaffolds through freeze-drying — a process that preserves the integrity of the polymer network while enabling efficient drug loading. Gelatin and CMC were chosen not arbitrarily, but for their well-established biocompatibility, biodegradability, and the flexibility they offer in fine-tuning physicochemical properties for skin-based applications.

In vitro drug release and permeation studies reveal that these scaffolds are capable of delivering Mupirocin in a sustained and active manner over approximately 48–72 hours — far exceeding what a conventional ointment can offer. This extended-release window holds real promise for maintaining therapeutic concentrations at the target site, improving antimicrobial outcomes, and reducing the likelihood of resistance development.

Ultimately, this work presents Gelatin-CMC biopolymeric scaffolds as a scientifically grounded and clinically meaningful step forward in topical antibiotic delivery.

Graphical Abstract



Keywords: Composite Biopolymer, Transdermal Drug Delivery, Mupirocin, Gelatin-CMC Scaffolds, Hydrogels.

Next Generation Molecularly Imprinted Polypyrrole Sensor for Point of Care Electrochemical Sensing of Estradiol

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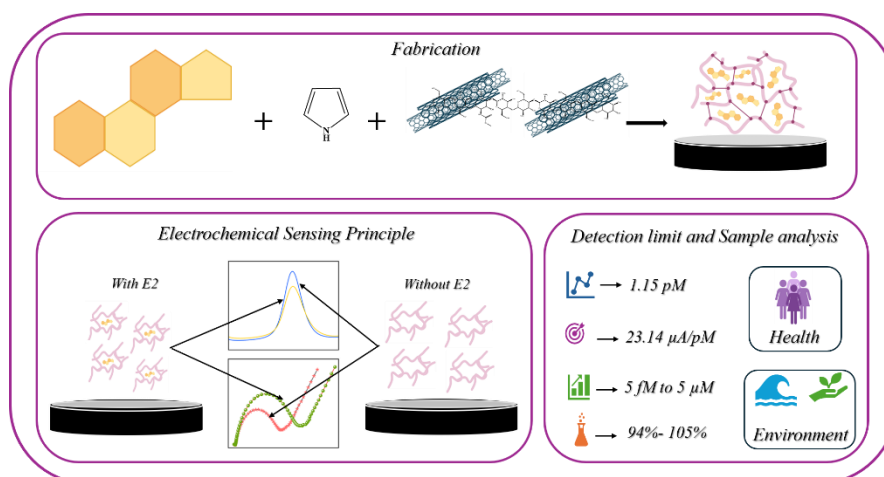
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Abstract

Female hormones both endocrinal steroids and xenobiotic analogues trigger the reproductive dysfunctions including fecundity and gestational complications. This work reports an electrochemical sensor for quantifying E2 using molecularly imprinted pyrrole-based polymer/MWCNT-Cht/GCE (P-MIP). MWCNT improves the sensitivity and MIP serves as a biomimetic matrix for specific determination of E2. E2 is indirectly detected using surrogate oxidation peak current of the potassium ferricyanide redox probe. This sensor exhibits linear range from 5 fM to 5 μ M and a detection limit of 1.15 pM with high selectivity, high sensitivity (23.14 μ A/pM) and good reproducibility. Fabricated sensor subjected to determine the E2 in drinking water and tap water with good recoveries (94%~105%). This study offers the versatile platform for sensitive monitoring of E2 in environmental samples can be further useful for biological monitoring.

Graphical Abstract



Keywords: Electrochemical sensors, Electropolymerization, Estradiol, Pyrrole, Molecularly Imprinted Polymer (MIP), Steroids, Breast cancer

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A Comparative Study of Management of Wound with Hyperbaric Oxygen Therapy Along with Ionic Silver Dressings in Burn and Plastic Surgery Department in AIIMS Rishikesh

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Abstract

Introduction

Hyperbaric oxygen therapy has proved to be very effective in management of chronic wounds. Chronic wounds have a paucity of oxygen supply thereby impairing its healing. This study was a UCOST sponsored project in the management of wounds with ionic silver and hyperbaric oxygen therapy in patients with chronic wounds who report in OPD and emergency of the Department of Burn and plastic surgery, AIIMS Rishikesh. The aim of this study was to evaluate the outcome of wound healing with ionic silver and hyperbaric oxygen therapy.

Methods

This study was done in patients with chronic wounds with ionic silver and hyperbaric oxygen therapy who reported in the OPD and emergency of the Department of Burn and Plastic surgery, AIIMS Rishikesh. Demographic profile of the patients was noted in a proforma and a strict PAC protocol with a chest X ray and ENT examination was done in all cases. The patients were given 10-20 sessions of HBOT ranging from 1.5 to 2.4 ATA over 90 minutes 5 days in a week in a multiplace chamber. Patients were evaluated on the basis of Bates Jensen criteria and wound healing parameters.

Results

87 patients of chronic ulcers were subjected to treatment with ionic silver and hyperbaric therapy with good results. The majority of the ulcers healed with good results. Wound cultures revealed *Pseudomonas* followed by *Staphylococcus* and MRSA organisms.

Conclusion

The hyperbaric oxygen therapy potentiates the role of ionic silver in chronic wounds with accelerated healing times and decreased morbidity. It leads to a better wound bed preparation facilitating skin grafting. Ionic silver preparations are very effective against *Pseudomonas* infections,

Keywords: hyperbaric oxygen, ionic silver, *Pseudomonas*, non healing ulcers

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Regenerating Cartilage Using Bioenergetics Hydrogel

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Abstract

Articular cartilage exhibits a limited intrinsic capacity for repair due to its avascular nature, restricted nutrient diffusion, and low density of resident progenitor cells. Consequently, even minor cartilage defects often progress to osteoarthritis (OA), a debilitating joint disease projected to affect over one billion people by 2050. Although hydrogels have emerged as promising cartilage-mimicking scaffolds because of their high water content and tissue-like architecture, their clinical translation remains limited by inadequate mechanical strength, poor tissue integration, insufficient support for cellular metabolism, and limited resistance to oxidative stress.

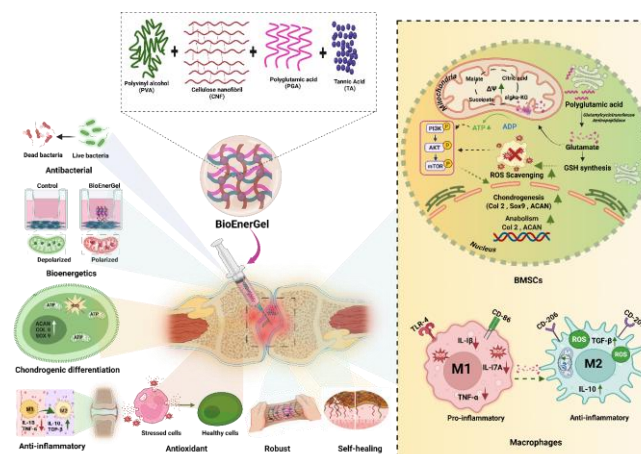


Figure 1: Schematic representation of multifunctional nature of bioenergetic hydrogel (BioEnerGel) for cartilage repair

To address these challenges, we developed a multifunctional bioenergetics hydrogel designed to promote cartilage regeneration by integrating mechanical resilience with metabolic support. The hydrogel comprises polyvinyl alcohol (PVA) physically crosslinked with tannic acid and reinforced with cellulose nanofibers to provide enhanced mechanical strength, self-healing capability, and robust tissue adhesion. Polyglutamic acid (PGA) was incorporated as a bioenergetic component to improve cellular metabolic activity and maintain chondrocyte homeostasis. *In vitro* studies demonstrated excellent cytocompatibility, enhanced mitochondrial membrane potential as determined by JC-1 staining, and reduced inflammatory responses, confirming the hydrogel's bioactivity and biosafety. Therapeutic efficacy was further evaluated in a drill injury-induced OA rat model using micro-computed tomography, gait analysis, and histological assessment. The bioenergetics hydrogel significantly enhanced neotissue formation, promoted cellular infiltration and extracellular matrix deposition, and restored hyaline-like cartilage, as evidenced by increased Sox-9 and collagen type II expression. Collectively, this bioenergetics hydrogel represents a promising regenerative platform that combines structural robustness, self-repair, tissue adhesion, and metabolic regulation to achieve durable cartilage regeneration for osteoarthritis treatment as illustrated in Figure 1.

Keywords: Osteoarthritis; Bioenergetic hydrogel; Metabolic regulation; Mitochondrial membrane potential; Cartilage repair

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Liquid Crystal Based Optical Aptasensr for the Detection of Tumor Biomarker

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Abstract

An aptamer-functionalised liquid crystal (LC) droplet platform was developed for the optical detection of platelet-derived growth factor BB (PDGF-BB), a tumour-associated biomarker. PDGF-BB-specific aptamers were electrostatically immobilised onto surfactant-stabilised 4-cyanopentyl biphenyl (5CB) LC droplets patterned on silane-modified glass, producing characteristic four-clover fan-like textures under a polarised optical microscope (POM). Upon target recognition, the planar LC alignment transitioned to a homeotropic configuration, generating a distinct uniform dark optical response. The sensing platform was optimised by adjusting surfactant concentration and aptamer loading, enabling PDGF-BB detection in diluted human serum down to 10 pM. Sensor sensitivity was further evaluated through optical transmission measurements using a photodetector under crossed polarizers with monochromatic laser illumination. Specificity was assessed against PDGF-AA, PDGF-AB, and IgG under identical experimental conditions. Negligible changes in POM textures and optical transmission upon exposure to non-target biomolecules confirmed the platform's selective response toward PDGF-BB. These findings demonstrate the potential of aptamer-functionalised LC droplets as a sensitive and label-free optical sensing strategy for tumour biomarker detection in complex biological samples.

Carbon Quantum Dot-Hydrogel Nanocomposite For Chondrogenic Differentiation Induction in Mesenchymal Stem Cells

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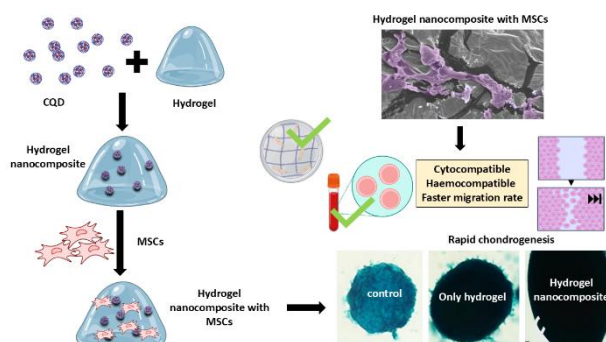
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Abstract

Articular cartilage injury is quite common in traumatic and sports-related accidents, as well as inflammatory conditions such as osteoarthritis. The limited regenerative capacity of cartilage due to the absence of blood vessels and nerves makes the repair challenging. Traditional chondrocyte grafts fail to restore the native tissue architecture and microenvironment. In this quest, tissue engineering offers solutions such as fabrication of porous 3D scaffolds, providing superior structural support and a microenvironment for cell growth and differentiation. Hydrogels are promising scaffold materials because of their tunable water content and porous structure, mimicking the extracellular matrix (ECM). An addition of nanoparticles to these hydrogels can improve their mechanical and biological properties. Carbon quantum dots (CQDs) with hydrophilic surfaces, chemical stability, functional groups, and the potential to guide stem cell fate offer a viable biocompatible option. Thus, CQD-integrated hydrogel nanocomposites may offer the synergistic effects of combining the structural and biological advantages of hydrogels and the chondrogenic potential of CQDs. Here, we developed a CQD-based hydrogel nanocomposite and investigated its ability to direct stem cell differentiation toward chondrocytes. Notably, full chondrogenic differentiation was achieved in 14 days on the nanocomposite as compared to 18 days on neat hydrogel and tissue culture plates. The results indicate that the combination effect of CQDs and hydrogel is able to induce faster chondrogenesis, thus providing a potential scaffold-based regenerative solution.

Graphical Abstract



Keywords: Hydrogel nanocomposites; Carbon quantum dots; Mesenchymal stem cells; Cell fate determination; Chondrogenesis; Scaffold development

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Development of an Electrochemical Sensor Using a Molecularly Imprinted Polymer for the Rapid Detection of Astaxanthin in Environmental Samples

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Abstract

Astaxanthin (ASTX) is a xanthophyll pigment found predominantly in marine microorganisms and is the colorant that gives salmon its distinctive pink-red color. With its high antioxidant properties, it can protect cells from damage induced by reactive oxygen species (ROS). ASTX NPs in agriculture facilitate the uptake of nutrients by plants more effectively and sustain chemical balance, mainly under heavy metal stress, which helps plants to withstand harsh environmental conditions. The detection of ASTX is vital, as it serves as a biomarker of biological activity, soil fertility, and environmental health, highlighting its contribution to enhancing plant resistance. Existing detection technologies, including HPLC-DAD and LC-MS, are efficient, but it is costly, labour-intensive, and require skilled personnel. To overcome this, a novel biosensor is fabricated by employing Screen-Printed Electrodes (SPE) modified with molecularly imprinted polymers and metal-organic frameworks. Further, the electrochemical sensor facilitates quicker and cheaper detection of ASTX within a few seconds. Electrodeposition of metal-organic frameworks onto the SPE, followed by MIP coating, is the main approach used to selectively detect ASTX in the environmental sample. The developed biosensor was optimized for pH, temperature, concentration, and reproducibility studies. As a result, it showed a linear range of 0.2 nM to 500 nM, and a lower detection limit of 0.2 nM. The fabricated biosensor has future applications in both environmental monitoring and modern diagnostics.

Keywords: *Astaxanthin, Electrochemical Sensing, Screen-Printed Electrode, Molecularly Imprinted Polymer, Metal-Organic Framework, Environmental sample analysis*

Session 7

Artificial Intelligence: The New Era of Healthcare

Smart Health: An AI-Powered Multi-Disease Prediction and Assistance System

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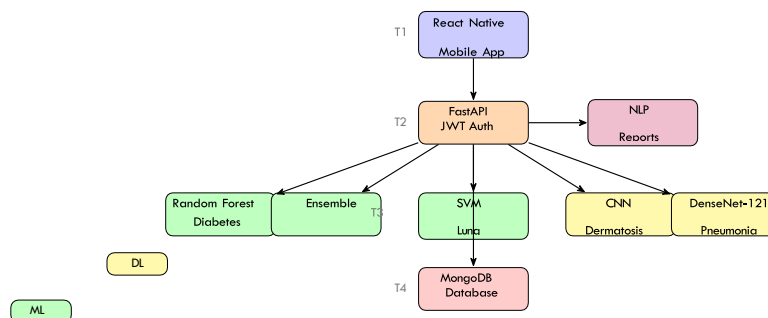
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Abstract

Despite significant advances in technology, accurate and timely detection of a certain disease continue to be amongst the most challenging tasks faced by modern medical practitioners, especially in places where access to specialists and infrastructure is limited. As we discovered during the literature review, almost every disease-detecting AI application on the market focuses on one particular condition, which, in practice, is rather restricting given that patients often face several health issues at once. In this research paper, we present YouCare, our unique approach to multi-condition diagnostics that integrates classic machine learning and deep learning techniques into a single platform. Five diseases can be predicted using the app: diabetes, heart disease, risk of lung cancer development, dermatosis (or skin lesions) and pneumonia. Classic ML algorithms such as Random Forest, SVM and soft-voting combination of Random Forest and XGBoost were applied to tabular data. For visual analysis, a custom three-block CNN was trained to detect seven types of skin lesions, while for binary detection of pneumonia, DenseNet-121 was fine-tuned. Our platform relies on the FastAPI architecture, NLP pipeline, which processes textual data of the submitted medical documents, conversational AI assistant and React Native front-end design. Average accuracy in all modules varies between 80% and 95%, although we prioritized recall in our algorithm design due to the critical nature of undiagnosed diseases in the healthcare setting.

Graphical Abstract



Legend:

Fig. 1. YouCare four-tier system architecture. Green = ML (tabular) modules; Yellow = DL (image) modules; Purple = NLP module.

Keywords: Healthcare AI, Multi-disease Prediction, Convolutional Neural Network, FastAPI, Deep Learning, NLP, LLM, Groq, Transfer Learning, Clinical Decision Support

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Artificial Intelligence Inspired Serotype Independent Multi-Epitope Vaccine for *Streptococcus pneumoniae*

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Abstract

Streptococcus pneumoniae is the leading cause of respiratory deaths globally. The available polysaccharide vaccines and glycoconjugate vaccine provide suboptimal protection and doesn't have similar response against all the targeted serotypes. Current work has focused on the design of multi-epitope protein-based vaccine against *Streptococcus pneumoniae* which can provide better immune response and can cover multiple serotypes through the conserved epitope targeting. The conserved as well as non-conserved B cell and T cell epitopes in the diverse proteome of *Streptococcus pneumoniae* were identified using artificial intelligence and bioinformatics tools. Epitopes were selected based on their strong IFN- γ stimulation and limited allergenic response. β -defensin 1 was added as an adjuvant, and linkers were employed to link the epitopes and adjuvants in the final vaccine. The vaccine showed a high antigenicity score, was non-allergenic, non-toxic, and demonstrated stable physicochemical properties, including good solubility. Docking results indicated a ~ 14.5 kcal/mol binding affinity for the TLR4-vaccine interaction. MD simulations confirmed stability, with RMSD and hydrogen bond counts indicating consistent structure. Immune simulations showed robust responses, including memory formation in B and T cells, with a shift from IgM to IgG1/IgG2 dominance. Cytokine analysis revealed peak IFN- γ levels post-exposure, highlighting the vaccine's strong immune-stimulating potential. Further the vaccine construct was successfully expressed and purified using *E. coli* (BL21) and have shown promising results in PBMC stimulation as well as in *In-vivo* animal immunization studies.

Idea to Reality: An AI-Assisted Framework Enabling Clinicians to Independently Build Longitudinal Public Health Monitoring Systems

Joel Rajan Mathew^{1*}, Vartika Saxena¹

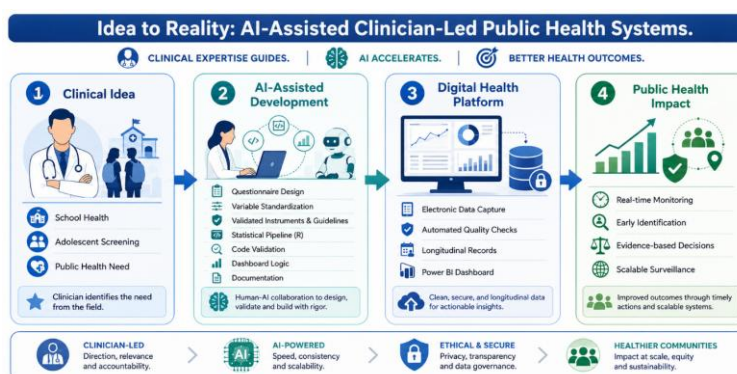
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Abstract

Artificial Intelligence (AI) is extending beyond diagnostics to enable clinicians themselves to design and deploy digital health solutions. Yet most healthcare professionals lack formal training in programming, sustaining a gap between public health need and technological implementation. This work presents an AI-assisted framework that translates a clinical idea into a functional, longitudinal monitoring system through structured human–AI collaboration, and demonstrates it via a school health registry. The framework was applied while developing the AIIMS School and Adolescent Public Health Registry under the Department of Community Medicine, AIIMS Rishikesh. Generative AI supported questionnaire refinement, variable standardization, integration of validated instruments and reference standards, statistical-pipeline generation, code validation, dashboard logic, and documentation, while an R pipeline (WHO 2007 anthropometric references) and Power BI enabled reproducible derivation and interactive visualization. Clinical expertise remained central to defining indicators, selecting validated tools, and validating outputs; AI accelerated software development without replacing domain judgement. A flag-never-drop data-quality principle ensured missing values were logged, never silently imputed. In its first round (77 adolescents, two schools), the platform delivered standardized electronic data capture, automated quality checks, longitudinal records, and a live nutritional-status dashboard, with anaemia, blood pressure, dental, and mental-health screening modules architected for subsequent rounds. This proof-of-concept shows how AI can democratize digital health innovation, empowering clinicians to independently build scalable surveillance and decision-support systems. The approach is transferable to non-communicable disease surveillance, community registries, and national health-monitoring initiatives.

Graphical Abstract



Keywords: Artificial intelligence; Digital health; School health registry; Adolescent health; Health surveillance; Power BI; Longitudinal monitoring; Community medicine

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Machine Learning Algorithms for Predicting Micronutrient Deficiency Risk: A Systematic Review and Nutrient-Specific Meta-analysis

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Abstract

Background/Objectives: Micronutrient deficiencies are common. Universal biomarker testing is often not practical. Machine learning models may help with targeted screening, but their performance and generalisability are still unclear. This review assessed model classification for individual micronutrients using separate meta-analyses in clinical and community settings.

Methods: A PRISMA-guided search was done from database inception to 1 July 2026. Studies on human model development or validation that predicted laboratory-confirmed micronutrient deficiency were included. For each study, one independent validation or test-set AUROC was chosen. AUROCs were logit-transformed and analysed separately with restricted maximum-likelihood random-effects models. Standard errors were taken from reported confidence intervals or calculated from sample and class counts. Nutrients with fewer than three comparable studies were summarised narratively.

Results: Nine studies were included in three quantitative syntheses. For low-ferritin iron deficiency, the pooled AUROC was 0.916 (95% CI 0.831–0.960; $I^2=99.7\%$). For vitamin D deficiency below 50 nmol/L, the pooled AUROC was 0.920 (95% CI 0.414–0.995; $I^2=99.8\%$). Vitamin B12 models had a pooled AUROC of 0.760 (95% CI 0.506–0.908; $I^2=95.1\%$). Iron-deficiency anaemia and folate deficiency had fewer than three comparable estimates. There was not enough biomarker-confirmed evidence for zinc, iodine or vitamin A. Internally validated models with near-perfect results had a strong effect on the iron and vitamin D summaries.

Conclusion: Machine learning may provide useful discrimination for iron and vitamin D deficiency and moderate performance for vitamin B12 deficiency. However, high heterogeneity, limited external validation and inconsistent diagnostic thresholds make it difficult to interpret the summary estimates for clinical use. Prospective multicentre validation, standardised outcome definitions, calibration reporting and decision-curve analysis are needed before these models can be used in routine clinical practice.

Keywords: machine learning; micronutrient deficiency; iron deficiency; vitamin D deficiency; vitamin B12 deficiency

Impact of Educational Attainment on Cognitive Performance in Leprosy

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Abstract

Background: There has been awareness of cognitive impairment in leprosy patients, but little is known about how educational status is related to cognitive functioning.

Methodology: The aim of the study was to evaluate the association between educational attainment and cognitive performance in leprosy patients. A cross-sectional study was conducted with 50 patients with multibacillary leprosy. The Mini-Mental State Examination (MMSE) was used to measure cognitive performance. There were three categories of education level: Middle education, Secondary/high-school education, and Higher education. Cognitive performance was compared between educational groups, and a multivariable linear regression was used to assess the independent effect of education on MMSE scores, after adjusting for demographic and clinical characteristics.

Results: Fifty patients with multibacillary leprosy were included in the analysis. Mean MMSE scores increased with educational attainment, from 23.45 ± 4.31 in the Middle Education group to 24.46 ± 3.48 in the Secondary/High School Education group and 26.67 ± 2.58 in the Higher Education group. Although the overall difference in MMSE scores among educational groups was not statistically significant (ANOVA: $F = 1.72$, $p = 0.190$), participants with higher educational attainment consistently demonstrated better cognitive performance across several MMSE domains, particularly attention, reading, and writing.

Conclusion: Cognitive performance should be interpreted with regards to education in leprosy. Assessment of MMSE might enhance cognitive screening, and aid in selecting patients who need additional neuropsychological testing.

Graphical Abstract

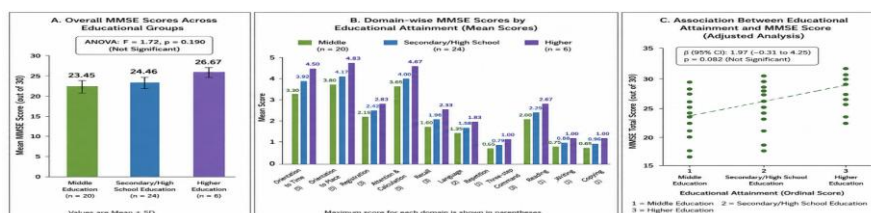


Figure-Overall MMSE scores, domain-wise cognitive performance, and the association between educational attainment and MMSE scores among patients with multibacillary leprosy. Data are presented as mean $\pm$ SD. One-way ANOVA: $F = 1.72$, $p = 0.190$.

Keywords: Leprosy, Cognitive Impairment, MMSE, Functional Independence, Multidrug Therapy

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Deploying the Drug Repurposing strategy for the Identification of Selective COX-2 Inhibitors for Use as Anti-inflammatory and Anti-Cancer Agents

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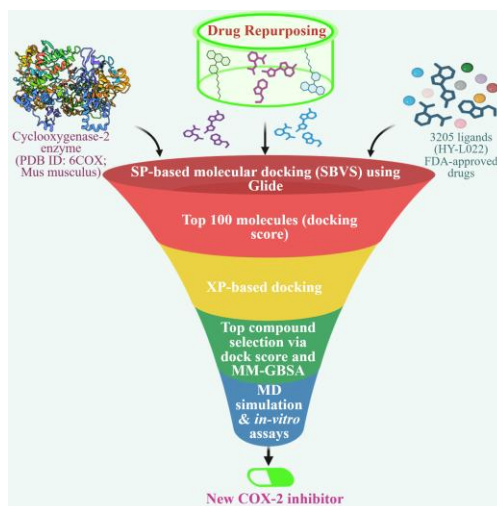
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Abstract

The dominant adverse events related to the cardiovascular system, nephrotoxicity, and liver toxicity associated with selective COX-2 inhibitors demand new inhibitors or modifications in the existing scaffolds. Among numerous drug discovery strategies, drug repurposing or repositioning is a major approach and a more rational, validated alternative to traditional drug discovery. In the present research, we employed the drug repurposing of 3205 FDA-approved drug molecules reported in MedChem Express library (HY-L022), and performed structure-based virtual screening (SBVS), followed by molecular docking, molecular mechanics, and molecular dynamics (MD) studies, to identify a hit lead. The cumulative analysis of the outcomes identified entecavir as the most promising lead, with a docking score of -10.546 kcal/mol and an MMGBSA score of -49.87 kcal/mol. In contrast, the reference drug, celecoxib, exhibited docking and MMGBSA scores of -11.687 kcal/mol and -75.57 kcal/mol, respectively. The MD simulations of 100 ns revealed that the protein-ligand complex is stable under small, abrupt forces, and that interactions such as hydrogen bonding, hydrophobicity, and water bridging are maintained at the active site of COX-2 throughout the experiment. The results from *in silico* studies were further corroborated by *in vitro* experiments, which were consistent with the *in-silico* findings. The studies present entecavir as a promising lead against COX-2 for the management of inflammation and cancer. The primary biological validation will be further expanded to *in vivo* experiments and, if required, lead optimization to develop more promiscuous and selective COX-2 inhibitors for use against cancer and inflammation.

Graphical Abstract



Keywords: Drug Repurposing; Selective COX-2 Inhibitors; Inflammation & Cancer; Molecular Docking; Molecular Dynamics

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Poster Session

Poster Presentations

Phytochemical Characterization, Fractionation, and Antioxidant Potential of Himalayan Stinging Nettle Foliage (*Urtica dioica* L.)

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Abstract

Himalayan stinging nettle (*Urtica dioica* L.) is a wild edible medicinal plant with nutritional value and medicinal importance for the management of inflammation, with limited scientific evidence. The current study was designed to profile the chemical composition of hydroethanolic extract of *Urtica dioica* L. and to assess its *in vitro* antioxidant activity. The foliage of *Urtica dioica* was extracted using 80% aqueous ethanol, and the resulting extract was fractionated. The fractions were assayed for total phenolic and total flavonoid content and further chemically characterized by validated HPLC for quantification of targeted phenolics and flavonoids. The *in-vitro* antioxidant activity was evaluated using standard assays such as Total antioxidant assay (TAA), Ferric reducing antioxidant power assay (FRAP), and 2,2'-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid), (ABTS) assay. Among all the fractions, the chloroform and ethyl acetate fractions obtained from the hydroethanolic extract showed maximum potency with total phenolic contents of 83.74 ± 1.22 and 114.17 ± 4.91 mg GAE/g of extract, respectively, whereas total flavonoid content was 67.60 ± 3.30 and 35.00 ± 3.30 mg QE/g of extract, respectively. HPLC analysis validated the occurrence of various phenolics and flavonoids, including protocatechuic acid, vanillin, epicatechin, and quercetin, with rutin and Apigenin being the dominant ones. The abundance of these polyphenolic compounds is likely responsible for the observed higher antioxidant activity. Hence, the study concludes that *Urtica dioica* foliage fractions are a potential source of polyphenolic compounds and exhibit promising *in vitro* antioxidant activities. These insights provide strong evidence of its ethnomedicinal use and also supports its traditional use as potential natural source for development of phytopharmaceuticals.

Keywords: Himalayan stinging nettle, Antioxidant activity, Polyphenolic compounds, Phytopharmaceuticals, Ethnomedicinal

Phytochemical Profile and Antioxidant Potential of *Lotus corniculatus* L. Foliage and Flower Fractions

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Abstract

Edible plant products play a vital role in food and pharmaceuticals by understanding and determining bioactive compounds of plants for the drug development process to manage several lifestyles- related disorders. *Lotus corniculatus* L. (Fabaceae) is commonly known as Bird's foot trefoil. The present study focused on screening the phytochemical composition of foliage and flower fractions and antioxidant activities. The percentage yield of leaves and flower fractions and antioxidant activities. The percentage yield of leaves and flowers was 32.37% and 36.87%, respectively. The ethyl acetate fraction of flowers exhibited higher total phenolics (163.32 mg g⁻¹ GAEq.), and flavonoids were higher in the crude and n-butanol fractions of leaves (279.62 and 257.24 mg g⁻¹ QEq.). Antioxidant activities were evaluated using synthetic free radical assays (FRAP, DPPH, and ABTS). The lowest IC₅₀ values were recorded in the ethyl acetate fraction in a dose-dependent manner in the crude and ethyl acetate fractions of the flower. GC-MS analysis reveals the presence of saturated fatty acids (palmitic acid) and polyunsaturated fatty acids like linoleic and α -linoleic acid in the hexane fraction. Liquid chromatography of targeted polyphenolic compounds indicated the presence of rutin in the highest quantity in the ethyl acetate fraction of both flower (132.95 mg g⁻¹) and leaf extracts (15.48 mg g⁻¹). Hence, the ethyl acetate fraction of *L. corniculatus* contains significant quantities of bioactive metabolites and antioxidant activity for use in herbal and phytopharmaceutical health product development.

Keywords: *Lotus corniculatus*, Phytochemicals, HPLC, GC-MS, Polyphenolic Compounds, Antioxidant Activities

Determinants of Home Delivery, the Role of Traditional Birth Attendants, and Health System Gaps in a Tribal District of Meghalaya, India

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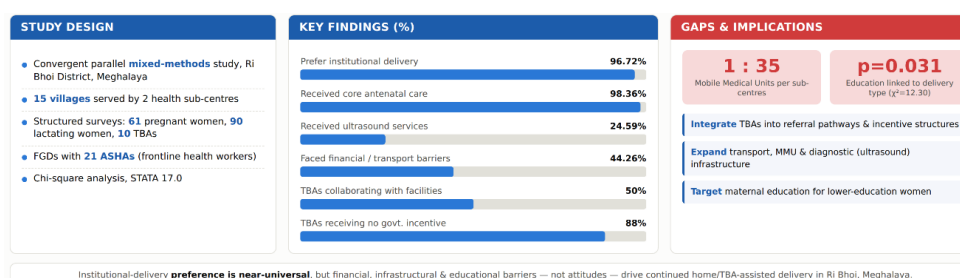
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Abstract

Home deliveries assisted by Traditional Birth Attendants (TBAs) remain common in tribal Northeast India despite national efforts to promote institutional delivery. This study, conducted within The Hans Foundation's maternal health project across 50 health sub-centres in Meghalaya, examined determinants of delivery preference, the role and health-system integration of TBAs, and maternal healthcare gaps among pregnant and lactating women in Ri Bhoi district. A convergent parallel mixed-methods design was used across 15 villages served by two sub-centres, combining structured questionnaires with 61 pregnant women, 90 lactating women, and 10 TBAs, with focus group discussions among 21 Accredited Social Health Activists (ASHAs); associations were tested by chi-square analysis in STATA 17.0. Among pregnant women, 96.72% preferred institutional delivery, yet educational attainment was significantly associated with delivery type (chi-square=12.30, df=5, p=0.031). Financial constraints (32.79%) and distance/transport barriers (29.51%) were the leading obstacles, affecting 44.26% of women. All TBAs provided delivery services, 80% offered family planning counselling, and 70% provided newborn care, but only 50% collaborated with formal facilities and 88% received no government incentive. Core antenatal care reached 98.36% of women, while only 24.59% received ultrasound services; ASHAs identified a severe shortage of ambulances and Mobile Medical Units, with one MMU serving 35 sub-centres. The gap between near-universal preference for institutional delivery and actual practice reflects structural, not attitudinal, barriers. Formally integrating TBAs into referral pathways, expanding transport and diagnostic infrastructure, and targeting maternal education for less-educated women are needed to translate preference into practice and advance the project's maternal mortality reduction goals.

Graphical Abstract



Keywords: Traditional Birth Attendants; Institutional Delivery; Maternal Health; Tribal Health; Health System Integration; Northeast India

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Holistic Care Using Medicinal Plants and Natural Products: An Evidence Based Review

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Abstract

Holistic healthcare emphasizes a comprehensive approach to health by addressing physical, mental, and overall well-being. Medicinal plants and natural products have long contributed to traditional healthcare and remain important sources of biologically active compounds for modern research. This review evaluates their role and therapeutic potential in evidence-based holistic care, with emphasis on phytochemical diversity and pharmacological activities. Major bioactive constituents, including flavonoids, alkaloids, terpenoids, phenolics, tannins, and essential oils, are associated with antioxidant, anti-inflammatory, antimicrobial, immunomodulatory, and other health-promoting effects.

Selected medicinal plants, including *Ocimum tenuiflorum* (Tulsi), *Curcuma longa* (Turmeric), *Azadirachta indica* (Neem), *Phyllanthus emblica* (Amla), and *Aloe vera*, demonstrate potential in traditional and contemporary healthcare applications. Integration of traditional knowledge with modern pharmacological research may support safe, effective, and sustainable complementary healthcare approaches. However, variability in phytochemical composition, standardization, quality control, dosage, toxicity, herb-drug interactions, and limited clinical validation remain important challenges. Therefore, rigorous research, appropriate regulation, and well-designed clinical studies are essential to establish safety, efficacy, and therapeutic relevance. Overall, medicinal plants and natural products offer promising complementary strategies for holistic, evidence-based, and patient-centred healthcare.

Keywords: Medicinal plants; Natural products; Holistic healthcare; Phytochemicals; Herbal medicine; Phytotherapy; Antioxidants; Anti-inflammatory activity; Traditional medicine;

Patient-centred care

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Spatio-Temporal Dynamics of Microplastic Contaminants in Riverine Ecosystems and Their Implications for Preventive Health: An Overview

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Abstract

The ubiquitous presence of microplastics in aquatic environments has emerged as a critical ecological and public health concern, particularly in dynamic lotic systems. This review paper provides a comprehensive synthesis of current research on the sources, transport mechanisms, and human health impacts of microplastics in river ecosystems. By evaluating diverse sampling and analytical methodologies, the paper assesses the spatio-temporal distribution of plastic polymers across various geographical zones, placing a specific focus on regions subject to high anthropogenic stress and seasonal variations.

The review systematically examines the complex interactions between microplastics, fundamental physicochemical water quality parameters, and the potential vectors for microbial colonization on synthetic substrates. These microplastic-pathogen complexes act as direct threats to drinking water safety and public health. Furthermore, the paper highlights significant knowledge gaps in tracking industrial and domestic contaminant pathways through freshwater networks. By consolidating recent empirical data, this review underscores the urgent necessity for standardized monitoring frameworks to support "Sciences Driving Healthcare." It offers strategic insights for targeted environmental engineering interventions to mitigate downstream pollution. Ultimately, this comprehensive evaluation aims to inform future regulatory policies, safeguard water supplies, and advance preventive health and holistic care in highly vulnerable riverine communities.

Keywords: Microplastic Polymers, Water Quality, Microbial pollutions, River ecosystem, Human health impacts

Integrating Traditional Knowledge with Water Safety Planning for Climate-Resilient Rural Water Security

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Abstract

Background: Rural drinking water systems are increasingly vulnerable to interconnected risks such as climate variability, environmental degradation, and changing land use. In decentralized networks, routine monitoring alone is insufficient for early hazard detection. Addressing this gap requires a shift toward participatory and sustainable solutions that actively build climate resilience at the grassroots level.

Participatory Framework: To drive preventive action, this study integrates traditional community knowledge into a systematic Water Safety Planning framework. By crowdsourcing local observations regarding historical rainfall patterns, seasonal shifts, ecological indicators, and traditional source-protection practices, communities become active participants in identifying and prioritizing emerging hazards.

Scientific Validation for Sustainability: While traditional knowledge provides a vital first line of defense, building a truly sustainable solution requires addressing its limitations. The framework pairs participatory observations with rigorous laboratory-based assessments, including chemical, heavy metal, and microbiological analyses, to detect contaminants lacking visual or sensory indicators.

Conclusion: This holistic approach unites public health science, local governance, and community participation across the entire water supply chain. By positioning traditional knowledge as a highly relevant, complementary tool within a scientifically guided system, this "Veda to Village" model successfully promotes preventive action and climate resilience through participatory and sustainable solutions tailored for rural water security.

Keywords: Traditional Knowledge, Water Safety Planning, Rural Water Security, Climate Resilience, Public Health

Influence of Geographic Location on Yield and Chemical Composition of *Skimmia laureola* Leaves Essential Oil in Uttarakhand Region

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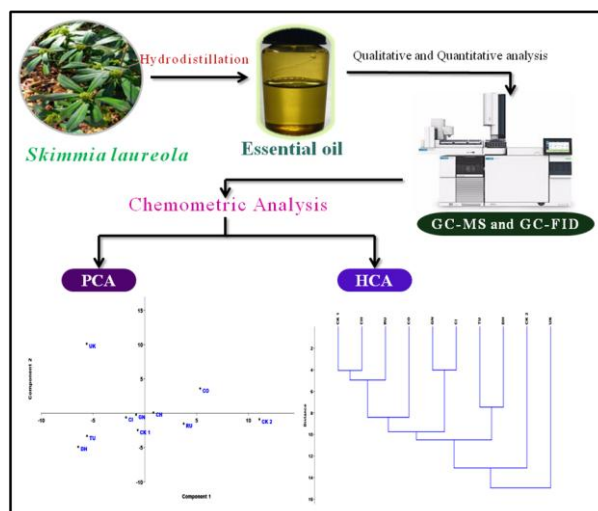
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Abstract

Skimmia laureola is a traditionally used medicinal, aromatic, and perennial evergreen shrub found in the eastern and western Himalayan region. The current study was carried out to find the geographical impact on the essential oil yield and chemical composition across Uttarakhand. *S. laureola* leaf essential oil yield ranged from 0.33% to 0.94% (v/w), obtained by hydrodistillation, and the chemical characterisation by GC-MS and GC-FID analyses identified and quantified 55 compounds, representing 89.90–97.87% of the total oil composition. In which monoterpenoids are present as the major class of compounds. Monoterpenoids such as linalyl acetate, linalool, geijerene, β -phellandrene, α -terpineol, and geranyl acetate are major constituents, with marked differences among samples. To determine the pattern of chemical variability and relationships among the locations, Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCA) were employed, revealing significant differences among the locations. This shows there is a considerable geographical variation in the *S. laureola* leaves essential oil composition. These observations provide important insight into the chemical profile of *S. laureola* leaf essential oil across Uttarakhand for future conservation and potential industrial utilization.

Keywords: *Skimmia laureola*; Essential oil; Qualitative and Quantitative analysis; PCA; GC-MS; GC-FID.

Graphical Abstract



From Veda to Village: A Review of Integrated Agro-Health Traditions and Their Relevance to Sustainable Rural Development

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Abstract

Classical Indian agro-medical literature Rigvedic/Atharvavedic hymns, Krishi-Parashara (c. 400–500 CE), and the foundational Ayurvedic compendia Charaka Samhita and Sushruta Samhita models, soil fertility, crop phytochemistry, cattle-based nutrient cycling and human physiology as an interdependent system, framed by Panchamahabhuta (five-element) and Tridosha (Vata-Pitta-Kapha) theory. Given rising soil organic-carbon depletion, agrichemical dependency and diet-related non-communicable disease in rural India, this review appraises their relevance to rural development. Krishi-Parashara specifies soil taxonomies (Krishna-bhumi, Panduka-bhumi), Nakshatra-calibrated sowing calendars and cattle dung/urine biofertilisation, precursors of the Jeevamrita/Beejamrita formulations used in Zero Budget Natural Farming (ZBNF). Ayurvedic Dravyaguna pharmacology prescribes cultivation parameters for medicinal taxa (*Withania somnifera*, *Ocimum sanctum*, *Azadirachta indica*) modulating withanolide, eugenol and azadirachtin yield. Field-scale evaluation of ZBNF across 128 fields in Andhra Pradesh demonstrated yield parity with agrichemical systems (+1.5%; 95% CI –5.6 to +19.3%) and 123.6% higher profit (95% CI 63.1–244.0%). A kitchen-garden-based nutrition programme raised household adoption from 30% to 79% over three years, improving Dietary Diversity Score. Nationally, ICMR–INDIAB-17 (n=113,043) reports hypertension in 35.5%, diabetes in 11.4% and dyslipidaemia in 81.2% of adults; 48.5% of cropland is organic-carbon deficient. Agroecological trials, nutrition-sensitive programmes and epidemiological surveillance substantiate plausible links between Vedic-Ayurvedic principles and measurable outcomes, though clinical validation of protocols such as Ritucharya remains absent. Randomised agronomic trials, phytochemical standardisation and implementation research are needed before policy-scale adoption.

Key words: Agroecology; Ahara-Aushadhi; Ayurveda; Dravyaguna; ethnopharmacology; natural farming; rural development; Tridosha; Veda; Zero Budget Natural Farming

Prevalence and Correlates of Depression and Anxiety Disorders in District Dehradun, Uttarakhand: A Community-Based Cross-Sectional Study

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Abstract

Background: Depressive and anxiety disorders are among the most prevalent mental health conditions globally, yet community-level data from hilly regions of North India, including Uttarakhand, remain scarce.

Objective: To estimate the prevalence of major depressive episodes (MDE) and generalized anxiety disorder (GAD) and their socio-demographic correlates among adults in rural and urban (slum and non-slum) areas of district Dehradun.

Methods: A community-based cross-sectional survey was conducted among 1,700 individuals aged 20 years and above, selected through multistage stratified random sampling across rural, urban non-slum, and urban slum areas. Participants were screened using the pretested MINI-6 diagnostic tool (Hindi version). Data were analyzed using SPSS, with chi-square tests applied to assess associations ($p < 0.05$).

Results: The overall prevalence of MDE was 5.4%, highest in urban non-slum areas (9.6%) compared to rural (4.6%) and urban slum areas (3.7%). GAD showed an overall prevalence of 4.1%, again markedly higher in urban non-slum areas (11.6%) than rural (2.9%) and urban slum areas (1.0%). Both conditions were significantly associated with age, sex, marital status, religion, and socio-economic status, with distinct urban–rural patterns emerging across correlates.

Conclusion: Depression and anxiety disorders show a substantial urban–rural gradient in Dehradun, with urban non-slum populations disproportionately affected. These findings underscore the need for area-specific mental health screening and intervention strategies, particularly given the largely undetected and untreated burden of common mental disorders in this Himalayan region.

Sleep Quality and Academic Performance Among School-Going Adolescents in Uttarakhand, India

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Abstract

Background: Sleep is essential for adolescent physical health, cognitive functioning, emotional well-being, and educational engagement. Biological changes during adolescence may delay sleep timing and reduce restorative sleep. Poor sleep quality may adversely affect attention, memory, learning, and academic performance. Understanding this relationship is important for strengthening school based health and wellness initiatives. **Objectives:** To assess sleep quality and academic performance and determine the relationship between sleep quality and academic performance among school-going adolescents in Uttarakhand, India. **Methods:** A quantitative, cross-sectional research design was adopted. A total of 1,522 school-going adolescents, comprising 982 females and 540 males, were included using total enumerated sampling. Data were collected through self-reported questionnaires. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), while academic performance was assessed using the Scholastic Performance Scale. Descriptive and inferential statistics were used for analysis. **Results:** The mean PSQI Global Score was 9.37 ± 1.161 , while the mean academic performance score was 39.827 ± 9.950 . A statistically significant strong negative correlation was observed between PSQI Global Score and academic performance ($r = -0.672$, $p = 0.001$), indicating that poorer sleep quality was associated with lower academic performance among adolescents. **Conclusion:** Sleep quality emerged as an important and potentially modifiable factor associated with academic performance during adolescence. Integrating sleep education, counselling, healthy sleep routines, and supportive teacher–student interactions into school wellness programmes may promote healthier sleep behaviours and educational well-being. The findings highlight the importance of prioritising healthy sleep within adolescent health promotion and school-based preventive strategies.

Keywords: Adolescents; Sleep quality; Pittsburgh Sleep Quality Index; Academic Performance; Scholastic Performance Scale; School Health; Uttarakhand.

Unravelling the Phytochemistry of Underexplored Flower *Tupistra nutans* Wall. Ex Lindl (Nakima) from the Indian Himalayan Region

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Abstract

In this modern world, consumption of traditional wild edible flowers plays a key role in promoting balance between Reactive Oxygen Species and the cellular antioxidant defence system to combat major chronic diseases. However, limited scientific-backed data on these flowers and on the active fractions playing this role remain inconclusive. *Tupistra nutans* (Nakima), is an underexplored flower from the Himalayan region, traditionally known to lower blood sugar levels with limited scientific validation. Accordingly, the study was designed to evaluate the fractionation of Nakima flowers, their phytochemical fingerprinting, and antioxidant activities. The liquid chromatography profiling of targeted polyphenols and organic acids revealed the presence of chlorogenic acid, vanillic acid, and para-coumaric acid as key molecules. Similarly, the hexane fraction was characterized using GC-MS, confirming the presence of essential fatty acids such as linoleic and α -linoleic acid with other sterol-like compounds. The ethyl acetate fraction exhibited significant levels of polyphenols (TPC: 49.32 mg GAE/g; TFC: 6.67 mg QE/g) with dose-dependent antioxidant activity (ABTS: IC₅₀ – 32.33 μ g/ml; DPPH: IC₅₀ – 167.05 μ g/ml) & FRAP values up to 1.99 TE mM/g, respectively. Further, LC-MS confirmation of the major class of compounds was performed. Hence, the findings of Nakima flower phytochemistry of the best-performing fraction could be a lead for the development of nutraceutical formulations against the management diabetes.

Keywords: *Tupistra nutans*, Phytochemistry, HPLC, Polyphenolic compounds, Antioxidant Activities

Ilaprazole Degradation: Product Identification, Pathway Elucidation and Toxicity Prediction.

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Abstract

The drug ilaprazole (ILA) is a proton pump inhibitor it is used for the management of acid-related gastrointestinal disorders. Understanding its degradation behavior is important to establish stability, safety, and quality during pharmaceutical development. In the current study, a chromatographic method was established for the separation and determination of ILA and its degradation products generated under different stress conditions. The degradation behavior of Ilaprazole was investigated under alkaline, acidic, oxidative, thermal, and photolytic conditions. Six degradation products were identified, and their structures were characterised using high resolution LC–MS/MS with an Orbitrap mass analyser, enabling accurate-mass measurement and interpretation of characteristic fragmentation patterns. Based on the analytical findings, plausible degradation pathways of ILA were proposed to provide insight into its chemical transformation under different stress environments. Further in silico studies to assess the potential toxicological significance of degradation products. Ilaprazole showed pronounced degradation under acidic, alkaline, and oxidative conditions, whereas comparatively higher stability was observed under thermal and photolytic stress. Chromatographic separation was achieved using C18 column with a gradient mobile phase comprising ammonium acetate and acetonitrile. The developed method demonstrated satisfactory performance with respect to the relevant validation parameters in accordance with ICH guidelines. Overall, the study provides a comprehensive understanding of the degradation profile of ILA and combines analytical characterization with computational toxicity assessment. The present study may be useful for impurity profiling, formulation development, stability evaluation, and quality control of ilaprazole containing pharmaceutical products.

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From Pigments to Nutrition: Exploring Bioactive Compounds in Colored Rice

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Abstract

Colored rice, including black, red, and purple varieties, is gaining attention as a functional food due to its nutritional value and bioactive constituents. Processing methods such as dehusking, milling, polishing, soaking, germination, fermentation, parboiling, and cooking influence nutrient retention and functionality. Unlike polished white rice, colored rice generally retains its bran layer, providing higher dietary fibre, minerals and phytochemicals, including anthocyanins, phenolic acids, flavonoids, proanthocyanidins, γ -oryzanol and tocopherols. Physicochemical characteristics, including grain color, size, hardness, amylose content, water absorption, gelatinization and pasting behavior, vary with cultivar and processing conditions. Functionally, colored rice flour may exhibit distinct water- and oil-absorption capacity, swelling power, solubility, pasting characteristics and antioxidant activity compared with white rice, supporting its application in functional food products. Its phenolic compounds and natural pigments contribute to antioxidant activity and may provide anti-inflammatory, glycemic-regulating and cardiometabolic benefits. In contrast, extensive polishing of white rice reduces fibre and several bran-associated bioactive compounds. Overall, colored rice offers promising nutritional and functional advantages over polished white rice, although further standardized human studies are needed to substantiate specific therapeutic effects.

Keywords - Colored rice; Bioactive compounds; Anthocyanins; Phenolic compounds; Antioxidant activity; Functional properties; Nutritional composition; Processing methods

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Studies on Population Status, Habitat Assessment and Threat Categorization of Astavarga Herb *Polygonatum cirrhifolium* Royle from Kumaun Region of Uttarakhand

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Abstract

Polygonatum cirrhifolium, commonly known as "Maha Meda" or "Giant Solomon's Seal," is one of the eight medicinal herbs of "Astavarga" group of medicinal plants and belongs to the family Asparagusaceae. Over exploitation and habitat degradation have been causing decreases in the population of *Polygonatum cirrhifolium* hence, it is important to know existing status of the species for developing a systematic conservation and management plan. Keeping this in mind, the present study was conducted in different sites of Kumaun region of Uttarakhand. Total 17 natural populations of *P. cirrhifolium* in Kumaun Uttarakhand were surveyed to assess its population status by quadrat method using random sampling and following vertical belt transects approach. Data were analyzed for population study such as frequency (%F), density (D, plant m⁻²), A/F ratio, relative frequency, relative density, relative dominance and total basal cover (TBC, cm²m⁻²). Study reveals that the density and area covered by this species is low as compared to other species of the region. Some of the medicinal plants of high therapeutic value are endangered and require protection, so it is important to determine population status of such species at the local and regional level to develop an appropriate conservation strategy for these plants.

Key Words: *Polygonatum cirrhifolium*, Habitat assessment, Population Status, Threat Categorization, Conservation.

Scanning Electron Microscopy-Based Quantification of Biofilm in Chronic Diabetic Wound Infections and Its Association with Antimicrobial Resistance

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Abstract

Background: Biofilm formation is an important feature of chronic diabetic wounds and may contribute to persistence of infection and antimicrobial tolerance. Scanning electron microscopy (SEM) provides direct visualization of the ultrastructural organization of wound-associated bacteria, while quantitative image analysis can provide objective measures of biofilm-associated architecture. This study aimed to quantitatively characterize extracellular polymeric substance (EPS)-associated coverage and bacterial cell packing in chronic diabetic wound specimens and examine these findings alongside antimicrobial susceptibility profiles.

Methods: SEM images from 96 specimens obtained from chronic diabetic wounds were analyzed using ImageJ. EPS-associated surface coverage (%) and bacterial cell packing density (%) were quantified from the SEM fields using standardized image-analysis procedures. Bacterial isolates were identified and antimicrobial susceptibility testing (AST) was performed using VITEK 2.

Results: EPS-associated coverage demonstrated marked heterogeneity, ranging from 0.14% to 70.89%, with a mean of $36.91 \pm 19.77\%$. Cell packing density ranged from 3.76% to 63.42%, with a mean of $35.88 \pm 14.57\%$. EPS-associated coverage showed a significant positive correlation with bacterial cell packing density (Pearson's $r = 0.593$, $p < 0.001$), indicating that greater EPS-associated surface coverage was accompanied by increased bacterial packing within the examined SEM fields. The predominant organisms were *Pseudomonas aeruginosa* (28), *Klebsiella pneumoniae* (15), methicillin-resistant staphylococci (15), and *Acinetobacter baumannii* (11). AST demonstrated substantial antimicrobial resistance among the major pathogens, including resistance to amikacin in 82.1% of *P. aeruginosa* and 81.8% of *A. baumannii*, while 93.3% of *K. pneumoniae* isolates were resistant to cefuroxime and 73.3% of methicillin-resistant staphylococcal isolates were resistant to cefoxitin.

Conclusion: Quantitative SEM analysis of chronic diabetic wounds revealed significant heterogeneity and a strong correlation between EPS coverage and bacterial cell packing, confirming coordinated biofilm organization. Because these robust biofilm structures co-occur with high antimicrobial resistance in key pathogens, integrating quantitative SEM with microbiological and susceptibility testing offers an effective framework for characterizing chronic wound infection phenotypes.

Keywords: Biofilm architecture, Chronic diabetic wounds, Extracellular polymeric substances (EPS), Scanning electron microscopy (SEM), ImageJ analysis, Bacterial cell packing, Antimicrobial resistance (AMR)

Association Between Types of Febrile Seizure and Focus of Infection with Characterization of Spectrum of Respiratory in These Children with Febrile Seizure

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Abstract

Background Febrile seizures constitute a common neurological presentation in early childhood and are frequently encountered during acute febrile illnesses. Respiratory infections are reported frequently in this setting; however, whether the anatomical focus of infection is related to the clinical phenotype of febrile seizures, particularly the distinction between simple and complex seizures, remains insufficiently characterized. Evidence addressing this association in Indian children is limited.

Methods

Study design: Prospective observational study

Sample Size: Total 40 (Pearson's $\chi^2 = 0.684$, $p = 0.408$)

Study site: Department of Pediatrics, All India Institute of Medical Sciences, Rishikesh.

Case Enrollment: To evaluate whether the focus of infection, classified as respiratory or non-respiratory, is associated with the type of febrile seizure in children aged 6 months to 5 years

Baseline Assessments

Primary Outcome: -

Association between the type of febrile seizure and the focus of infection.

The focus of infection will be categorized as respiratory or non-respiratory based on clinical evaluation and relevant laboratory investigations.

Secondary Outcome -

The characterization of the spectrum of respiratory viral infections detected among children with febrile seizures who have a respiratory focus of illness.

Respiratory specimens collected from these children will be tested using multiplex real-time PCR, and the specific viral pathogens identified will be recorded.

Methods - This hospital-based, observational study evaluated children aged 6 months to 5 years presenting with febrile seizures. Patients were classified based on the seizure type (simple vs. complex) and the confirmed clinical focus of infection, with a dedicated sub-analysis of the respiratory spectrum (URTI vs. LRTI). Statistical correlation between the infection focus and seizure phenotypes was determined using Chi-square and ANOVA tests, setting significance at $(p < 0.05)$

Keywords: Febrile Seizures Phenotypes, Focus of Infection, Respiratory Tract Infections, Observational Study

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Assessment of Knowledge of Early Risk Indicators of Insulin Resistance among Reproductive-Aged Women

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Abstract

Insulin resistance has come to be recognised as one of the most prevalent but unrecognised metabolic disorders amongst reproductive women, straddling the boundary between type 2 diabetes, metabolic syndrome, and Poly-Endocrine Metabolic Ovarian Syndrome (PMOS), the last of which exhibits insulin resistance in almost 35–80 percent of women. Current trends show a sustained rise in insulin resistance and associated metabolic disorders, driven primarily by nutritional transition, physical inactivity, and population ageing, with genetic and epigenetic factors also contributing alongside unhealthy lifestyle triggers. Globally, more than 10 percent of the adult population is estimated to exhibit some degree of insulin resistance, varying by ethnicity, age, and BMI. Beyond its reproductive consequences, insulin resistance is a well-established precursor to type 2 diabetes, hypertension, and cardiovascular disease, underscoring why its early recognition matters well beyond reproductive health alone. The clinical relevance of the problem is further underscored by its gradual onset; insulin resistance rarely reveals itself upfront and gradually progresses to the point when it shows up as menstrual abnormalities, hyperandrogenism, infertility, acne, or hirsutism, while also driving chronic subclinical inflammation and atherogenic lipid changes — by which time the opportunity to reverse the problem through lifestyle changes alone may have passed.

It is in this space of non-recognition where awareness becomes clinically relevant. Anthropometric and clinical parameters such as waist circumference, waist-to-height ratio, BMI and hirsutism score, along with clinical manifestations such as acanthosis nigricans and menstrual irregularity, provide a non-invasive, low-cost, and accessible way to detect metabolic dysfunction early, before the need for diagnostic laboratory testing arises, provided this risk is acknowledged in good time. This paper seeks to examine the knowledge levels of women, between 18 to 45 years of age, regarding the causes, early signs and modifiable risk factors of insulin resistance including diet, physical inactivity, obesity, sleep, and stress, each of which independently worsens insulin sensitivity through distinct pathways such as diet-driven inflammation, reduced muscle glucose uptake, and cortisol-related glucose disruption — and to establish how their anthropometric profile and clinical manifestations reflect their actual metabolic risk, using a questionnaire and physical measurements.

The entire basis for this study hinges on one important principle: the earlier insulin resistance is discovered, the greater are its reversible effects.

Through this study, we aim to check the prevalence of insulin resistance among reproductive-aged women and create awareness through a structured knowledge-assessment form covering the causes, early clinical signs, and modifiable risk factors of insulin resistance, thereby giving women practical tools to close the gap between science and reality.

DIABETES MELLITUS (A chasm between awareness and action)

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Abstract

"Diabetes mellitus, a widely recognized chronic disease", the conversation is not limited to just creating awareness but translating it into habitual and sustainable action. A community health issue is about awareness, comprehension and execution known to everyone. For instance, despite China's advancement in healthcare it has the highest absolute number of people living with diabetes. Despite general awareness about diabetes, only a few know about the type they have and some rarely make any changes in their lifestyle. These observations were made on the basis of community-based assessment aimed to explore the gap between diabetes-related awareness, health literacy and lifestyle practices within a community setting. Participants included teachers, support staff, students and the family where they were asked about the type of diabetes they have, the lifestyle changes they made, common misconceptions regarding that and their daily life routine. An expert clinical perspective was also taken in consideration through an interaction with an endocrinologist from IMS BHU. This assessment identified how there's a gap in applicable knowledge is there amongst the general public regarding the role of lifestyle modification alongside pharmaceutical treatment. So based on the observation made in my surrounding the gap between awareness and action may potentially be fulfilled by bringing up solutions which are cost effective and time effective and can easily be accommodated in their daily lifestyle apart from medication rather than requiring substantial finances. There is gap in health literacy amongst people. Educating the whole household instead of the diagnosed individual can be more beneficial making them understand that small sustainable behavioural changes may show huge difference. It is also important to measure awareness campaigns on the basis of behavioural outcome involving lifestyle changes which will lead to long term metabolic help because everybody knows about diabetes but only a few know how to live with it.

Decoding the Potential Combinatorial Effect of *Nardostachys jatamansi*, *Withania somnifera*, *Bacopa monnieri*, and *Rauvolfia serpentina* against Schizophrenia: A Multi-Target Systems Pharmacology and Molecular Docking Investigation

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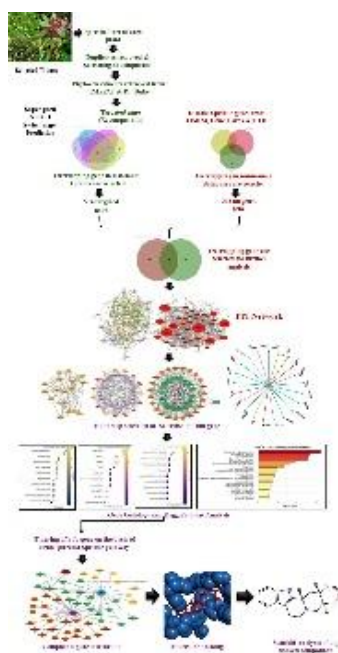
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Abstract

Schizophrenia is a heterogeneous neuropsychiatric illness with disrupted dopaminergic, serotonergic and glutamatergic neurotransmission, neuroinflammation and synaptic dysfunction for which, single-target antipsychotics has limited effectiveness. *Nardostachys jatamansi*, *Withania somnifera*, *Bacopa monnieri* and *Rauvolfia serpentina* are well-described in Ayurveda for psychosis, cognitive decline and mood disturbance, symptoms directly overlapping with the Schizophrenia spectrum. However, the mechanical basis of their combinatorial effect across Schizophrenia-associated molecular targets remains undiscovered. The study systematically identified the multi-target, multi-component pharmacological mechanisms of a four-herb combination against Schizophrenia with an integrated network pharmacology and computational perspective and elucidate the relevant mechanistic basis for their rational application as polyherbal strategy. Using ADMET criteria, bioactive compounds of four medicinal plants were screened, and herb-disease targets were mapped using Venn diagram analysis. PPI network construction revealed 21 hub genes which were verified with SZDB 2.0. GO and pathway enrichment analyses; molecular docking of nine top priority targets; toxicity profiling; scaffold comparison with FDA-approved antipsychotics. The herb-target network showed extensive coverage of dopaminergic, serotonergic and glutamatergic pathways with 21 hub genes identified, nine of which were prioritized for docking. GO and pathway enrichment showed that neurotransmitter modulation was a prominent process. Docking confirmed potential favourable binding interactions, and scaffold analysis displayed that these compounds obtained structural similarities to FDA-approved antipsychotics. This study offers computational systems-level, mechanism-based evidence to the combinatorial effect of four-herb combination toward multiple schizophrenia-associated pathways. These results provide a rationale for the experimental validation and optimization of multi-component herbal interventions in schizophrenia.

Key words: Multi-target therapy, Hub—gene analysis, Network pharmacology, traditional medicine



Preventive Health-Oriented Development and Characterization of Dysphagia Diets Using Surface Electromyography

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Abstract

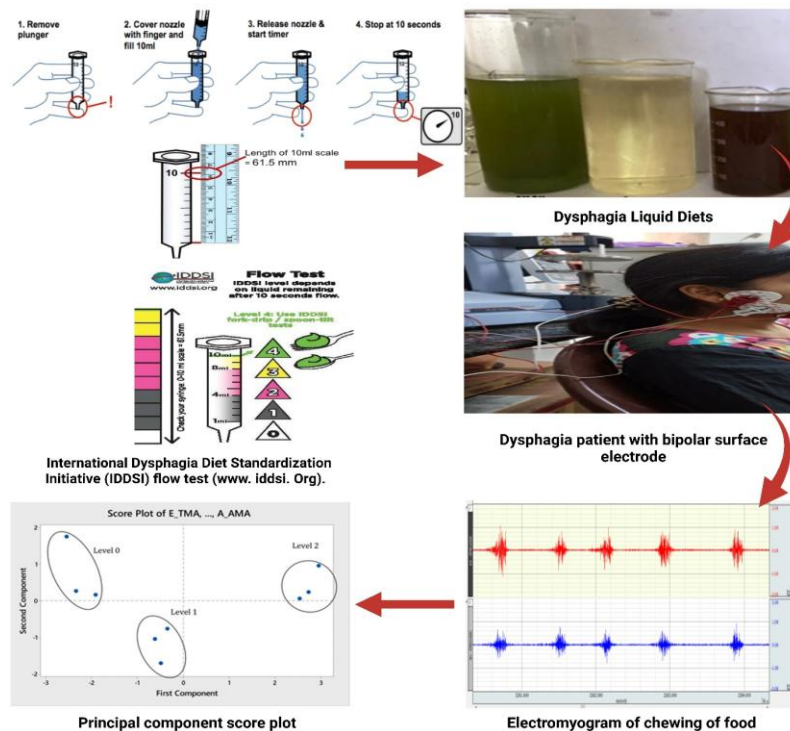
Dysphagia is a swallowing difficulty that may affect a person's food and fluid intake, hydration, and wellbeing. Texture modified foods are sometimes recommended to increase food viscosity to improve swallowing safety, but this can also change the amount of effort needed to swallow. A non-invasive way to assess muscle activity during swallowing (surface electromyography or sEMG) can be used to characterize the physiological response to various consistencies of a dysphagia diet. The current study used electromyography to assess the effects of different dysphagia diet consistencies on swallowing muscle activity.

Food consistency and texture were modified to make dysphagia diet samples in compliance with recognized principles of texture-modified diets. The homogeneity, consistency, and swallowability of the samples produced were evaluated. Each participant had to ingest samples of various food consistencies. During swallowing, muscle activity was recorded using surface electromyography with electrodes placed over the masseter muscle. The muscle activation levels were evaluated using EMG data as a function of diet thickness.

The modified dysphagia diet formulations produced gradual changes in texture and consistency, appropriate for modifying food texture. The electromyographic measurement revealed that the thicker the food, the higher the muscle activity. More swallowing muscle activation was required with thicker diet consistencies than with less viscous diet consistencies. This discovery suggests that increased viscosity may require more muscle work to transfer the bolus during swallowing. The EMG response was an objective technique for differentiating swallowing demands for various stages of the dysphagia diet.

It is shown that texture modification and instrumental assessment can be used to develop and define dysphagia diets. To assess physiological needs for various diet consistencies, electromyography was helpful. Viscosity also affects swallowing efforts, as thicker diets have been reported to enhance muscle activity and should be taken into account when choosing the appropriate dysphagia diet. Further research with a larger number of subjects and quantitative EMG data is recommended to generate consistency-specific swallow profiles that are clinically applicable.

Graphical Abstract



Keywords: Dysphagia, Food, Texture, Muscle, Swallow, Electromyography.

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Graphene Nanodots-Enabled Electrochemical Biosensor for the Sensitive Detection of Chlorpyrifos towards Sustainable Detection in Agro-Systems

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Abstract

The widespread application of organophosphate pesticides (OPPs) poses significant concerns for food safety and environmental health owing to their toxicity and persistence in agricultural ecosystems. This highlights the need for rapid, sensitive, and reliable analytical approaches for monitoring pesticide residues throughout the food chain. In this work, a novel electrochemical biosensor was developed for the sensitive determination of chlorpyrifos, a widely used organophosphate pesticide. The biosensor was constructed using a carbon screen-printed electrode (CSPE) modified with graphene nanodots (GNDs) and acetylcholinesterase (AChE), providing an effective electrochemical sensing interface for chlorpyrifos detection. The GNDs were synthesized through a microwave-assisted approach and characterized using spectroscopic and microscopic techniques to evaluate their optical and structural properties. The analytical performance of the fabricated biosensor was assessed using electrochemical transduction techniques. By enabling rapid and potentially on-site detection of chlorpyrifos residues, the proposed biosensor supports the emerging concept of Food Safety 4.0, which emphasizes advanced sensing technologies, real-time monitoring, rapid decision-making, and improved traceability throughout the food supply chain. Such portable biosensing platforms can contribute to early identification of pesticide contamination and facilitate more effective food-safety and agricultural risk management. Furthermore, this approach is consistent with the United Nations Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-Being), SDG 6 (Clean Water and Sanitation), and SDG 12 (Responsible Consumption and Production). The developed biosensor offers substantial potential to enhance food safety, enable on-site monitoring, and support more sustainable farming practices.

Keywords: chlorpyrifos detection, food safety 4.0, electrochemical biosensor, sustainable agriculture

AI Based Personalised Nutrition Recommender System for Regional Indian Cuisines and Health Profiles

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Abstract

As a consequence of nutrition transition, urbanisation and decreasing adherence to traditional dietary patterns, diet-related non-communicable diseases (NCDs) like diabetes, hypertension, obesity and dyslipidaemia are increasing rapidly in India. At present, public health nutrition programs are based on generalised standards that do not effectively address the regional cuisines, socio-economic variety and cultural dietary practices in India, and hence are not effective. This study reviews and proposes a new AI-based personalised nutrition recommender system that integrates regional Indian cuisine data with individual health profiles to support preventive nutrition and reduce NCD risk and additionally emphasises the gaps in the existing systems in terms of regional and cultural representation of food. A systematic review was done on AI-based dietary recommender systems, personalised nutrition frameworks and public health nutrition initiatives in India to study common data sources, modelling approaches (collaborative filtering, content-based filtering, hybrid techniques) and evaluation parameters. They presented a conceptual framework based on integration of annotated regional recipe data with individual health indicators and ICMR-NIN standards utilising machine learning based ranking. AI-based recommender systems are better than generic guidance for dietary adherence and engagement yet, they poorly represent regional and low-resource groups. The suggested approach has the ability to increase the cultural relevance, clinical appropriateness and feasibility of adoption in urban and rural settings and highlights the promise of AI in improving preventive public health nutrition policy in India.

Keywords: Public Health Nutrition, Artificial Intelligence Recommender System, Non-Communicable Diseases, Regional Indian Cuisine, Health Equity, Preventive Healthcare

Unlocking the Phytochemical Potential of Pomegranate Peel Waste through Solvent Optimization and LC-QTOF-MS/MS Profiling

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Abstract

Pomegranate (*Punica granatum* L.) peel is a major by-product of fruit processing and is often discarded despite being a rich source of phenolic and other bioactive compounds. The present study aimed to optimize the solvent system for efficient recovery of polyphenolics from pomegranate peel waste and characterize the phytochemical composition of the optimized extract using LC-QTOF-MS/MS. Pomegranate peel extracts were prepared using five ethanol–water solvent systems, namely 100% ethanol, 100% water, 50% ethanol:50% water, 80% ethanol:20% water, and 20% ethanol:80% water. The extracts were evaluated for total phenolic content (TPC) and total flavonoid content (TFC) to determine the most effective solvent system. Among the tested systems, the 20% ethanol:80% water extract showed the highest TPC (425.82 mg GAE/g) and TFC (406.39 mg QE/g) and was selected for detailed phytochemical profiling. LC-QTOF-MS/MS analysis tentatively identified 80 phytochemical constituents belonging to diverse classes, including phenolic compounds, flavonoids, tannins, and other bioactive constituents. The findings demonstrate that solvent composition strongly influences polyphenolic recovery from pomegranate peel, with 20% ethanol:80% water proving effective under the investigated conditions. This study provides a systematic approach for valorizing pomegranate peel waste and highlights its potential for value-added food, nutraceutical, and pharmaceutical applications while contributing to sustainable waste management.

Keywords: *Punica granatum* peel waste; Solvent optimization; LC-QTOF-MS; phytochemical profiling; Polyphenolics.

Anthocyanin-Integrated Biodegradable Films for Intelligent Food Packaging

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Abstract

The use of conventional plastic for food packaging has raised severe environmental issues as the majority of plastics are not easily degradable and can remain in the ecosystem for a longer period. Their degradation can also lead to the formation of microplastics in the ecosystem, which can negatively affect the environment and raise concerns about human health. These concerns have increased the interest in biodegradable packaging materials generated from renewable sources. Plant-based packaging materials can help to minimize the reliance on petroleum-based plastics and offer a more environmentally responsible approach to food packaging. However, switching to biodegradable materials alone does not address the requirement to monitor the food quality during storage. Intelligent packaging can be used for the purpose of giving an added function by displaying visible changes associated with food freshness. Anthocyanins, natural pigments found in many fruits, vegetables, flowers & plants, are promising for intelligent packaging because they have antioxidant properties and change colour when the pH changes. They can be incorporated with biodegradable polymers like starch, chitosan, cellulose, and other biopolymers to create multifunctional packaging films. In addition to altering the colour, these films can also offer natural antioxidant properties, slow down bacterial growth, and enhance moisture and gas barrier properties of the packaging material. Various sources of anthocyanins, biodegradable polymer matrices, colour changing process and its usage as food freshness monitor have been recently investigated. The practical use of anthocyanins is, however, limited due to their sensitivity to temperature, light, oxygen and pH that has the potential to impact the stability and colour response of the anthocyanins. Stability and consistent colour response under real food-storage conditions is thus important. The removal of these challenges would pave the way towards sustainable intelligent packaging which will not need to rely on conventional plastics, but will offer an easily visible and accessible feature to track the freshness of food products and enhance the overall performance of food packaging.

Keywords: Anthocyanin, Intelligent food packaging, Biodegradable packaging, Conventional plastic.

Unveiling Rice Bean: A Nutritional Gem for Health and Protein Innovation

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Abstract

Rice bean (*Vigna umbellata*), an underutilized legume of South and Southeast Asia, holds considerable potential to contribute to food security and serve as a sustainable, plant-based protein source. Proximate analysis of Rice bean seeds revealed high protein (24.76g/100g), crude fibre (11.50g/100g) content, corresponding to an energy value of 299.49 ± 4.94 kcal/100g. Physical characterization showed excellent 100-seed weight, seed length and breadth, hydration capacity, swelling capacity, seed volume and bulk density, reflecting favourable dimensional uniformity and water-uptake behaviour relevant to soaking, cooking, and milling operations. Functional property evaluation revealed a water absorption capacity (1.99 ± 0.22 g/g), an oil absorption capacity (1.63 ± 0.89 g/g), and a high foaming capacity indicating strong hydration behaviour, favourable lipid-binding potential, and excellent air-entrapment ability suited to emulsified, aerated, and extruded food systems. These compositional, physical, and functional attributes, together with a balanced essential amino acid profile and diverse bioactive compounds, position ricebeans as a potent source within the expanding global plant-protein isolate market, which is valued at approximately USD 11.5–11.7 billion in 2024 and projected to reach USD 19.6 billion by 2030. Regular rice bean consumption has further been associated with improved protein adequacy, glycaemic regulation, and gut health, supporting its incorporation into functional foods, protein isolates, and clean-label meat/egg analogues, in alignment with United Nations Sustainable Development Goal 12.

Keywords: Ricebean (*Vigna umbellata*), Underutilized Legume, Proximate Composition, Functional Properties, Plant-Based Protein, & Food Security

Chemical Composition, Physicochemical Analysis, and Technological Properties of Selected wild Himalayan Berry Powder

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Abstract

Increasing consumer awareness of health issues has led to calls to maximize the benefits of underutilized crops and berries. Globally recognized as superfoods, berries are increasingly incorporated into functional foods and nutraceuticals, with phenolic compounds serving as the primary phytochemicals. The aim of our investigation is to examine and repurpose freeze-dried powder obtained from wild Himalayan berries from Uttarakhand, including *Myrica esculenta*, *Potentilla indica*, *Rubus ellipticus*, *Morus nigra*, and *Berberis asiatica*. The freeze-dried powder was analyzed for its chemical composition, physicochemical attributes, and technological properties. Proximate composition, encompassing moisture, protein, fat, ash, fiber, and carbohydrate content, was determined using standard analytical techniques. Additionally, physicochemical parameters such as pH, color, and water activity were assessed. Technological characteristics, including water-holding capacity, oil-holding capacity, swelling capacity, emulsifying ability, and foaming properties, were also evaluated to explore their potential functional applications within food systems. Phytochemical analysis of the berries, conducted using HPLC-PDA, GC-MS, and LC-MS, revealed the presence of various flavonoids, anthocyanins, phenolic acids, fatty acids, and phytosterols. The berry powder possessed significant nutritional and functional value; making these underutilized materials into value-added food ingredients supports sustainable food production, reduces environmental waste, and promotes a circular economy.

Keywords: - Himalayan berries; wild; flavonoid; anthocyanin; freeze-drying; functional food

Wild Himalayan Mushrooms: A Sustainable Source of Bioactive Compounds for Nutrition, Functional Foods, and Global Health

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Abstract

Wild Himalayan mushrooms are increasingly recognized as nutrient-rich functional foods owing to their diverse repertoire of bioactive compounds. However, comprehensive biochemical characterization of indigenous Himalayan species remains limited. The present study investigated the antioxidant potential and sterol composition of 100 wild mushroom samples collected from different ecological regions of Uttarakhand, India. Ethanolic extracts were evaluated for total phenolic content (TPC), total flavonoid content (TFC), DPPH, ABTS, and FRAP antioxidant assays using standard spectrophotometric methods, while sterols were characterized by gas chromatography–mass spectrometry (GC–MS). Among the investigated species, *Phaeolus schweinitzii* exhibited the highest total phenolic content (3339.09 ± 74.25 mg GAE/100 g extract), together with high DPPH antioxidant capacity (2062.36 ± 43.97 mg AAE/100 g extract) and ABTS activity (1733.70 ± 52.35 mg AAE/100 g extract). *Ganoderma applanatum* recorded the highest FRAP value (3936.70 ± 38.05 mg AAE/100 g extract). GC–MS analysis identified ergosterol as the predominant sterol in all investigated species, with *Pleurotus ostreatus* containing the highest concentration (789.43 ± 43.00 mg/100 g dry weight). Several species also exhibited appreciable levels of other nutritionally important sterols and fatty acids, highlighting their potential as sustainable sources of health-promoting biomolecules. These findings demonstrate that wild Himalayan mushrooms represent valuable natural resources for the development of functional foods and nutraceuticals, supporting sustainable nutrition and contributing to global health.

Keywords: Ergosterol; Gas chromatography–mass spectrometry; Phenolic compounds; Free radical scavenging; Lipid profiling

Quantitative Determination of Potentially Toxic Metals in Commercial Eye Cosmetics Marketed in India Using Atomic Absorption Spectrometry

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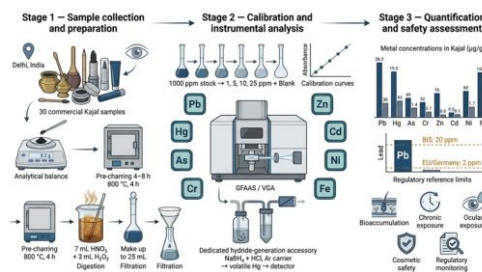
Abstract

Eye cosmetics such as kajal, surma, and kohl are widely used in Indian households and are applied directly to the periocular and ocular regions, potentially increasing exposure to toxic elements. The presence of heavy metals in these products may contribute to chronic exposure and subsequent bioaccumulation, with potential adverse effects on neurological, renal, developmental, and systemic health. The present study aimed to assess the concentrations of selected heavy and trace metals, including (Pb, Hg, Zn, Ni, Fe), in commercially available kajal products marketed in Delhi, India.

A total of 30 kajal samples were collected from local markets and cosmetic retail outlets across Delhi. The samples were oven-dried for 8 h and subjected to thermal treatment in a muffle furnace at 800°C for 4 h prior to elemental analysis. The concentrations of the target metals were determined using Atomic Absorption Spectrophotometry (AAS).

Lead is of particular toxicological concern due to its established neurotoxicity and potential for bioaccumulation. The Bureau of Indian Standards (BIS) has prescribed a permissible limit of 20 ppm for lead in cosmetics, whereas stricter regulatory limits have been adopted in the European Union and Germany. Previous investigations have reported elevated metal concentrations, particularly in traditional and inadequately regulated kajal products. Chronic exposure to such contaminants may pose risks to ocular and systemic health, including ocular irritation and dry eye symptoms, as well as neurological and renal effects. The findings of this study provide insight into the elemental safety profile of kajal products available in Delhi and highlight the need for effective quality control and regulatory surveillance.

Graphical Abstract



Keywords: Heavy metals; Kajal (Kohl/Surma); Atomic Absorption Spectrophotometry (AAS); Bioaccumulation; Cosmetic safety regulation

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Chemical Profiling and Forensic Characterization of Components Present in Commercial Mu'assel (Shisha) from Indian Markets by Triple Quadrupole GC-MS/MS

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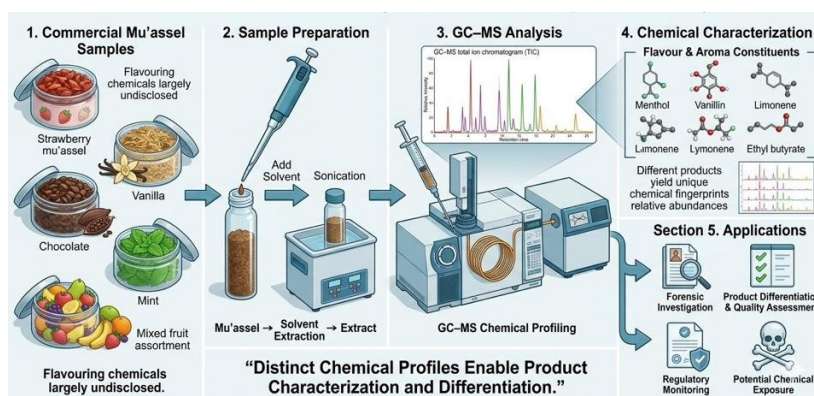
Abstract

Flavoured water-pipe tobacco (mu'assel/shisha) has become increasingly popular, particularly among young adults, largely because of its wide variety of flavours and aromas. Although commercial products are commonly marketed using flavour descriptors such as strawberry, chocolate, vanilla, and other fruit or aromatic profiles, the specific chemical constituents responsible for these characteristics are often not disclosed on product labels. The complex mixtures of flavouring compounds present in mu'assel therefore pose challenges for product characterization, quality assessment, and forensic examination. In addition, some flavouring chemicals may present toxicological concerns, particularly when they are subjected to thermal degradation during smoking.

The present study aimed to develop a chemical profiling approach for the characterization of flavouring constituents in commercial mu'assel using gas chromatography–mass spectrometry (GC–MS). Seven commercially available mu'assel samples were subjected to solvent extraction followed by sonication and instrumental analysis. The resulting chromatographic profiles were evaluated to identify volatile and semi-volatile compounds associated with the characteristic flavour and aroma of the products.

GC–MS analysis enabled the detection and characterization of multiple flavouring constituents in the investigated samples, demonstrating substantial variation in the chemical composition and relative abundance of individual compounds among different products. The findings highlight the usefulness of GC–MS for the rapid and comprehensive profiling of flavouring additives in mu'assel and provide a chemical basis for differentiating commercial products. Such analytical profiling may have applications in forensic investigations, product quality assessment, regulatory monitoring, and the evaluation of potential chemical exposure associated with flavoured water-pipe tobacco.

Graphical Abstract



Keywords: Shisha; Chemical Profiling; GC-MS; Forensic chemistry; Tobacco.

Cannabis Cultivation, Legal Status, Narcotic Constituents and Therapeutic Properties: An Indian Context

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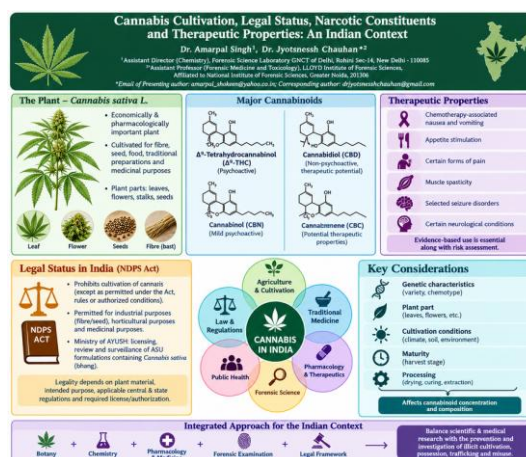
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Abstract

Cannabis (*Cannabis sativa* L.) is an economically and pharmacologically important plant cultivated for centuries for fibre, seed, food, traditional preparations, and medicinal purposes. Cannabis and cannabinoid-based preparations have considerable scientific therapeutic potential, including use in chemotherapy-associated nausea and vomiting, appetite stimulation, certain forms of pain, muscle spasticity, selected seizure disorders, and certain neurological conditions. World Health Organization has recognized both the potential therapeutic value and public-health risks associated with cannabis and its constituents. Cannabis is also one of the most widely used psychoactive plants and contains the principal psychoactive constituent Δ^9 -tetrahydrocannabinol (Δ^9 -THC). The concentration and composition of cannabinoids vary according to genetic characteristics, plant part, cultivation conditions, maturity, and processing. In India, cultivation and use of cannabis are primarily regulated under the Narcotic Drugs and Psychotropic Substances (NDPS) Act. It prohibits the cultivation of a cannabis plant except as permitted under the Act, rules, or authorized conditions. However, provides a specific provision under which cultivation of cannabis may be permitted for industrial purposes, particularly for obtaining fibre or seed, or for horticultural purposes, and medicinal purposes. Ministry of AYUSH initiatives have addressed the licensing, review, and surveillance of ASU formulations containing *Cannabis sativa* (bhang). Thus, cannabis represents a complex intersection of agriculture, traditional medicine, pharmacology, forensic science, public health, and law. Its appropriate interpretation requires an integrated understanding of botany, chemistry, pharmacology, medicine, forensic examination, and the applicable legal framework. Its legality depends on the plant material, intended purpose, applicable central and state regulations, and required license or authorization. In the Indian context, therefore, cannabis should neither be viewed solely as an illicit narcotic plant nor solely as a medicinal resource. Conclusively, evidence-based research is required for balancing industrial, recreational, and medicinal uses.



Keywords: *Cannabis sativa*, cannabis cultivation, Δ^9 -THC, cannabidiol, medicinal cannabis, NDPS Act, industrial hemp, forensic toxicology, therapeutic cannabinoids, India.

Differentially Capped Gold Nanoparticles Based Nanosensor Array for Multiplex Detection of Pesticides

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Abstract

Based on aggregation of differentially capped gold nanoparticles (GNPs) with pesticides, a simple yet effective colorimetric sensor array has been fabricated for the multiplex detection of pesticides. Four differentially capped GNPs were synthesised to form four sensing elements of the array. As analytes, five pesticides from three different classes, namely, organophosphates (OP), pyridine azomethine (PA), and dithiocarbamates (DC), were taken for the study. The discrimination ability of the sensor was validated by linear discriminant analysis (LDA) and principal components (PC) were used for calibration curve plot, obtaining LOD in a range of 0.42 to 5.44 $\mu\text{g/ml}$. The sensor showed excellent discrimination ability with 100% accuracy for multiple classes of pesticides as well as for within class discrimination. Furthermore, selectivity, sensitivity, reproducibility, and interference studies were done indicating the robustness of the sensor. At last, the sensor array was validated with real world samples by spiking tomatoes with Pym and obtaining good recovery rates with RSD less than 10%. To authenticate the sensor's efficacy for real world samples, the detection value for Pym was compared with that of HPLC. The results strongly suggest that the facile colorimetric sensor array may provide an excellent platform for on-site monitoring of multiple pesticides.

Rewiring Bacterial Signaling Pathways through Proximity-Induced Post-Translational Modifications of Response Regulators using Molecular Glues

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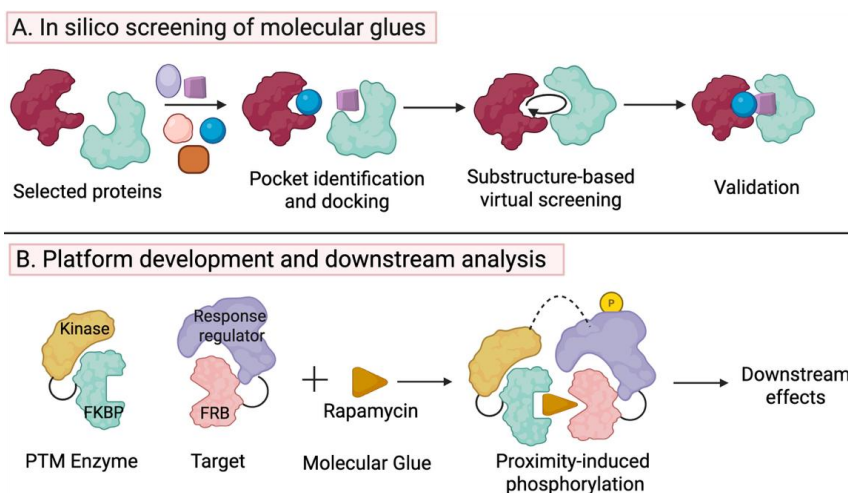
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Abstract

Proteins are often subject to post-translational modifications (PTMs) in cells that impart covalent alterations to the amino acids side chains thereby further enhancing the protein diversity for functional selection. Bacteria use two-component systems (TCSs) to sense and respond to environmental changes. In the prototypical system, the TCS consists of a sensor histidine kinase (HK) that auto-phosphorylates and activates its cognate response regulator (RR) by transferring the phosphate group from its histidine residue to the aspartate residue of the RR. RRs function as transcriptional factors, regulating genes involved in various processes ranging from virulence to antibiotic resistance. However, deviations from the existing classical TCS model have also been reported in some species. In certain systems, serine-threonine kinases (STKs), act in parallel with HKs to achieve full RR activation, and in some cases STK-mediated phosphorylation enhances the DNA-binding affinity of RRs. Given the diversity of bacterial kinases, artificially rewiring TCS pathways—by inducing proximity between the kinases and RRs using small-molecule binders—could redirect regulatory outputs governing virulence or antimicrobial resistance. Since PTM impart transient function without the need of DNA encoding, dynamic selection pressure operates on them on smaller timescales rather than being multigenerational. Discovery or development of such molecular glues can provide a promising strategy for novel antibiotics to combat anti-microbial resistance (AMR).

Graphical Abstract



Keywords: Bacterial post-translational modifications (PTMs); Two-component systems (TCSs); Proximity induction; Virulence regulation; Antimicrobial resistance; Next-generation antibiotics

Key References:

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Assessing Cr(VI) Penetration in Agri Produce from Polluted Waters using *Solanum tuberosum* as Model Crop towards Food Safety

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Abstract

Hexavalent chromium [Cr(VI)] is a highly toxic and carcinogenic environmental contaminant associated with industrial activities and contaminated water and soil [1,2]. In India, chromium concentrations exceeding the permissible limit of 0.05 mg/L have been reported in parts of 62 districts across 16 states, indicating widespread chromium contamination in groundwater [3]. Such contamination can reach agricultural systems through contaminated water and soil, creating a potential pathway for chromium accumulation in food crops [2,4]. Cr(VI) is known to undergo reduction to Cr(III) within biological matrices. However, the distribution of the Cr(VI) fraction that remains detectable within edible plant tissues following exposure is less understood. Understanding this distribution is important for assessing the extent of Cr(VI) contamination within food crops.

Potato (*Solanum tuberosum*) tubers were exposed to 2, 5, and 10 ppm Cr(VI) for 2 and 24 h under peeled and unpeeled conditions. Three tissue-depth fractions were analyzed for Cr(VI) following alkaline digestion and DPC-based colorimetric determination using UV–Vis spectrophotometry [5]. Cr(VI) was detected in all three tissue layers under all exposure conditions. The distribution varied with exposure duration and peel condition. In peeled tubers, Cr(VI) concentrations generally decreased from the outer to inner layers after 2 h, while the opposite trend was observed after 24 h. In unpeeled tubers, higher concentrations were observed towards the inner layers after 2 h, whereas concentrations decreased with depth after 24 h. The 24 h exposure also resulted in higher detectable Cr(VI) concentrations than the 2 h exposure across the analyzed tissues.

The detection of Cr(VI) throughout the investigated tissue depths, despite the known reduction of Cr(VI) in biological matrices, demonstrates that the hexavalent species can remain detectable within edible potato tissue following exposure. The changes in its depth-dependent distribution with exposure duration and peel condition further indicate that Cr(VI) contamination within the tuber is spatially heterogeneous. These findings highlight the importance of depth-resolved analysis when assessing Cr(VI) contamination in food crops and provide useful information for evaluating contaminant distribution in agricultural systems and its potential relevance to food safety.

Graphical Abstract

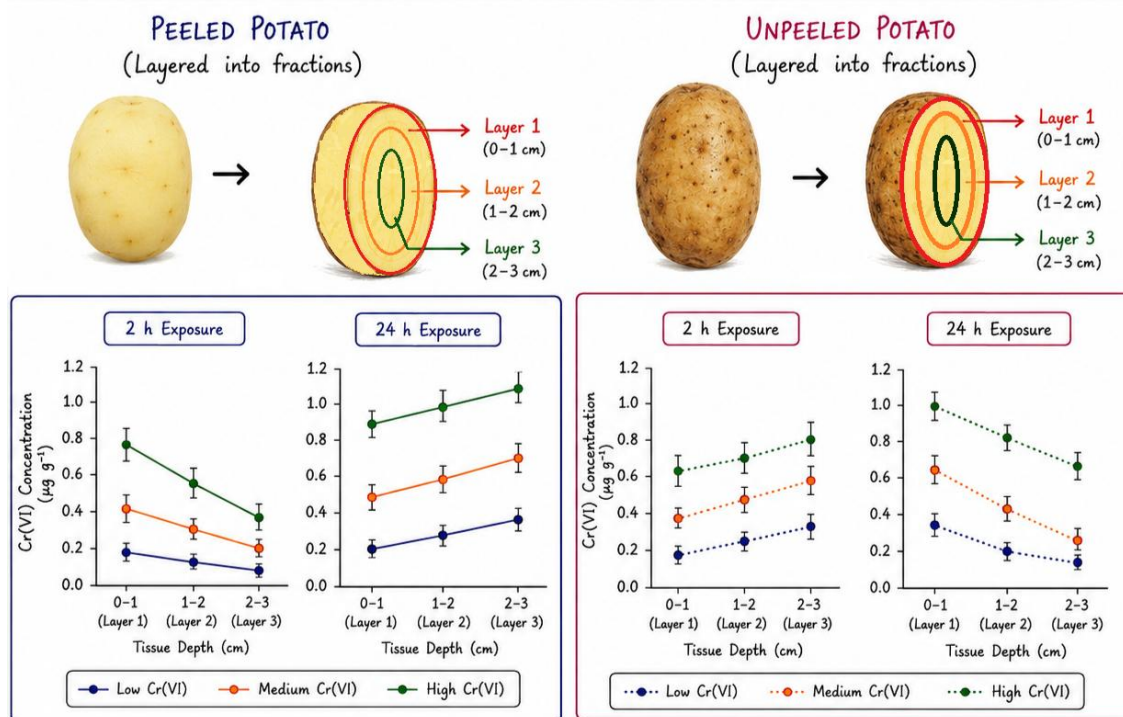


Figure 1 Assessment of Cr(VI) penetration and depth-dependent distribution in potato tuber tissue

Keywords: Hexavalent chromium [Cr(VI)], *Solanum tuberosum*, Food safety, Environmental contamination, Depth-dependent distribution

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Valorization of Canola Oil Cake for Co-Production of Polyhydroxyalkanoate and Biosurfactant for the Development of a Biodegradable and Antibacterial Biomaterial

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Abstract

The increasing accumulation of agro-industrial residues and dependence on petroleum-derived plastics have created a need for sustainable strategies for producing biodegradable polymeric materials. Polyhydroxyalkanoates (PHAs) are microbial polyesters that offer an attractive alternative to conventional plastics because of their biodegradability and biocompatibility. Microbial biosurfactants, another class of biologically derived metabolites, possess surface-active, biodegradable and antimicrobial properties, making them promising eco-friendly alternatives to conventional synthetic surfactants while expanding the functional potential of biomaterials. Polyherbal formulations offer a complementary source of diverse bioactive compounds with antibacterial effects, providing an additional natural approach for imparting antimicrobial functionality to biomaterials. However, the relatively high production cost of both PHA and biosurfactants remains a major limitation for large-scale applications, with the carbon source among the most significant contributors to overall production costs. The present work explores the valorization of canola oil cake, an underutilized agro-industrial residue, as a renewable and low-cost carbon source for the microbial co-production of PHA and biosurfactant, providing a sustainable route for converting inexpensive biomass into value-added bioproducts. The recovered PHA was processed into a biodegradable polymeric film, demonstrating its potential as a functional biomaterial. The biosurfactant and selected polyherbal formulation demonstrated antibacterial activity. These components provide complementary functions; PHA serves as the biodegradable structural matrix, the biosurfactant provides surface-active and antibacterial functionality, and the polyherbal formulation contributes herbal antibacterial bioactives. The integration of these biologically derived components represents a promising approach towards developing a biodegradable antibacterial biomaterial, while the use of canola oil cake provides an opportunity for simultaneous waste valorization and reduced dependence on refined substrates. Future research will focus on the fabrication of the optimized formulation into nanofibrous biomaterials and, ultimately, a multifunctional antibacterial medicated fabric for potential healthcare applications.

Keywords: Polyhydroxyalkanoate (PHA), biosurfactant, antibacterial, polyherbal extracts, medicated fabric, sustainable, biomaterial.

Overcoming Chemoresistance: A Review of TME-Activated Endoperoxide-Curcumin Nanocarriers for Synchronized Ferroptosis

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Abstract

Plant-derived endoperoxides, particularly artemisinin and ascaridole, have emerged as promising candidates for cancer therapy because of their ability to generate reactive oxygen species (ROS) through iron-mediated activation of their endoperoxide moieties. The resulting oxidative stress can induce lipid peroxidation and promote ferroptosis, an iron-dependent form of regulated cell death. However, cancer cells can adapt to oxidative stress by activating survival and antioxidant pathways, including nuclear factor-kappa B (NF- κ B), thereby limiting the therapeutic efficacy of endoperoxide-based approaches. In addition, the clinical translation of these phytochemicals is challenged by poor aqueous solubility, rapid systemic clearance, limited tumour accumulation, and differences in the pharmacokinetic profiles of combination agents.

This review explores recent advances in stimuli-responsive nanomedicine as a strategy to overcome these limitations, with particular emphasis on the conceptual development of tripartite nanocarrier systems incorporating endoperoxides and curcumin, a phytochemical reported to modulate NF- κ B-mediated survival pathways. A key approach involves incorporating these agents into nanocarriers using glutathione (GSH)-responsive disulfide linkers, enabling preferential intracellular release under the reducing conditions of the tumour-cell cytosol. Nano-encapsulation can additionally improve the aqueous dispersibility and systemic stability of poorly soluble phytochemicals while facilitating their co-delivery to tumour tissue.

The proposed therapeutic framework involves a sequential mechanism in which nanocarrier-mediated tumour accumulation is followed by cellular uptake and GSH-triggered cleavage of the disulfide linkage, resulting in coordinated release of the therapeutic components. Endoperoxides can subsequently undergo iron-mediated activation to generate ROS and promote oxidative damage, while curcumin may simultaneously attenuate NF- κ B-associated cellular defense mechanisms. The resulting combination of enhanced oxidative stress and reduced antioxidant/survival signaling may increase tumour-cell susceptibility to ferroptosis and other forms of programmed cell death.

By integrating phytochemical pharmacology, ferroptosis biology, stimuli-responsive chemistry, and nanotechnology, this review highlights the potential of GSH-responsive co-delivery systems as an emerging strategy for overcoming the limitations of conventional phytochemical cancer therapy. Current evidence, mechanistic insights, translational challenges, and future opportunities for developing such multifunctional nanomedicines are critically discussed, with particular emphasis on their potential application against drug-resistant malignancies.

Keywords : Artemisinin, Ascaridole, Reactive Oxygen Species, Tumor Microenvironment (TME), Curcumin, Disulfide, Nano-encapsulation (PEG-PLGA)

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Multi-Omics Insight into Bioremediation of As(V) by *Klebsiella planticola* CSG1 Isolated from Contaminated Aquatic Environments.

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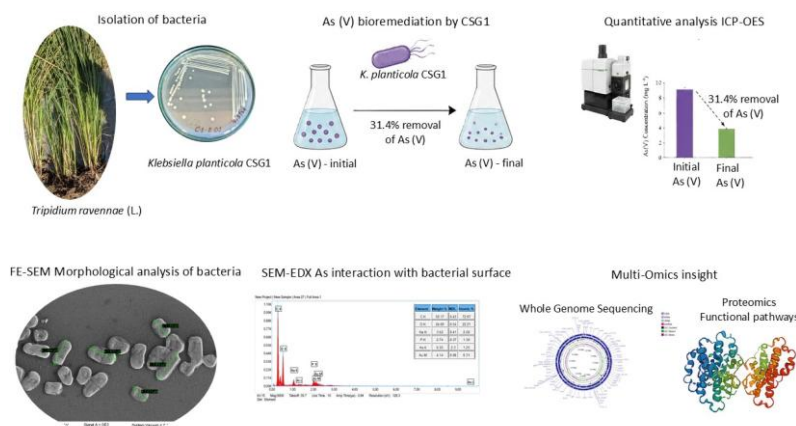
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Abstract

Heavy metal pollution of aquatic environments is an unrelenting environmental issue that demands novel, cost-effective bioremediation strategies. This study explores As (V) remediation capability of *Klebsiella planticola* CSG1, identified through whole-genome sequencing and isolated from the roots of *Tripidium ravennae* (L.) H. Scholz (sourced from Haridwar, India) by combining genomic, proteomic, quantitative analytics and elemental analyses. Inductively coupled plasma-optical emission spectroscopy (ICP-OES) based quantitative analysis indicated 31.4% removal of As(V) ions by *Klebsiella* sp. CSG1. Moreover, a specific metal uptake capacity (q_e) of 0.4457 mg g⁻¹ dry biomass for As(V) by isolate CSG1 demonstrated accumulation or biosorption of metal ions within bacterial biomass. Field-emission scanning electron microscopy (FE-SEM) revealed stress-induced morphological changes on bacterial surfaces, exhibited by an increase in cell size following As(V) exposure. These results were supported by findings from scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDX), which highlighted strong interactions of metal ions with bacterial surfaces through detection of distinct As L peaks in the EDX spectrum. WGS analysis provided insights about metal tolerance, metal transport and cellular defence at the genetic level. Moreover, proteomic analysis helped in assessing the functional pathways under As(V) exposure. This exhaustive amalgamation of genomics and proteomics, combined with ICP-OES, FE-SEM and SEM-EDX, demonstrates the significance of multi-omics and analytical techniques in elucidating the molecular dynamics behind heavy-metal tolerance and establishes *Klebsiella planticola* CSG1 as an eco-friendly candidate for the bioremediation of arsenic-contaminated aquatic environments.

Graphical Abstract



Keywords: Bioremediation; Heavy metal; WGS; Proteomics; ICP-OES; FE-SEM; SEM-EDX

Hospital Wastewater-Derived Microalgae for Antibiotic and Heavy Metal Removal: A Sustainable Approach to Healthcare Wastewater Management

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Abstract

The bioremediation potential of microalgae is well explored, but lacks understanding of the potential to deal with the complex nature of hospital wastewater. Thus, the prevalence of heavy metals and antibiotic resistance requires focused attention. This study investigates the treatment of synthetic wastewater by using isolated *Chlorella sorokiniana* microalgae strain from hospital wastewater. The microalgae culture was analyzed for its organic and antibiotic waste degradation, along with heavy metal adsorption potential throughout the incubation period of 20 days. The findings demonstrated pH stabilization and a significant decrease in biological oxygen demand, chemical oxygen demand, and heavy metal concentrations. The maximum growth experiments yielded a biomass under optimized conditions for 5.13 g L^{-1} at (pH=6, $30\text{ }^{\circ}\text{C}$, 16:8 light-dark period, 0.2 mg L^{-1} chlorination). The microalgae demonstrated removal efficiency of up to 80% for total nitrogen, 70.3% for phosphate. Further, the removal of antibiotic revealed, 76% efficiency in case of Ciprofloxacin and 87.81% by day 10 for Azithromycin in comparison to photodegradation in similar conditions used for the growth of *Chlorella sorokiniana*. Further, lead (Pb) removal was quantified with 85% removal in the experiment. The results highlighted the efficiency of microalgae as an environment friendly, economical, and sustainable bioremediation systems for hospital effluents along with biomass valorisation. The initial delay of the Ciprofloxacin degradation, suggests the competitive interaction of antibiotic during its uptake and metabolic processing. This low-cost, eco-friendly approach offers promising prospects for integrating microalgae into tertiary treatment systems for pharmaceutical effluents, contributing to sustainable wastewater management and environmental protection.

Keywords: Microalgae; bioremediation; heavy metal removal; antibiotic resistance; hospital waste water treatment; *Chlorella sorokiniana*

Correlation Between the Visual EEG Confusion Assessment Method Severity (VE-CAM-S) Score at Baseline and Functional Outcome in Children with Acute Encephalitic Syndrome: a Prospective Observational Study

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AIIMS RISHIKESH

Abstract

Background Acute Encephalitic Syndrome (AES) is a major cause of pediatric morbidity and mortality across India. Standardized electrophysiological severity scoring via the Visual EEG Confusion Assessment Method Severity (VE-CAM-S) provides an objective bedside assessment of acute cerebral dysfunction. This study evaluated the relationship between baseline VE-CAM-S electrophysiological severity, neuroimaging changes, inflammatory indices, and 3-month functional recovery using the Functional Status Scale (FSS).

Methods

Study design: Prospective observational study

Sample Size: Total 69 (Fisher's Z-transformation: $n = ((Z\alpha/2 + Z\beta) / Zr)^2 + 3$)

Study site: Pediatric Neurology Division, AIIMS Rishikesh.

Case Enrollment: Children aged 1 month to <18 years meeting WHO clinical criteria for AES (acute fever, altered sensorium, new-onset seizures).

Baseline Assessments (<48 Hours):

- Video EEG scored via VE-CAM-S (0–20 scale).
- Contrast brain MRI graded using the 5-tier Pöyhönen severity classification.
- Systemic Immune-Inflammation Index (SII: [platelet $\times$ neutrophil] / lymphocyte).
- Functional Status Scale (FSS: 6–30) at admission and at 3-month post-discharge follow-up.

Role Of Visual EEG Confusion Assessment Method Severity (VE-CAM-S) Score

VE-CAM-S is a visual EEG-based scoring system used to assess the severity of encephalopathy in children with altered mental status. Higher VE-CAM-S scores indicate more severe EEG abnormalities and potentially greater cortical dysfunction. The score provides a rapid, structured, and semi-quantitative assessment of encephalopathy, making it useful in resource-limited settings. VE-CAM-S shows promise as a prognostic tool, but further studies are needed to establish its relationship with long-term functional outcomes and neurological recovery.

Statistical analysis

All analyses will be conducted using latest version of SPSS software, with a two-sided p-value <0.05 considered statistically significant.

Continuous variables will be summarized as mean $\pm$ SD or median (IQR), and categorical variables as frequencies and percentages; normality will be tested using the Shapiro-Wilk test.

Correlation between baseline VE-CAM-S score and other parameters with 3-month FSS scores will be assessed using Pearson's or Spearman's coefficient, depending on distribution.

Results

- **Baseline Demographics & Severity (N = 35):** The cohort had a mean age of 7.87 ± 4.98 years (range 0.5–16.0 years), with 18 males (51.4%) and 17 females (48.6%). All 35 patients (100%) presented with acute fever and seizures, and 34 (97.1%) exhibited altered sensorium. Fourteen patients (40.0%) required pediatric intensive care admission (mean ICU stay: 6.43 ± 5.12 days), and 6 (17.1%) received mechanical ventilation.
- **Electrophysiological & Imaging Profiles:** Baseline VE-CAM-S scores ranged from 1 to 10 (mean: 4.31 ± 2.61 ; median: 4.0). Brain MRI demonstrated abnormal findings across all imaged patients (mean severity score:

2.32 $\pm$ 0.60), with focal non-enhancing/meningeal involvement (Score 2) in 74.2% (n = 23), multifocal lesions (Score 3) in 19.4% (n = 6), and confluent changes (Score 4) in 6.5% (n = 2).

- **Functional Recovery** (n = 28 evaluated at 3 months): Significant functional improvement occurred from baseline (mean FSS: 18.57 $\pm$ 6.29) to 3 months post-discharge (mean FSS: 8.68 $\pm$ 3.50; $p < 0.001$). Baseline functional morbidity strongly predicted 3-month recovery ($r = 0.765$, $p < 0.001$). Baseline VE-CAM-S showed a positive trend with admission functional impairment ($r = 0.238$), while long-term 3-month functional status was predominantly governed by the severity of the initial clinical insult.

Conclusion Bedside electrophysiological evaluation via VE-CAM-S and structural neuroimaging severity grading offer practical, objective parameters for acute risk stratification in pediatric AES. Acute baseline functional compromise serves as the strongest predictor of 3-month recovery deficits, emphasizing the necessity of early multidisciplinary neuro-rehabilitation post-discharge.

"Acute Encephalitic Syndrome carries substantial risk of long-term disability in North India. In our cohort of 35 children evaluated at AllMS Rishikesh, we prospectively captured early electrophysiological dysfunction using the VE-CAM-S score within 48 hours of admission. We observed significant functional recovery across 3 months—FSS improved from 18.57 down to 8.68 ($p < 0.001$). While baseline clinical severity strongly dictated long-term recovery, VE-CAM-S provided a reliable, standardized metric to quantify cortical dysfunction at the bedside without relying solely on subjective exams."

- **Addressing Sample Size** (N = 35 enrolled vs. 69 target):

"Our protocol target is 69 patients to power correlation analyses. This presentation represents our planned interim analysis of 35 enrolled patients with completed 3-month follow-up available for 28 children. Patient recruitment and ongoing long-term assessments are actively continuing."

- **Clinical Takeaway:**

"VE-CAM-S standardizes EEG reporting in pediatric critical care where sedation and acute encephalopathy make clinical grading challenging. Combined with baseline Functional Status Scale assessments, it helps identify patients requiring prioritized neuro-rehabilitation early in the post-discharge phase."

Isolation and Screening of Biosurfactants Produced by Extremophilic Microorganisms from Uttarakhand Regions for Applications in Food Industry

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Abstract

Biosurfactants are eco-friendly surface-active compounds produced by microorganisms and as promising alternatives to chemical surfactants in food processing and preservation. This study focusses on the potentials of biosurfactants produced by extremophilic microorganisms for applications in the food industry. Biosurfactants possess properties like antimicrobial, anti-adhesion, and anti-biofilm which can prevent the food spoilage and help in shelf-life retention. Here, we focus on biosurfactants that can be stable at both very low and very high temperatures, from extremophilic microbes. Here, we isolated ~ 188 bacterial isolates from various hot springs of the Garhwal region in Uttarakhand as well as fuel-depot dumps from higher altitudes. Samples were enriched in a mineral salt (MSM) and Bushnell Haas (BH) media, with added hydrocarbons (diesel, olive oil, and mustard oil), as the sole carbon source. 33 isolates showed promising ability to produce biosurfactants based on oil spreading activity ranging from 29 – 73 mm and emulsification index (E24) ranging from 35.7 - 54.4%. Of them, five best potential strains have been selected for isolation and characterisation of biosurfactants for potential applications in the food industry. The best potential strain was identified as a thermophile *Deinococcus geothermalis* APSB1, using 16SrRNA sequencing. This strain was isolated from Ganganani, hot spring and thrives at 55°C, producing a highly thermostable biosurfactant, showing activity, even after autoclaving the culture supernatant at 121°C. Extracted biosurfactants from such extremophilic cultures is presently under investigation for applications in food industry.

Keywords: Biosurfactant, Extremophilic, Hot springs, *Deinococcus*

Valorization of Agro-Food Waste into Functional Materials for Sustainable Active Food Packaging

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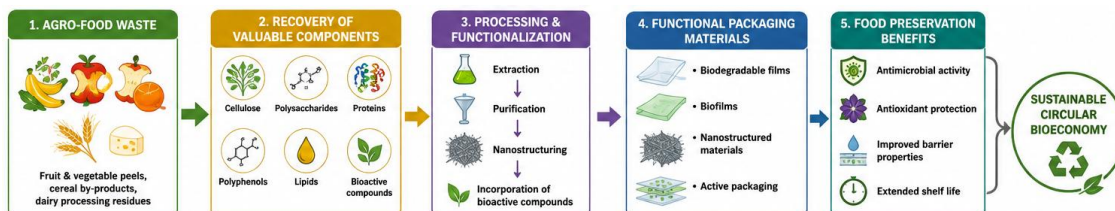
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Abstract

The rapid development of the agro-food industry generates large amounts of organic waste, producing serious environmental and economic challenges. At the same time, these wastes are a valuable and largely underutilized source of useful biomaterials. Increasing concerns about plastic pollution and food losses after harvest have also created a strong requirement for sustainable and biodegradable alternatives to conventional petroleum-based packaging. Agro-food waste like fruit and vegetable peels, cereal by-products, and dairy processing residues, contain valuable components including proteins, lipids, cellulose, polysaccharides, polyphenols, organic acids, and other bioactive compounds. These materials can be recovered and processed to develop biodegradable films, biofilms, and nanostructured packaging materials with improved mechanical strength, gas and moisture barrier properties, and antioxidant or antimicrobial activity. Unlike conventional packaging, waste-derived materials can also be designed as active packaging systems. These systems can interact with food and help reduce oxidation, moisture loss, and oxidation and microbial growth, thereby improving food quality and extending shelf-life. Such packaging materials can potentially be applied to a variety of food products, including fresh fruits and vegetables, dairy products, and ready-to-eat foods. This reviews the current strategies for converting agro-food waste into sustainable packaging materials. It focusses on approaches for recovering valuable components, developing functional packaging materials, characterizing their properties, and evaluating their performance in real food systems. By converting agricultural and food residues into useful packaging materials, this method supports a circular economy, decreases waste, and delivers an environmentally friendly solution for improving food preservation and developing sustainable packaging.

Graphical Abstract



Keywords- Agro-food waste; Waste valorization; Active food packaging; Biodegradable packaging; Functional materials; Bioactive compounds; Circular economy; Sustainable food preservation

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Exploring Gold Nanoparticle Based Colorimetric Nanosensor Arrays for Detection of Antibiotics

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Abstract

Antibiotic residues are a known health hazards and can cause severe health issues contributing to antimicrobial resistance (AMR), allergic responses, disruption of gut microbiota, toxicity and liver damage and in some cases hormonal disruption. Traditional detection methods such as high-performance liquid chromatography (HPLC), gas chromatography (GC), surface-enhanced Raman scattering (SERS), mass spectrometry and electrochemical methods have the shortcoming of being expensive, complex to operate and require long time periods. Thus, traditional analysis and detection methods cannot meet the demand of monitoring antibiotics which should be very quick, convenient, and cost effective in resource limiting environment. To overcome these shortcomings, we have developed nanosensor array-based strategies for multiplexed detection of antibiotics using differentially capped gold nanoparticles (AuNPs). For this study, we employed four differentially capped AuNPs namely Citrate, Mercaptobenzoic acid (MBA), 2-mercapto-6-nitrobenzothiazole (MNBT) and Cysteamine capped AuNPs. Colorimetric detection can generate a result based on aggregation /disaggregation of AuNPs, which can be observed with naked eyes, but their signal can also be enhanced with their outputs converted into simple RGB based data. Using Artificial intelligence and machine learning (ML) algorithms we enhanced the sensors capability to distinguish different classes of antibiotics with upto 100% accuracy for some classes. Thus, by using these tools we can successfully discriminate antibiotics based on their spectral signatures and RGB values providing a method for easy, and rapid detection of multiple antibiotics of different categories. Therefore, it can be utilized for rapid on-site detection in food and agriculture industries as well as for environmental monitoring.

Keywords: Multiplex Colorimetric detection, Antibiotics, Gold nanoparticles, Machine Learning and Artificial Intelligence.

Thermophilic Bacteria from Hot Springs as Sustainable Bioleaching agents for Red Mud

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Abstract

Red mud, an alkaline byproduct of alumina production, poses significant environmental challenges due to its high pH and elevated concentrations of iron oxides, aluminum compounds, and Critical metals. Conventional chemical leaching processes are energy-intensive and generate secondary waste. Thermophilic bacteria with acid-producing capability and alkaline tolerance offer a sustainable alternative for bio-hydrometallurgical processing. This study isolated and characterized thermophilic bacterial strains from Ringidhar hot spring (tempt. 82.33°C, pH 6.65, 79.645372°, 30.490966°) in Uttarakhand, India, to assess their potential for red mud bioleaching. Water samples from the hot spring were enriched in nutrient broth and R2A media at 70°C. Using spread plate methodology, twelve thermophilic bacterial isolates were obtained and purified through quadrant streaking. Morphological characterization revealed all isolates to be Gram-positive, rod-shaped bacteria, except one isolate which is gram-negative, rod-shaped. Biochemical analysis (IMViC and catalase tests) with predominantly negative IMViC results and positive catalase activity indicated affiliation with thermophilic *Bacillus* species. Physicochemical profiling showed optimal growth at 70°C and 80°C, with exceptional growth in neutral to alkaline pH conditions (pH 6–9, with maximum absorbance at pH 8). Growth optimization in Minimal Salt Medium (MSM) demonstrated robust biomass production with glucose and yeast extract supplementation. The isolated strains physiological characteristics—thermostability, alkaline pH tolerance, and metabolic versatility—position them as promising biocatalysts for red mud remediation. Their ability to produce metabolic acids under optimized conditions, combined with tolerance of alkaline environments, suggests suitability for facilitating acid-assisted bioleaching of strategic metal oxides from red mud. This research provides a molecular foundation for advancing sustainable bio-hydrometallurgical strategies for managing industrial waste while potentially recovering valuable critical metals.

Keywords: Thermophilic bacteria, Red mud, Bioleaching, Biohydrometallurgy,

Magnetic Nanoparticles: Potential Emerging Method for Extraction of Microplastic

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Abstract

The widespread use of plastics in daily life causes environmental pollution from microplastics, as plastics are non-biodegradable and break down into microplastic and nano-plastic particles (MNPs) through physical, chemical, and biological weathering. When MNPs enter the human body, mainly through inhalation and ingestion, they cause serious health issues. To manage MNPs, using a circular economy framework becomes essential. This study investigates the potential of magnetite nanoparticles with hydrophobic surface modification for microplastic extraction from environmental matrices. Magnetite is one of the most abundant iron ores and is synthesized in the laboratory by co-precipitation of ferrous and ferric salts under inert conditions. We coated the synthesized particles with long hydrocarbon chains using the sol-gel technique. We then characterized the coated particles to obtain compositional and surface information. DLS for hydrodynamic diameter of particles, XRD for crystallite structure, SEM-EDS for surface and compositional information, and TEM for grain size of magnetite were performed, and the results show that the hydrophobic coating was successfully achieved on the magnetite surface. After synthesizing and characterizing the coated magnetite, we tested extraction efficiency for common microplastics (PE, PET) using the coated magnetite and achieved more than 90% microplastic extraction. These results suggest that surface modification enhanced heterogeneous interactions between coated magnetite and MPs through hydrophobic-hydrophobic interactions, leading to more efficient MP removal than conventional methods like density separation and oil-based extraction.

Evaluation of Antibacterial Potential of *Matricaria recutita* (Chamomile) against Pathogenic Bacteria

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Abstract

Chamomile is an extraordinary plant which has been used since immemorial time due to its many medicinal properties such as anti-cancer, anti-inflammatory, anti-microbial, sedative, wound healing, and analgesic properties etc. This study was carried out to determine the antibacterial activity of *Matricaria recutita* plant's flower hydrosol and leaves, stems and flowers extract with different solvents (water & methanol) using agar well diffusion methodology against *Staphylococcus aureus*, *Enterococcus faecalis*, *Pseudomonas aeruginosa* and *Escherichia coli*.

In results it is seen that the hydrosol showed best result in comparison to all the extracts. Largest zone was observed on *P. aeruginosa* of 28mm followed by *E. coli* and *S. aureus* (23mm) and 30mm for *En. faecalis* plates at 7% which was lowest inhibitory conc. and extracts showed best result at 400 – 200 mg/mL concentrations. *En. faecalis* gave smallest zones by all the extracts in comparison to other bacteria. And *S. aureus* & *P. aeruginosa* gave significant results followed by *E. coli*. And overall methanolic extract gave better result than aqueous extract. Chamomile hydrosol is less studies and its comparative study of components & composition has to be studied further in future which can be used for various purposes.

An Extraction Process Associated with Abating Degradation to Improve Yield as well as Reaction Time for Lutein from Marigold Flowers -A Research.

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Abstract

A Recent extraction technique for Lutein from both wet and dry marigold flowers using sodium hydroxide and methanol. To isolate pure lutein from its easy resources, such as the marigold flower's petals. That leads to an easy extraction process within a short time period. During the reaction, a single polar organic solvent is used. Such as Methanol and sodium hydroxide react to sodium methoxide, which is favorable in SN2 reaction. Hydrolysis of Lutein ester from marigold flowers is accomplished shortly. This hydrolysis reaction occurs within 30 minutes at 60 to 65°C and improves the yield. The extraction process is cost-effective and optimised for high yield with negligible degradation during a short reaction time at a favourable temperature.

Lutein is not synthesized in humans and animals. This molecule comes in the carotenoid class, makes a yellow spot of the macula lutea in the human retina. That can be protected by daily consumption of Lutein. Macular degeneration occurs due to a deficiency in old age. It is biologically active against diabetes and some cancers. Lutein protects the eyes from direct exposure to UV rays of sunlight. Keywords: Lutein, Lutein ester, Marigold flower, methanol, NaOH, Zeaxanthin, etc.

Citrus Processing Waste as a Multifunctional Bio-Resource: Green Extraction, Sustainable Packaging Films and Prebiotic-Probiotic Applications

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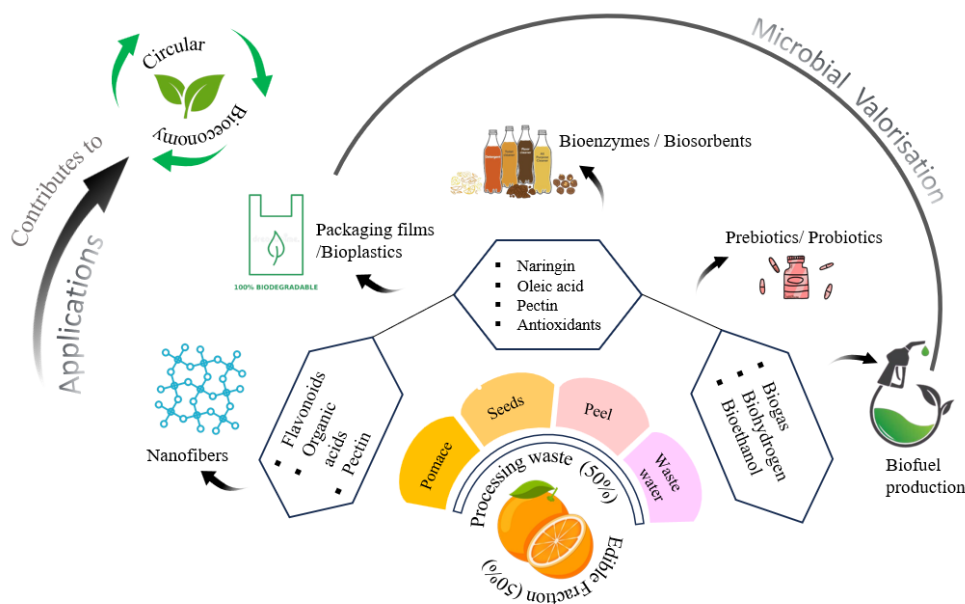
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Abstract

Citrus processing generates large volumes of peel, pomace, seed and wastewater by-products annually, which on conventional disposal drive methane emissions from landfill and oxygen depletion in receiving water bodies. These by-products are rich in pectin, cellulose, citric acid, flavonoids, essential oils and fermentable sugars, offering antioxidant, antimicrobial, prebiotic and bioenergetic functionality of industrial relevance. This work reviews the recovery of these compounds through green extraction methods such as ultrasound- and microwave-assisted extraction, and examines their application across three areas. In packaging, citrus-derived pectin and cellulose are crosslinked with citric acid and combined with essential oils to produce biodegradable films with antimicrobial, barrier and self-healing properties, offering an alternative to petroleum-based plastics and a route to extended food shelf life. In functional foods, pectin can be depolymerized into pectic oligosaccharides that act as prebiotics, supporting probiotic growth and enabling the development of fermented beverages and other value-added products. Taken together, the reviewed evidence indicates that systematic valorisation of citrus processing waste can deliver market-relevant packaging and functional-food applications from a low-value residue, establishing it as a viable industrial raw material within a circular bioeconomy framework.

Graphical Abstract



Keywords: Citrus by-products; green extraction; antimicrobial packaging films; pectic oligosaccharides; probiotics; circular bioeconomy

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Deciphering the Potential of Electroactive Microflora for Mitigating Emerging Contaminants in Bioelectrochemical Systems

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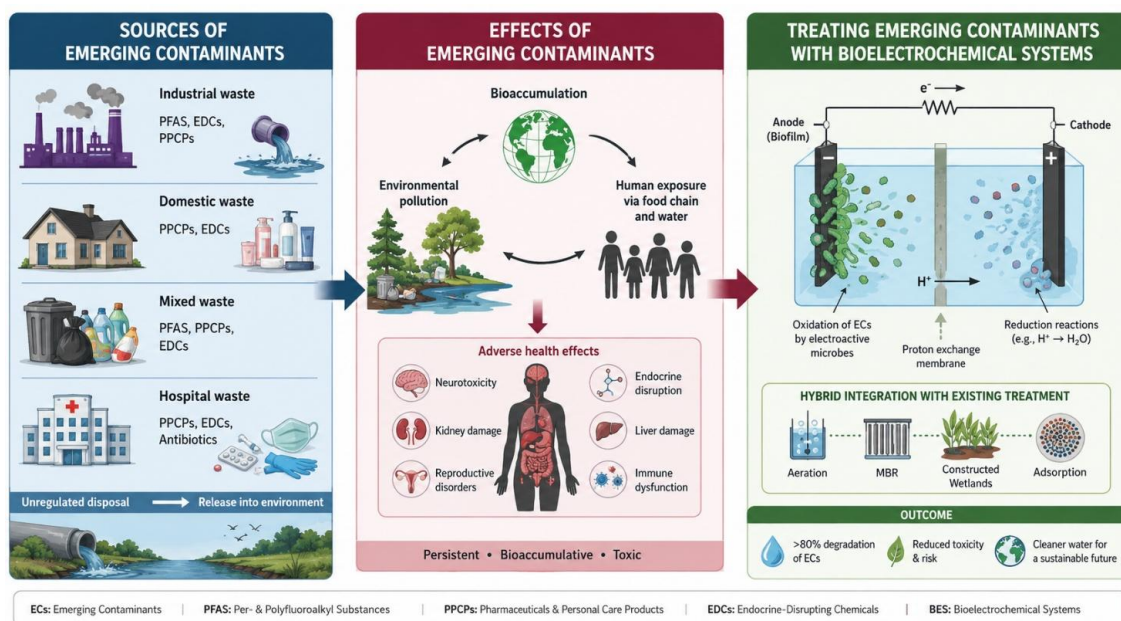
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Abstract

With the advancement in technology for analytical research, techniques like high-performance liquid chromatography and gas chromatography-mass spectrometry have shed light on an increasing threat existing in the environment for decades. Various classes of chemicals that have evolved since the industrial boom, through their chemical structure and stability, have remained persistent in the environment. Emerging contaminants (ECs) are recalcitrant chemicals that pollute the environment and through food chain and shared resources, ends up in the human body causing substantial harm to human health. These contaminants include classes such as Pharmaceuticals and personal care products (PPCPs), per- and polyfluoroalkyl substances (PFAS) and endocrine-disrupting chemicals (EDCs). With increasing global population and demand, the rapid increase in the influx of such chemicals in waste has been observed while several studies have deemed conventional wastewater treatment plants incapable of neutralizing the threat of these contaminants. In face of these challenges, bioelectrochemical systems (BES) present themselves as a solution that can address a wide range of ECs by bringing multiple disciplines under a single technology. A sustainable technology, BES employs microorganisms for degradation of contaminants and has proven to be versatile in terms of being integrated with existing technologies for wastewater treatment. BES has been studied for <80% degradation of contaminants like ethanolamine (250mg/L) in microbial fuel cell and perfluorooctanoic acid in microbial electrosynthesis cell (1mg/L). This study explores the impact of these contaminants on health, environment and their remediation using hybrid BESs while critically discussing the system design, electroactive microflora, electrodes, operational parameters, key electron transfer pathways, and degradation mechanisms.

Graphical Abstract



Keywords: Health; Microbial fuel cells; Pharmaceuticals and personal care products; PFAS; Electroactive bacteria;

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Importance of Zebrafish in Health Industry

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Abstract

ABSTRACT ARTICLE ON ZEBRA FISH (*Danio rerio*)

George Streisinger, co-founder of the Institute of Molecular Biology at the University of Oregon, cloned this fish as it is physiologically more simple than mouse, inexpensive and feasible for study of the nervous system. Wellcome Trust Sanger Institute set out to rectify this and began to sequence the zebrafish genome in 2001, completing it in 2013. The purpose of this fish is to study the human genome as 70% of its genome is similar to humans. It is being used as models for diseases such as cancer, diabetes, heart disease, Parkinson's disease, muscular dystrophy, and Alzheimer's. Zebrafish's embryo benefits scientists in doing their research as it is transparent, its tissues are optically clear, allowing light to pass through it so they can directly see internal organs, blood vessels, and cell movements in a living body without cutting or harming. It has a high offspring producing rate of about 200 eggs per week. Zebrafish are primarily used as a model organism for studying genetics, human diseases, embryonic development, drug testing, regeneration, and environmental toxicity.

Drugs are easily delivered into the system of the fish due to water solubility. Their unique and remarkable property to regenerate their damaged heart line and cells is ingenious and will be a forthcoming game changer. This fish helps researchers to study the evolution of the genome of vertebrates.

Keywords: Zebrafish, transparent embryo, genome, drug delivery, heart line repair

References: Wikipedia, Google, Tiny fish, big splash: the story of the zebrafish - History of the *Danio rerio*

Multifunctional Folic Acid-Functionalized Nanocarriers for Targeted Breast Cancer Therapy: *In Silico* NRF2 DNA-Binding Inhibition and Hydrogen Gas Adsorption

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Abstract

Aberrant activation of nuclear factor erythroid 2-related factor 2 (NRF2) is correlated with increased antioxidant defence, tumor progression and therapeutic resistance in breast cancer. Targeting the NRF2 - DNA interaction is therefore a promising approach to suppress cancer cell survival pathways. In this research, an integrated computational and materials-based approach was used for the development of a multifunctional nanocarrier system for targeted cancer therapy for breast cancer. Initially, *in silico* molecular docking studies were carried out to analyse the interaction of the designed system with the DNA-binding site of NRF2 in order to inhibit the transcriptional activity mediated by NRF2. Later on, a nanocarrier was synthesized and functionalized with folic acid for receptor-mediated targeting of folate receptor overexpressed breast cancer cells. The synthesized nanocarrier was further engineered to be able to adsorb hydrogen gas to add another working component to the system. Physicochemical characterization supported successful synthesis, surface functionalization and the hydrogen adsorption capability for the material. The biological performance of the developed platform was tested by preliminary *in vitro* assays against breast cancer cells. The results showed better target and a better biological response of the folic acid modified nanocarrier. Overall, this work reports a multifunctional nanomaterial platform of NRF2 targeting, cancer-specific delivery, and hydrogen gas adsorption that can provide the potential for advanced breast cancer therapeutics.

Keywords: nanocarriers; folic acid functionalization; ; breast cancer targeting; nanomaterials for cancer therapy.

Integrated Wastewater Treatment Using Conventional Treatment Followed by Electro-Oxidation: A Sustainable Approach for Enhanced Pollutant Removal

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Abstract

Domestic and industrial wastewaters, if not treated, contain a complex mixture of organic and inorganic pollutants that are a threat to aquatic ecosystems and to public health. Conventional treatment includes primary settling, coagulation-flocculation, and biological (activated sludge) processes. It is effective in removing suspended solids and biodegradable matter, but it typically removes only 60-75% of COD and is ineffective at removing refractory, non-biodegradable, and color-imparting compounds. This review discusses the coupling of conventional treatment with electro-oxidation (EO) as a tertiary polishing step to fill this gap. In such hybrid systems, conventional processes are applied to reduce the bulk pollutant load before electrochemical treatment, and EO generates reactive oxidizing species ($\bullet\text{OH}$, active chlorine) at the anode for the mineralization of residual organics. According to literature reports, the overall removal rates for COD, BOD, TSS, and color can reach 85-98%, over 90%, more than 95%, and more than 90%, respectively, depending on operating conditions when coupling EO with conventional pretreatment. The key parameters influencing the EO performance include the current density (10-60 mA/cm² in general), treatment time (30-180 min), electrode material (boron-doped diamond, mixed metal oxides, Ti/RuO₂-IrO₂, etc.), concentration, and pH of the electrolyte (6-8 is the optimum for most of the systems). The review summarizes the results of process optimization, energy consumption (2-15 kWh/m³), and cost implications and shows that integrated conventional-EO systems are always better than standalone conventional treatment. The results demonstrate that electro-oxidation is a strong low-chemical post-treatment technology that can meet stringent discharge and water-reuse standards.

Keywords: Wastewater treatment, electro-oxidation, conventional treatment, COD removal, BOD removal. Electrode material, current density, advanced oxidation process, water reuse, and refractory pollutants

Prediction of the Thermostable Nature of Keratinase from *Bacillus paralicheniformis* SuvM Through Computational Analysis

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Abstract

The thermostability of enzymes is significantly impacted by their structural organization, residue packing, and conformational rigidity. In this study, computational methods were used to predict the thermostability of keratinase from *Bacillus paralicheniformis* strain SuvM. The mature keratinase sequence was used to predict its three-dimensional structure using AlphaFold. The predicted structure showed a mean pLDDT score of more than 90, suggesting the accuracy of the predicted structure. The validation of the stereochemical quality of the structure using MolProbity showed that 97.91% of the residues were in favored Ramachandran regions, 0.35% were outliers, and 98.57% were favorable rotamers with only 0.48% being poor rotamers. The structural comparison of the protein with other known experimentally characterized keratinases (1GNS, 3UNX, and 1THM) showed close structural correspondence, with RMSDs of 1.80, 1.26, and 1.37 Å, respectively. The keratinase from SuvM had a radius of gyration of 16.608 Å, comparable to 3UNX (16.608 Å), while 1GNS and 1THM showed values of 16.366 Å and 16.749 Å, respectively. Hydrophobic core analysis further showed that there were 86 buried residues and 154 hydrophobic contacts (1.791 contacts per residue) in SuvM, indicating efficient internal residue packing. Collectively, these structural characteristics suggest compactness and conservation of the protein architecture, especially in the catalysis region, compatible with the enhanced thermal stability. Finally, molecular dynamics simulations were performed at 323.15 K (50 °C), 338.15 K (65 °C), and 353.15 K (80 °C) further to confirm the temperature-dependent structural stability of the keratinase.

Keywords: *Bacillus paralicheniformis* SuvM; Keratinase; Thermostability; AlphaFold; Molecular dynamics simulation; Structural bioinformatics

Mapping Druggable Hotspots at The Human KRAS:SOS1 Interface Through Integrative Sequence and Structural Bioinformatics

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Abstract

The interaction between Kirsten rat sarcoma (KRAS) and Son of Sevenless 1 (SOS1) is a critical signalling bottleneck in RAS-mediated oncogenic pathways, making it an attractive therapeutic target for RAS-driven cancers. KRAS-mutant cancer cells exhibit a greater dependence on SOS1-mediated KRAS activation than normal cells, providing a favourable therapeutic window for selective intervention. Activation of KRAS by SOS1 occurs through the insertion of the SOS1 helical hairpin into the Switch-II region of KRAS, triggering conformational changes that promote GDP release and nucleotide exchange. However, the large and relatively flat KRAS:SOS1 interface has hindered the identification of druggable binding sites. Here, we employed an integrative sequence- and structure-based bioinformatics approach to systematically map druggable hotspots at the human KRAS:SOS1 interface. Full-length human KRAS (UniProt: P01116) and SOS1 (UniProt: Q07889) sequences were analysed to annotate conserved domains, motifs, and secondary structural elements, while well-resolved crystal structures, either apo or ligand-bound, and the full-length AlphaFold model of SOS1 were examined to identify ligand-accessible pockets. Comparative structural analyses of KRAS:SOS1 complexes and inhibitor-bound SOS1 structures revealed binding pockets and high-confidence hotspot residues surrounding the catalytic nucleotide exchange interface. Overall, these findings provide new insights into the molecular determinants governing KRAS:SOS1 interaction that may facilitate the identification of novel KRAS:SOS1 interaction inhibitors.

Keywords: KRAS, SOS1, Protein-protein interaction, Inhibitors, MD Simulations, Binding pockets, Cancer.

Molecular Basis of Reproductive Failure: Advances in Female and Male Infertility Research

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Abstract

Infertility is a multifactorial disorder affecting approximately 17.5% of the global population and represents a major challenge in reproductive medicine. Advances in molecular biology have transformed our understanding of reproductive failure, revealing that infertility results from complex interactions among genetic susceptibility, epigenetic alterations, mitochondrial dysfunction, oxidative stress, endocrine imbalance, immune dysregulation, and environmental exposures. In females, impaired folliculogenesis, premature ovarian insufficiency, polycystic ovary syndrome, and implantation failure are driven by aberrant regulation of the PI3K, Akt, mTOR, Wnt, β -catenin, and TGF- β , SMAD pathways, together with disruption of the hypothalamic pituitary gonadal (HPG) axis, progesterone resistance, cohesin complex deterioration, and mitochondrial dysfunction. In males, reproductive failure is characterized by testicular microenvironment disruption, Y-chromosome microdeletions, blood-testis barrier dysfunction, excessive reactive oxygen species generation, sperm DNA fragmentation, and epigenetic abnormalities that collectively impair spermatogenesis, sperm function, and fertilization capacity. Shared molecular mechanisms include oxidative stress-mediated mitochondrial bioenergetic collapse, aberrant DNA methylation, dysregulated non-coding RNAs, endocrine-disrupting chemical exposure, neuroendocrine dysfunction, and altered immune tolerance that compromise gamete quality and embryo development in both sexes. Recent discoveries in multi-omics technologies, including genomics, transcriptomics, proteomics, metabolomics, and single-cell sequencing, have identified novel biomarkers and therapeutic targets that enable a systems-level understanding of reproductive dysfunction. Emerging precision medicine approaches including antioxidant therapy, targeted pathway modulation, epigenetic interventions, stem cell-based regeneration, extracellular vesicle, and exosome-mediated drug delivery, and phytochemical-based nanotherapeutics offer promising strategies to restore reproductive competence. This Article comprehensively discusses the molecular basis of female and male-specific infertility, integrates the common pathogenic mechanisms that underlie reproductive failure, and highlights recent advances in targeted therapeutic interventions. A deeper understanding of these interconnected molecular networks is expected to facilitate the development of personalized diagnostic tools and next-generation therapies, ultimately improving fertility outcomes and advancing precision reproductive medicine.

Keywords: Infertility, Reproductive failure, Molecular mechanism, Diagnostics

Hyaluronic Acid Functionalized Chitosan Nanoparticles Encapsulating Mogrol/Mogroside-V_Melphalan Conjugates for CD44 Targeted Ovarian Cancer Delivery

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Abstract

Ovarian cancer remains one of the most lethal gynaecological malignancies frequently requiring systemic chemotherapy. Melphalan, the alkylating agent has been employed in ovarian cancer therapy to trigger apoptosis. However, its utility is constrained by poor aqueous stability, tumor selectivity and systemic toxicities including gastrointestinal disturbances and hypersensitivity reactions. To address these limitations, a novel solvent-free mechanochemical approach enabling the conjugation of triterpenoid scaffolds with therapeutic agents was established. Mechanical trituration with glycerol as a plasticizer and citric acid as a catalyst enabled efficient esterification of Mogrol and Mogroside-V with Melphalan. Controlled thermal curing at 55 °C preserved glycosidic integrity while driving ester bond formation, and subsequent lyophilization ensured conjugate stability. Using precision ultrasonication and polyelectrolyte complexation, the conjugates were engineered into distinct, multi-layered nanoformulations. The Mogrol-based conjugate was integrated into a cationic chitosan matrix, stabilized with pectin, core-induced via NaOH, and finished with a hyaluronic acid (HA) corona. Conversely, the Mogroside-V conjugate was structured via precision nanoprecipitation, layered with a chitosan scaffold, and electrostatically coated with a receptor-mediated HA ligand shell. Characterization such as FTIR, NMR, TEM, NTA confirmed that this solvent-free strategy successfully yielded structurally stable products. These HA-functionalized, chitosan-scaffolded nanoformulations represent a delivery platform designed to enhance chemotherapeutic stability and achieve CD44 directed ovarian cancer therapy. Their therapeutic potential is being validated using *in vitro* ovarian cancer models via cell viability assays.

Keywords: Melphalan, Mogroside-V, Mogrol, Self-assembled nanoparticles, Hyaluronic acid, CD44

Structure-Based Rational Design and Computational Evaluation of Dual PDE1B/PDE10A Inhibitors as Potential Therapeutics for Schizophrenia

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Abstract

Schizophrenia is a chronic, debilitating neuropsychiatric disorder affecting approximately 1% of the global population, characterized by positive symptoms (hallucinations and delusions), negative symptoms (social withdrawal), and cognitive impairment. The aetiology is linked to dopamine system dysregulation, involving under-stimulation of D1 receptors in the prefrontal cortex, which impairs memory and executive function, and over-stimulation of D2 receptors in the striatum, which drives psychosis. While conventional antipsychotics primarily alleviate positive symptoms by blocking D2 receptors, they often fail to treat negative or cognitive deficits and are frequently associated with extrapyramidal side effects. To address this unmet clinical need, recent research has focused on phosphodiesterase (PDE) enzymes, particularly PDE1B/10A, which are dual-substrate regulators highly expressed in brain regions involved in schizophrenia. Simultaneous inhibition of PDE1B/10A represents a novel therapeutic approach to improve all three symptom domains by potentiating D1 receptor signalling and suppressing D2 receptor pathways. This study utilizes an integrated computer-aided drug design workflow to identify potential dual inhibitors. Potential leads were further refined using molecular docking to identify crucial interactions with the P-clamp and conserved glutamine residues within the protein active sites. The structural stability of the resulting complexes was measured through molecular dynamics simulations, followed by binding free energy estimations using MM/GBSA. Additionally, pharmacological properties including drug-likeness, blood-brain barrier penetration, and ADMET profiles were analyzed to ensure safety and central nervous system activity. These findings provide valuable insights for the rational design of novel therapeutics, offering a promising strategy to treat the multifaceted symptoms of schizophrenia with an improved safety profile.

RNA based Therapeutics - Emerging applications beyond vaccine

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Abstract

RNA based therapies are becoming an important area of modern medicine. The success of mRNA vaccines show that RNA can be used to help prevent and treat diseases. However the use of RNA is not limited to vaccines. Different RNA-based therapies can be used for diseases such as cancer, genetic disorders, metabolic diseases and other health conditions. This review aims to explore the recent development of RNA based therapies beyond vaccines and their medical applications, and the major challenges involved in their use. Traditional medicines mainly target proteins, but many diseases originate from faulty genes or RNA.

RNA therapeutics can regulate and generate expression without permanently changing DNA. The success of COVID-19 mRNA vaccines accelerated investment in RNA medicine, leading to therapies for many other diseases. Most public attention focuses only on vaccines. The therapeutic potential of RNA in cancer, rare diseases, and neurological disorders remains underexplored.

Recent peer-reviewed studies were analysed and compared based on RNA type, mechanism of action, medical applications, delivery methods, therapeutic advantages and current limitations. These analysis concludes as mRNA can provide cells with instructions to make useful proteins, while siRNA can switch off genes involved in diseases, ASOs can change or reduce the Activity of specific RNA molecules and are being used. Or studied for genetic and neurological disorders. Newer forms such as Circular RNA and self amplifying RNA are being studied because they may offer long lasting effects to require smaller amounts of RNA. Overall, RNA technology has the potential to support more targeted and personalized treatments, although challenges such as delivery, stability, and safety still need to be addressed.

Designer Babies: Scientific Progress or Social Standard?

By- Mahika Katiyar

Abstract

A designer baby refers to a baby whose genetic characteristics are deliberately altered or selected before birth to prevent diseases or potentially influence certain traits. Advances in reproductive genetics and gene-editing technologies have made this concept scientifically possible, although many applications remain experimental till date.

Designer-baby technology could have important medical applications, such as preventing inherited disorders like cystic fibrosis and sickle cell anemia. Preimplantation Genetic Testing can identify embryos carrying certain genetic conditions. Gene-editing techniques can potentially modify disease-causing genes. However, selecting traits such as eye colour, hair colour, intelligence, or other non-medical characteristics raises greater scientific and ethical concerns. Traits such as intelligence are influenced by many genes and environmental factors, making them much more complex.

A major example occurred in 2018, when Chinese scientist He Jiankui announced the birth of the first gene-edited babies. He used CRISPR-Cas9 on human embryos and targeted the CCR5 gene, aiming to reduce susceptibility to HIV. The experiment was not accepted because of concerns about safety, informed consent, and heritable genetic changes. In December 2019, He was sentenced to three years in prison for illegal medical practices.

Other risks of genetic modification include unintended heritable changes and off-target mutations that could impact future generations.

Therefore, the debate is not only about whether science can alter human genetics, but whether it should. Preventing serious inherited diseases may provide major medical benefits, but using genetic technology for cosmetic traits could increase discrimination and inequality. Such technologies are expensive and they are mostly available to the economically stronger section of the society, increasing the gap between the rich and poor.

Designer babies may be a scientific achievement but without ethical boundaries, scientific progress can become a new social standard.

Structural and Functional Annotation of Hypothetical proteins of *Klebsiella pneumoniae* NTUH K-2044 to Identify Potential Drug Targets

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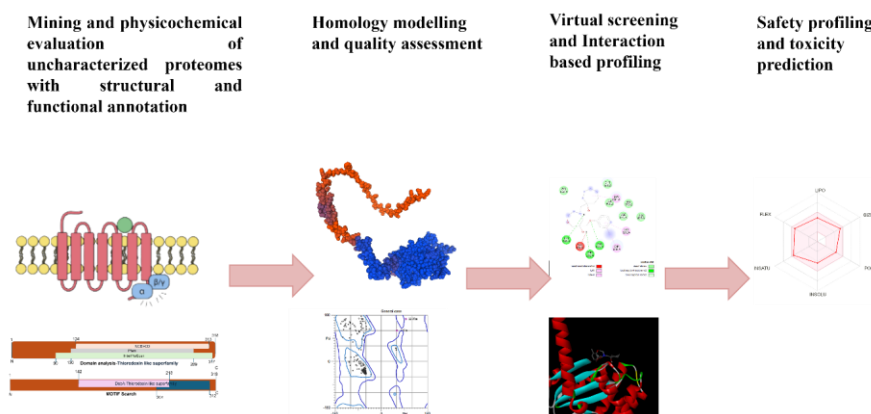
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Abstract

Bacterial infections have enormous burden on global health and economy. In recent years, Next-Generation Sequencing (NGS) has accelerated the high-throughput characterization of bacterial genomes. However, around one-third of the bacterial proteomes remain functionally unannotated and generally categorized as hypothetical proteins (HPs). Concurrently, the rapid dissemination and emergence of antimicrobial resistance (AMR) among multidrug-resistant (MDR) pathogens poses a critical threat to global health. This study aims to structurally and functionally annotation of an uncharacterized protein (Accession: BAH66024.1) from multidrug-resistant *Klebsiella pneumoniae* NTUH K-2044. Protein sequence, domain, and motif analysis identified the target as a DsbA-like thioredoxin family protein containing a conserved catalytic CXXC motif. High-confidence 3D structural models generated via *in silico* resources. The structural prediction results demonstrate robust stereochemical quality which was further validated by MolProbity (score 0.79), Ramachandran plot (96.20% favored), QMEAN (-1.27), and ProSA (z-score -7.26). Moreover, host non-homology screening confirmed no similarity to human proteins, reducing the potential for off-target toxicity. Notably, structure-based virtual screening of bioactive compounds from an online library led to the identification of 4 potential candidates showing favorable binding affinities (-7.0 to -7.2 kcal/mol) with protein's binding residues. The identified bioactive compounds exhibited zero Lipinski rule violations and valid bioavailability. Conclusively, these results illustrate the potential of *in silico* data mining and structural biology to reveal new drug targets to combat AMR. Further *in vitro* and *in vivo* studies will be crucial for the assessment of these bioactive compounds as potential drug candidates against lethal *K. pneumonia* infections.



Keywords: Antimicrobial resistance, protein, bioactive compounds, drug, infection, therapy.

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CRISPR-Cas9 Engineered Medicinal Plants as Molecular Farming Platforms for Next-Generation Pharmaceutical Production

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Abstract

The integration of CRISPR-Cas9 gene editing with plant molecular farming represents a paradigm shift in sustainable pharmaceutical manufacturing, bridging agricultural biotechnology with next-generation healthcare demands. This study investigates the application of CRISPR-Cas9-mediated genome editing in [plant species, e.g., *Nicotiana benthamiana* / *Withania somnifera*] to enhance biosynthetic pathways for [target compound: e.g., a therapeutic protein, antibody fragment, or secondary metabolite]. Using [transformation method: e.g., *Agrobacterium*-mediated delivery or hairy root cultures], we precisely edited [target gene/pathway] to boost expression and yield of the desired pharmaceutical compound. Quantitative analysis via [HPLC/LC-MS/ELISA] revealed a [X]% increase in target compound accumulation relative to unedited controls, while functional assays confirmed retained or enhanced bioactivity, including [specific activity: e.g., antimicrobial, anti-inflammatory, or immunogenic properties]. These results demonstrate that CRISPR-engineered plants can function as efficient, low-cost "bio factories," offering a scalable alternative to conventional cell-culture or synthetic drug production systems. This approach is particularly promising for producing complex biologics — including vaccines, monoclonal antibodies, and enzyme replacement therapies — directly within crop systems, reducing production costs and expanding access in resource-limited settings. By merging precision gene editing with molecular farming, this work advances the translational pipeline from agricultural innovation to pharmaceutical application, supporting the conference's vision of sustainable, next-generation healthcare solutions rooted in plant-based biotechnology.

Keywords: CRISPR-Cas9, plant molecular farming, medicinal plants, biopharmaceuticals, sustainable drug production

Drug-Facilitated Sexual Assault: Chemical Profiles, Forensic Detection Challenges, and Nano-Enabled Biosensor Solutions

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Abstract

Drug Facilitated Sexual Assault (DFSA) is done by incapacitating victim using various methods including use of 'Date Rape Drugs (DRDs)' such as Ethanol, Gamma-Hydroxybutyric Acid (GHB), 3, 4- Methylenedioxymethamphetamine (MDMA), Methamphetamine, Benzodiazepines, and Ketamine which when given to them, directly affects their Central Nervous System making them hallucinated, unconscious, weak, dizzy, unresponsive, comatose and confused. These drugs can be easily dissolved in drinks and food supplements, without being detected due to their colorless, odorless, and tasteless properties. Also, these drugs have a very short half-life, due to which they get eliminated from the body very quickly, which makes their detection difficult and a foremost step to be conducted. Many methods are available for detecting DRDs in biological samples, such as GC/MS, LC/MS, HPLC/MS, UHPLC/HRMS, and many more. But these methods are complex and require sample preparation, making them time-consuming and tedious processes. This drawback makes it important to come up with new methods for rapid, effective, and accurate detection of drugs. In recent times, many biosensors are being developed, such as voltammetric sensors, potentiometric sensors, and amperometric sensors using nanotechnology for effective detection of drugs from the sample matrix. This paper discusses the most commonly used DRDs in DFSA cases, laws related to them, their trends, and various methods available for their detection.

Keywords

Drug facilitated Sexual Assault, Date Rape Drugs (DRDs), Sexual Offence, Rape, Biosensors for DRDs

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Anandamide in Health and Disease: Pathophysiological Significance and Advances in Detection

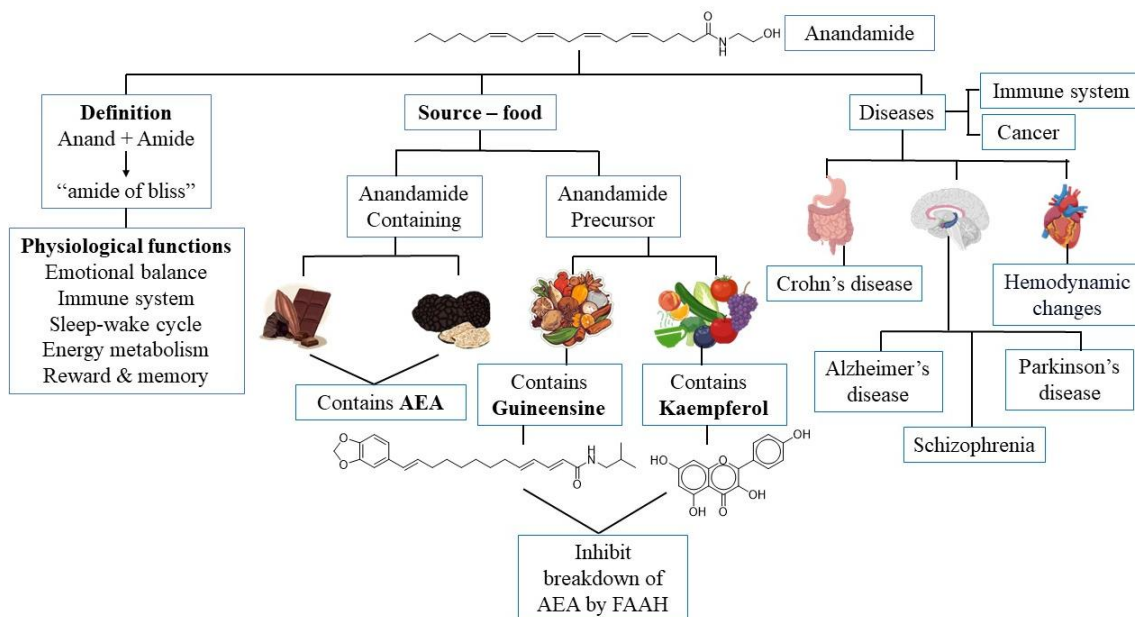
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Abstract

Anandamide (AEA), a natural cannabinoid, plays central roles in modulating physiological processes such as mood, pain perception, appetite, and the immune system. AEA has been recognized for its implication in several pathological conditions such as neurodegenerative disorders, inflammatory diseases, and cancer. Traditional detection techniques are limited by low sensitivity and intricate instrumentation. Advances in nanotechnology and biosensors provide potential solutions for selective, sensitive, and real-time detection, making AEA an important biomolecule for clinical use and research applications. This review systematically examines anandamide's participation in various diseases. Traditional techniques have certain limitations. Significantly, the review highlights novel molecularly imprinted polymer (MIP)-based biosensors which show considerable leaps in detection selectivity and sensitivity for low AEA levels. These developments provide rapid, economical, and convenient diagnostic approaches. The importance of AEA arises from its pivotal position in neurophysiology, immunity, and metabolism, with dysregulation being associated with devastating diseases. The novel nature of the paper is in explaining cutting-edge biosensor technologies, specifically MIP-based sensors, which excel over conventional methods in sensitivity and selectivity. The advancements provide revolutionary promise for real-time monitoring and diagnostics, rendering AEA an effective biomarker for disease diagnosis and drug development in contemporary medicine.

Graphical Abstract



Keywords: Anandamide, Alzheimer's disease, cancer, detection techniques, molecularly imprinted polymer (MIP)-based biosensor.

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miR-193b as a Tumor Suppressor and Prognostic Biomarker in Acute Myeloid Leukemia: Implications for Leukemic Stem Cell Behavior and Chemoresistance.

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Abstract

Acute myeloid leukemia (AML) is a difficult type of cancer to treat. Relapse often occurs because leukemic stem cells (LSCs) persist and become resistant to chemotherapy. MicroRNAs are becoming recognized as important factors in determining the fate of leukemic cells. Among these, miR-193b is seen as a tumor suppressor. Its improper regulation might affect stemness programs and how patients respond to treatment in AML.

This abstract aims to explain the role of miR-193b in AML. It will focus on how miR-193b regulates LSC behavior and contributes to chemoresistant traits. We believe that when miR-193b expression is lost, it removes inhibition from downstream oncogenic and stemness-related targets, which helps LSCs renew themselves and lessens their sensitivity to standard chemotherapy. Our approach involves profiling miR-193b expression in AML patient samples and linking these levels to clinical outcomes.

We will conduct functional tests in AML cell lines and patient-derived models to see how changing miR-193b levels (through overexpression or knockdown) affects stemness markers and colony-forming ability. Additionally, we will assess how altering miR-193b affects chemosensitivity compared to standard treatments. Identifying the downstream targets and pathway interactions of miR-193b will provide more insights into its role. Establishing miR-193b as a functional tumor suppressor and a prognostic biomarker could lead to new ways to use it for risk assessment and as a potential target for overcoming resistance in LSCs. This poster will outline the rationale, proposed experimental framework, and significance of this work for improving outcomes in AML.

Overcoming the Limitations of Topical Steroids: A Proposed Novel Electrospun Platform for Psoriasis treatment

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Abstract

Psoriasis is a chronic (long-term) immune-mediated inflammatory skin disease characterized by continuous epidermal hyperproliferation. Topical corticosteroids are still first-line treatment, but chronic use has been associated with dermal atrophy and conventional preparations have short skin residence time, necessitating frequent reapplication. Considering aforementioned limitations, the present study hypothesized that an electrospun nanofiber scaffold comprising a combination of polycaprolactone (PCL)/polyvinylpyrrolidone (PVP K-90) could enable simultaneous and sustained topical co-delivery of a corticosteroid and a natural antioxidant. PCL will be used to impart mechanical integrity, and PVP K-90 to impart hydrophilicity, and fiber architecture will be optimized between the two to minimize the effect of hydrophilicity on burst release (as PVP is water-soluble and it can cause burst release otherwise). The antioxidant effect is meant to prevent the action of reactive oxygen species and reduce collagen damage, in addition to the anti-inflammatory properties of the corticosteroid. Nanofibers can be fabricated by using electrospinning method. The nanofibers can be optimized on the basis of parameters such as applied voltage, flow rate, and tip-to-collector distance to achieve uniform fibers. The evaluation of optimized formulation will be characterized for physiochemical characteristics, morphology and other mechanical properties. Further the formulation will be subjected to wettability and drug release profile and will be compared to placebo and standard formulation. The *ex-vivo* permeation and retention will be determined using Franz diffusion cells. The anti-psoriatic effect and histopathological protection of the dermis will be assessed for *in-vivo* anti-psoriatic efficacy in appropriate *in-vivo* animal model. This proposed platform may enable prolong local drug residence, diminish the frequency of dosing and minimize the risk of steroid-induced dermal atrophy compared to available topical drug therapy.

Key words: Psoriasis; Electrospun nanofiber scaffold; Sustained drug release; Topical corticosteroid delivery; Topical corticosteroid; Antioxidant; Dermal atrophy

From Daily Burden To Weekly Ease: A Breakthrough In Diabetes Care

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Abstract

Many people with type 2 diabetes put off starting insulin therapy for years -- often because the thought of daily injections feels overwhelming or difficult to manage. This uncertainty, and the inconsistent adherence that may follow once treatment begins, often leads to poorly controlled blood sugar and a greater risk for long-term complications. Basal insulins administered once weekly, such as insulin icodec and efsitora alfa, can help fill this gap by simplifying the dosing regimen while maintaining glycemic control.

Evidence from the major phase 3 programs ONWARD for icodec and QWINT for efsitora alfa have been published in leading journals including The Lancet Diabetes & Endocrinology, Diabetes Care and the New England Journal of Medicine. In these trials, weekly insulin formulations decreased HbA1c to an extent similar to or greater than daily basal insulin, with comparable rates of serious hypoglycemia between groups.

A meta-analysis published in 2026 in the journal Diabetes, Obesity and Metabolism combined data from 16 trials with more than 10,000 participants and reported that weekly insulins achieved an additional reduction of HbA1c of about 0.12% and an improvement in time-in-range of about 2.4%, without an increase in the risk of severe hypoglycemia. The reduction in the injection schedule from seven doses per week to one dose per week has practical significance beyond convenience; it decreases the day-to-day burden of treatment, makes it easier for patients to remain consistent with their regimen, and may encourage clinicians to introduce insulin earlier in the course of disease, when it can do the most good.

Keywords: once-weekly insulin; insulin icodec; insulin efsitora alfa; type 2 diabetes; HbA1c; hypoglycemia; time-in-range; ONWARDS; QWINT; adherence.

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Proximity-induced Targeted Orthogonal Post Translational Modification (oPTM) as a Novel Therapeutic Approach using Phospholyase

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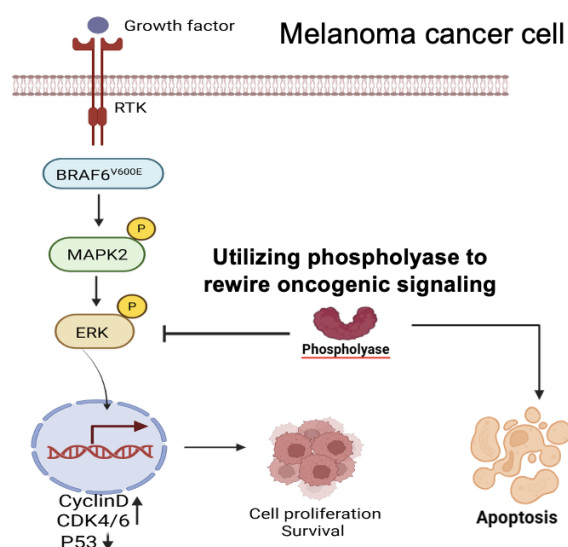
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Abstract

Protein post-translational modifications (PTMs) expand proteomic and functional diversity in cells. In contrast to canonical eukaryotic PTMs, bacterial pathogens deploy virulence effectors that introduce irreversible, non-native modifications on host proteins, termed oPTMs, to rewire host signalling and evade immune responses. Among eight known oPTM classes, phosphate β -elimination catalysed by phosphothreonine lyases such as OspF and SpvC - irreversibly converts phosphorylated serine/threonine residues into electrophilic Micheal acceptors; dehydroalanine (Dha)/dehydrobutyrine (Dhb), disrupting MAPK signalling. Exploiting such phospholyases as therapeutic tools could enable targeted reversal of pathological Ser/Thr hyperphosphorylation in cancer. However, the stringent pT-X-pY motif specificity of OspF/SpvC limits broader applicability. This constraint may be addressed through protein engineering of OspF/SpvC or by identifying alternative lyase systems. Notably, lanthipeptide synthetases contain homologous lyase domains with broad peptide substrate tolerance; a promising alternative for programmable protein editing in cancer therapy.

Graphical Abstract



Keywords: Orthogonal post-translational modifications (oPTMs), Bacterial effector proteins, Cell signalling, pathogenicity, immune invasion, non-canonical

Key References

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Rational Design of New Tryptanthrin Derivatives as EGFR Kinase Inhibitor: An *In-silico* Approach

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Abstract

Cancer signifies the unregulated multiplication of cells and ranks among the primary causes of mortality globally. Notwithstanding significant progress in diagnosis and therapy, cancer continues to impose considerable clinical, societal, and financial strains. The production of novel anticancer drugs continues to be an extended, costly, and risky endeavour. Consequently, a structure-oriented methodology is utilized for pharmaceutical development. Epidermal growth factor receptor (EGFR) is responsible for cellular proliferation, differentiation, programmed cell death, and survival. Small-molecule inhibitors provide enhanced specificity by altering specific oncogenic pathways. Sixty percent of chemotherapeutic agents approved by the US FDA are derived from heterocyclic structures. Tryptanthrin, an indoloquinazoline alkaloid of significant therapeutic value, demonstrated anticancer, anti-inflammatory, antibacterial, and antiviral properties. A collection of 80 novel tryptanthrin derivatives was formulated and assessed for their inhibitory efficacy against the EGFR anti-cancer target using molecular docking, molecular dynamics modelling, and *in silico* pharmacokinetic evaluation. Molecular docking was performed on EGFR proteins with T790M mutation (PDB ID: 5GNK) and the wild type (PDB ID: 3W2S), indicating that the compounds exhibited superior docking scores and interactions with the mutated protein compared to the reference Osimertinib, while demonstrating reduced binding energies toward the wild type protein, signifying diminished selectivity. The ideal leads underwent evaluation of binding free energies, investigation of chemical characteristics by MMGBSA and DFT. Molecular dynamics simulations of the most stable molecule and reference drug were conducted to determine the precise binding energy for the chosen compound. The Qikprop software was utilized to examine ADME characteristics; the compounds adhered to the Lipinski rule of five, indicating favorable bioavailability.

Keywords: Tryptanthrin derivatives, EGFR, Molecular docking, MD Simulation, DFT, ADME

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Discovery of Natural Cholinesterase Inhibitors via Integrated Computational Studies using Labdane-Related Diterpenoids-based Pharmacophore Model and *in-vitro* studies

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Abstract

Alzheimer's disease (AD) represents a progressively growing worldwide public health burden. Despite therapeutic advances, cholinesterase inhibition remains a primary pharmacological target against AD. Excessive depletion of acetylcholine by acetylcholinesterase (AChE) and butyrylcholinesterase (BuChE) contributes to cognitive impairment in AD. Current therapeutics largely rely on AChE inhibition and remain constrained by several adverse effects. Hence, these limitations highlight the growing need to identify a new dual cholinesterase inhibitor from natural sources that offers better efficacy with fewer side effects. In recent years, labdane-related diterpenoids have attracted significant attention for their reported anticholinesterase efficacy, in tandem with their anti-inflammatory, antioxidant, and neuroprotective properties. The current workflow leveraged a ligand-based pharmacophore model developed using labdane-related diterpenoids with reported cholinesterase inhibitory activity to perform multi-step virtual screening of natural product databases, aided by molecular docking coupled with molecular dynamics simulation. Four compounds were identified through a multi-step virtual screening procedure, which showed favorable pharmacophore fit scores and stable interaction profiles with key catalytic and peripheral anionic site residues of both enzymes. Molecular dynamics simulations further substantiated the conformational stability of the protein-ligand complexes over a 500 ns trajectory. In experimental validation, Corylin showed anti-AChE activity with IC_{50} values of $18.03 \pm 7.15 \mu M$, and 6-Hydroxy-2,2-dimethylchroman-4-one exhibited inhibitory activity against BuChE with 102 ± 4.64 . Among them, Glabridin showed dual inhibition with IC_{50} values of $12.7 \pm 6.09 \mu M$ for AChE and $156.16 \pm 4.64 \mu M$ for BuChE. Kinetic studies revealed that Glabridin acts in a non-competitive manner with AChE and mixed-type inhibition in competitive mode with BuChE, with K_i values of $27.59 \mu M$ and $56.42 \mu M$, respectively. The present study identified Glabridin as a promising dual cholinesterase inhibitor and demonstrated the precision of pharmacophore-based virtual screening integrated with experimental evaluation, thereby providing a rational strategy for identifying multifunctional lead compounds for AD.

Identification of Oxidative Phosphorylation Associated Metabolic Genes and Their Role in Pancreatic Ductal Adenocarcinoma Progression

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Abstract

Background: Oxidative phosphorylation (OXPHOS) has emerged as a critical metabolic pathway supporting the growth, survival, and therapeutic resistance of pancreatic ductal adenocarcinoma (PDAC). This study aimed to identify differentially expressed OXPHOS-related genes, evaluate their prognostic significance, and elucidate their potential roles in pancreatic cancer progression through an integrative bioinformatics approach.

Methods: RNA-sequencing and clinical data from the TCGA-PAAD cohort were analyzed and validated using independent Gene Expression Omnibus (GEO) datasets. OXPHOS-related genes were retrieved from the MSigDB Hallmark and KEGG oxidative phosphorylation gene sets. Differential expression, functional enrichment, protein-protein interaction (PPI) network construction, survival analysis, immune infiltration analysis, and clinicopathological correlation analyses were performed to identify key OXPHOS-associated biomarkers.

Results: Multiple OXPHOS-related genes were found to be significantly overexpressed in PDAC, including NDUFA9, NDUFS1, SDHA, UQCRC2, COX4I1, ATP5F1A, TFAM, PPARGC1A (PGC-1 α), CPT1A, GLS, and SIRT3. Functional enrichment analyses demonstrated that these genes were predominantly involved in mitochondrial electron transport, ATP synthesis, respiratory chain complex assembly, and cellular energy metabolism. Hub genes exhibited significant associations with poor overall survival, advanced tumor progression, and altered immune cell infiltration, suggesting that enhanced mitochondrial respiration contributes to PDAC aggressiveness and metabolic adaptation.

Conclusion: This integrative bioinformatics study demonstrates that aberrant activation of OXPHOS and overexpression of key mitochondrial metabolic genes are closely associated with pancreatic cancer progression and unfavorable prognosis. These findings identify NDUFA9, NDUFS1, SDHA, UQCRC2, COX4I1, ATP5F1A, TFAM, PPARGC1A, CPT1A, GLS, and SIRT3 as potential prognostic biomarkers and therapeutic targets, highlighting mitochondrial metabolism as a promising avenue for precision treatment of PDAC.

α 7-Nicotinic Acetylcholine Receptor as an Emerging Target for Drug Repurposing in Ulcerative Colitis

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Abstract

Ulcerative colitis (UC) is a chronic, recurrent inflammatory bowel disease with a complex pathogenesis involving immune system dysregulation, epithelial barrier dysfunction and persistent inflammation in the gut. Despite significant progress in biologic and targeted therapies, there is still a significant number of patients with poor therapeutic effects, relapsing effects over time or side effects due to the treatments. The challenges underscore the need for new therapeutic strategies and reinforce the growing interest in drug repurposing as a viable approach to accelerate the development of new drugs. The α 7-nicotinic acetylcholine receptor (α 7-nAChR) has gained attention as a potential target for new therapeutic approaches due to its significant involvement in the cholinergic anti-inflammatory pathway. Activation of α 7-nAChR can regulate innate immune responses by suppressing NF- κ B signalling and MAPK, which leads to a reduction in pro-inflammatory cytokines. This is a potential approach for addressing intestinal inflammation. With this biological basis, we suggest that current α 7-nAChR ligands could be promising candidates for drug repurposing in UC. There are three complementary perspectives that were combined and utilized in this approach to prioritizing molecules targeting α 7-nAChR as a target: target engagement, molecular recognition and drug-likeness. Target engagement and molecular docking were used to ensure that the selected compounds interact with the α 7-nAChR and to investigate the binding affinity and important protein-ligand interactions. In addition, ADME profiling investigates the pharmacokinetic characteristics and drug-likeness, which favours the selection of candidates with good translational potential. This integrated approach is a more comprehensive and biologically meaningful approach for the identification of molecules that can be repurposed, as opposed to relying solely on docking scores. Overall, this view highlights the promise of α 7-nAChR as a target for therapeutic development and proposes a rational pathway for drug prioritization for UC. The mechanistic basis along with computational target engagement, molecular docking and ADME evaluation could aid in streamlining the identification of promising drug candidates that could serve as a basis for further molecular dynamics studies, experimental validation, and clinical translation.

Keywords: Ulcerative Colitis, α 7-nicotinic acetylcholine receptor (α 7-nAChR), Drug repurposing, Emerging target, Cholinergic anti-inflammatory pathway

Phytochemical Characterisation and Antibacterial Evaluation of *Tephrosia maxima* L. Root Extract Against *Helicobacter pylori* and *Staphylococcus aureus*

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Abstract

With the increasing prevalence of antimicrobial resistance (AMR), mainly in ESCAPE category species such as *Helicobacter pylori* and *Staphylococcus aureus*, there is an urgent need to search for effective antimicrobial compounds from natural sources. The present study investigated the phytochemical composition of *Tephrosia maxima* L. root extract and evaluated its antibacterial activity. Successive solvent extraction resulted in the methanolic extract as the highest-yielding solvent, with a yield of 19.9%, leading to a higher concentration of total phenolic content (TPC; 480.33 ± 5.77 mg GAE/g extract), total flavonoid content (TFC; 22.82 ± 1.97 mg RE/g extract), and total steroid content (TSC; 115.01 ± 1.51 mg BSE/g extract). 178 compounds were detected through LCMS; within those, 72 compounds were identified as flavonoids, phenolics, glycosides and other secondary bioactive compounds. The methanolic extract indicated potent, concentration-dependent antibacterial activity against *H. pylori* and *S. aureus*, with maximum zone of inhibition of 12.17 ± 0.29 mm and 14.00 ± 0.50 mm, respectively. The extract showed the same MIC and MBC values of 3.125 mg/mL against *H. pylori* and 6.25 mg/mL against *S. aureus*. The significant antibacterial activity observed is likely due to the synergistic effects of phytochemicals identified by LCMS analysis. The above results suggest that *T. maxima* L. root is a promising antibacterial compound and could emerge as a plant-derived therapeutic against drug-resistant bacterial pathogens.

Drug Repurposing in Experimental Ulcerative Colitis: Current Landscape, Knowledge Gaps, and Future Opportunities

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Abstract

Ulcerative colitis (UC) is an inflammatory bowel disease (IBD) in which the colonic mucosa is chronically inflamed with relapsing-remitting disease course, and it causes considerable morbidity and a decreased quality of life. While traditional drugs such as aminosalicylates, corticosteroids, immunomodulators and biologics have improved the management of the disease, many patients fail to respond to the conventional treatments, or suffer from side effects, high cost of treatment, or lose efficacy over time. One approach that has emerged as an attractive strategy for finding new application of existing drugs that have been approved for use in humans for other conditions is a process known as "drug repurposing" which aims to identify new therapeutic uses for existing drugs.

There are some drug classes that have been found to have beneficial therapeutic activity in experimental models of ulcerative colitis, such as statins, antidiabetic drugs, antibiotics, antidepressants, antihypertensive drugs, and certain antihelminthic drugs. Most of the studies show that the severity of the disease is reduced, along with improved epithelial barrier function, reduced production of inflammatory cytokines, reduced oxidative stress and reduced histopathological damage. The molecular mechanisms that are often studied include the modulation of the NF- κ B, Nrf2, AMPK, JAK/STAT, TLR4, NLRP3 inflammasome, and Pregnane X Receptor (PXR) signalling pathways.

Drug repurposing is a promising approach to finding novel therapeutic agents for ulcerative colitis and to shorten the time and cost of drug development. Systematic prioritization of under-explored FDA-approved drugs and integrated *in silico*, *in vitro* and *in vivo* validation could aid in the identification of effective and clinically translatable therapeutics for UC.

Keywords: Ulcerative Colitis, Drug Repurposing, Molecular Pathways, Pregnane X Receptor

Bioassay-Guided Identification of an Anticancer Fraction Against Oral Squamous Cell Carcinoma

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Abstract

Oral cancer remains a major global health challenge owing to its substantial morbidity, therapeutic resistance, and considerable treatment-related costs, highlighting the need for novel anticancer agents with improved efficacy. *Ipomoea hederifolia* L. root has traditionally been used for gastrointestinal disorders, inflammation, and infections; however, its anticancer potential remains poorly investigated. This study aimed to identify a potent anticancer fraction from *I. hederifolia* L. root against oral squamous cell carcinoma using integrated in vitro and in silico approaches. The crude root extract was fractionated by column chromatography, and fractions were pooled according to their thin-layer chromatography profiles. Bioassay-guided screening identified the most active fraction, which was characterized by liquid chromatography-mass spectrometry. Its anticancer activity was evaluated in SCC9 cells through cytotoxicity, reactive oxygen species generation, apoptosis, cell-cycle analysis, and selectivity assays. Molecular docking using AutoDock Vina 1.2.7 was performed to investigate interactions of identified phytoconstituents with EGFR, STAT3, and TP53. Among six fractions (lh1–lh6), lh4 exhibited the strongest anticancer activity, with induction of apoptosis and G2/M phase cell-cycle arrest, together with greater selectivity toward SCC9 cells. LC-MS tentatively identified several phytoconstituents, including trans-ferulic acid, myricetin, pectolinarin, oleanolic acid, and ginsenoside. Selected compounds showed favourable binding affinities toward EGFR, STAT3, and TP53. Overall, these findings suggest that *I. hederifolia* L. root may exert anticancer effects through EGFR-, STAT3-, and TP53-associated pathways and provide preliminary evidence supporting its potential against oral squamous cell carcinoma.

Keywords: *Ipomoea hederifolia* L.; oral squamous cell carcinoma; bioassay-guided fractionation; SCC9, oral cancer.

An environmentally friendly RP-HPLC approach for estimating gliotoxin: A comprehensive evaluation of greenness, blueness, and whiteness

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Abstract

Gliotoxin (GT), a mycotoxin of the epipolythiodioxopiperazine class produced by *Aspergillus fumigatus*, shows promising anticancer therapeutic approach. Despite its biological and analytical significance, existing methods for analyzing this mycotoxin are either confined to basic chromatographic techniques or depend on sophisticated LC–MS/MS methods. This research introduces a dependable, cost-effective, and straightforward isocratic reverse-phase high-performance liquid chromatography (RP-HPLC) method for quantifying GT. The estimation of GT was conducted using a mobile phase composed of methanol and MilliQ water in a 60:40 ratio (v/v) under isocratic conditions, with a flow rate of 1.2 mL/min and a detection wavelength set at 268 nm, achieving a retention time of about 4.2 minutes (total run time of 7 minutes). Additionally, the method was validated following the ICH Q2(R1) guidelines. It demonstrated outstanding linearity ($R^2 = 0.999$) within the 10–50 µg/mL range, with detection and quantification limits of <6 and <17 µg/mL, respectively. Recovery % ranged from 98% to 102%, and the AGREE score of 0.58 indicated moderate greenness. Robustness tests highlighted the importance of flow rate, making its optimization (~1.2 mL/min) essential for consistent results. Furthermore, the method's greenness and practicality were evaluated using AGREE, AGREEprep, MoGAPI, BAGI, and CACI software tools. The greenness assessment showed a moderately green method due to minimal solvent use, shorter run times, and low energy consumption. Consequently, this method offers a practical and efficient approach for determining GT in biological and pharmaceutical samples.

Keywords: Mycotoxins, Reverse-phase High-Performance Liquid Chromatography, Green Analytical Chemistry, AGREE, AGRESSPrep, MoGAPI, BAGI, CACI

Biomechanical Interventions for High-Heel-Associated Musculoskeletal Pain: A Literature Review

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Abstract

The widespread use of high-heeled footwear imposes severe biomechanical demands, inducing compensatory postural adjustments that cascade through the neuromusculoskeletal system. Chronic heel elevation precipitates a well-documented mechanical chain reaction: forced ankle plantarflexion shifts the body's center of gravity anteriorly, necessitating kinematic compensations at the knee, pelvis, and lumbar spine to maintain equilibrium. Consequently, habitual wearers experience concentrated forefoot metatarsal loading and long-term morpho-functional adaptations in ankle and calf mechanics, though literature regarding lumbar spine strain remains etiologically inconsistent. Analysis of current interventions, including advanced foam materials for forefoot pressure redistribution, shock-absorbing insoles for ankle stabilization, and medial wedges for angular kinematic correction, reveals a distinctly reductionist approach. Existing solutions exclusively target anatomical sites in isolation rather than addressing the connected biomechanical chain. Furthermore, profound methodological heterogeneity across current clinical, computational, and biomechanical studies precludes quantitative meta-analysis, particularly for low back pain outcomes. By evaluating these divergent methodologies, this review identifies a critical gap in conservative orthopedic management. This review conclude that no published research currently evaluates a unified, multi-component, non-electronic intervention designed to simultaneously address forefoot loading and ankle angular correction as an integrated biomechanical system for habitual wearers. Addressing this gap necessitates a paradigm shift in biomechanical engineering, moving from isolated symptom management to holistic kinetic chain correction for footwear-induced pathology.

Graphical Abstract



Keywords: Biomechanics; High-Heeled Footwear; Kinematic Correction; Postural Adjustment; Musculoskeletal Pain; Orthopedic Interventions.

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Fractal Dimension Define the Electrochemical Performance of the MWCNT-Modified Electrodes

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Abstract

The surface properties of an electrode impact its electrochemical performance and sensitivity. Fractal dimension is one of the important parameter that describe surface morphology. Carbon base was used to synthesize the electrode and carbon nanotubes (MWCNTs) are used to enhance electrochemical performance. However, the effect of MWCNT modification on surface morphology and its relationship with electrochemical performance for biosensor has not been analysed. This study analysed how these surfaces parameters affect the electrochemical performance of MWCNT-modified electrodes. The electrode surface was characterized using field emission scanning electron microscopy, and fractal dimensions were obtained through Fiji.imageJ software. Electrochemical performance was analysed using differential pulse voltammetry. The MWCNT-modified SPCE indicated higher fractal dimension, greater roughness, and increased porosity than the unmodified SPCE. The modified SPCE demonstrated improved electron transfer with comparatively higher current response. The results demonstrate that surface morphology do affect electrochemical behaviour. This study provides a better understanding of the relationship between surface structure and electrochemical performance.

Keywords: Surface Morphology, Fractal dimension, Porosity, Roughness, MWCNT-modified Screen-printed carbon electrodes

Nanoparticle Enhanced Colorimetric Paper-based Biochip for Precision Breast Cancer Prognosis

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Abstract

The development of novel cancer treatments has increased survival chances for the patient, and on the other hand dramatically increased the cost per patient. It is necessary to have prompt screening and prognostic techniques for cancer positive patients to reduce the economic burden and assure timely access to patient-precise treatment. The WHO report highlights the need for precise screening techniques in breast cancer due to the increasing number of deaths caused by late diagnosis. The need for REASSURED criteria by WHO point towards paper based analytical devices as point-of-care test (POCT) platform. Urokinase-type plasminogen activator (uPA) is one of the ASCO approved biomarkers for prognosis assessment of breast cancer. A versatile paper analytical device for colorimetric detection of breast cancer biomarker validated for cell lysate and serum based dual sample window follows the principle of immunosandwich assay on a paper platform. The noble metal nanoparticle combination used as recognition element and signal enhancer in this device replaces the conventional enzyme-based assay due to the ease of bioconjugation. The output in the form of color intensity not only facilitates rapid naked eye detection of the biomarker as low as 6.948 fg/ml but also aids in risk assessment and relapse free survival screening.

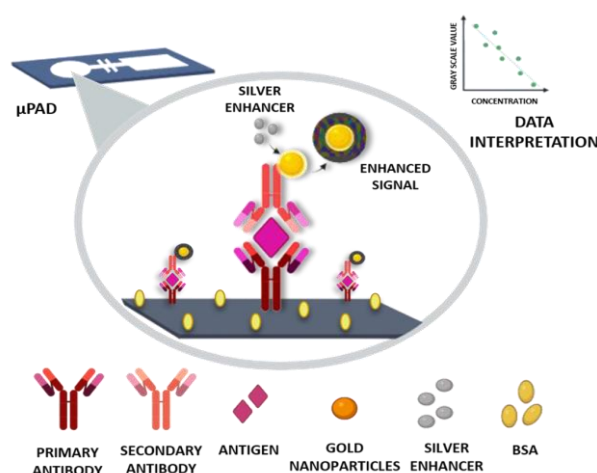


Fig. 1: Experimental design of cancer biomarker detection on paper-based biochip

Keywords: Colorimetric detection; Urokinase-type plasminogen activator; breast cancer; sandwich immunoassay; point-of-care test (POCT)

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From Visual Inspection to Molecular Contrast: A Review of Emerging Optical Imaging and Artificial Intelligence in Cervical Cancer Screening

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Abstract

For patients, waiting for cervical cancer screening results is often a period of immense anxiety. Traditionally, frontline screening has relied heavily on Visual Inspection with Acetic Acid (VIA), a method where clinical eyes look for simple tissue color changes. However, from an imaging perspective, human vision alone is highly subjective. Early cellular changes lack the visual contrast needed to stand out, which too often leads to painful, unnecessary biopsies or tragic false negatives.

This review explores a major paradigm shift in diagnostic imaging: the transition from basic anatomical observation to real-time molecular imaging at the patient's bedside. We evaluate recent advancements in optical contrast agents, specifically the new wave of near-infrared (NIR) fluorescent dyes and pH-activatable probes. Unlike traditional acetic acid, these "smart" dyes act as highly specific contrast agents. They are engineered to light up only when they bind to overexpressed cancer biomarkers. For the imaging technologist, this means we are no longer just looking at surface tissue; we are capturing the actual metabolic activity of pre-cancerous cells before they form a visible mass.

To capture these targeted dyes, the field is rapidly adopting High-Resolution Microendoscopy (HRME) and AI-assisted smartphone colposcopy. When these advanced optical sensors are paired with Artificial Intelligence—specifically Automated Visual Evaluation (AVE)—the imaging software can instantly analyze the fluorescent signals and map exact lesion margins on our screens in real-time.

Current literature shows that combining targeted optical contrast with AI-enhanced imaging significantly reduces human error. This review highlights how advancing our imaging tools goes beyond just capturing a better picture, it transforms patient care by providing immediate, highly accurate, and life-saving answers without the agonizing wait.

Keywords : Automated Visual Evaluation, Microendoscopy, Near, Infrared, Cervical Cancer

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Microcarrier-Based Mesenchymal Stromal Cells for Non Healing Ulcers.

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Abstract

Mesenchymal stromal/stem cells (MSCs) are multipotent, plastic-adherent cells with a characteristic fibroblast-like morphology and a defined immunophenotype. They express mesenchymal markers such as CD73, CD90, and CD105, while lacking hematopoietic markers including CD34, CD45, and HLA-DR. Beyond their differentiation capacity toward osteogenic, chondrogenic, and adipogenic lineages, MSCs are increasingly valued for their strong immunomodulatory and trophic effects. These properties make them attractive candidates for regenerative medicine, inflammatory disorders, and immune-mediated conditions. Mesenchymal stem/stromal cells (MSCs) have gained significant attention due to their intrinsic immunomodulatory properties and multilineage differentiation potential. Over the past decade, MSCs have been evaluated in numerous clinical trials for conditions such as graft-versus-host disease, myocardial infarction, liver cirrhosis, amyotrophic lateral sclerosis, and to support hematopoietic stem cell engraftment (recent clinical trials to be mentioned here). The capacity to modulate immune responses, suppress excessive inflammation, and promote tissue repair is an motivating trait of the MSCs and thus host-directed therapies in severe infectious and inflammatory conditions.

Although bone marrow was the earliest recognized source of MSCs, subsequent research has demonstrated that similar populations can be isolated from multiple tissues, including umbilical cord, placenta, dental pulp, skin, and adipose tissue. However, the translation of MSC therapy into routine clinical practice is heavily dependent on the ability to generate large numbers of high-quality cells. The stirred-tank bioreactors with microcarrier technology, offer a promising solution by enabling efficient cell growth in dynamic conditions while maintaining cell quality. This approach allows for higher cell yields within shorter timeframes, addressing the cost, time, and scalability challenges associated with traditional static cultures.

By bridging the gap between laboratory-scale research and clinical-scale production, this project seeks to contribute significantly to the advancement of cellular therapies, enabling safer, more effective treatments for non healing ulcers.

Development of a MoS₂-Modified Screen-Printed Carbon Electrode for Electrochemical Determination of Resorcinol

ANJU

Delhi University

Abstract

Rapid, sensitive, and selective detection of resorcinol is important because of its established pharmaceutical and dermatological applications, particularly as a keratolytic and antiseptic agent in topical formulations used for conditions such as acne, hyperkeratotic disorders, and hidradenitis suppurativa. Reliable determination of resorcinol is therefore important for quality control and assessment of pharmaceutical formulations. Conventional analytical techniques often require sophisticated instrumentation, extensive sample preparation, and time-consuming procedures, highlighting the need for simple, portable analytical alternatives.

This study developed a two-dimensional MoS₂-modified screen-printed carbon electrode (MoS₂/SPCE) for sensitive electrochemical detection of resorcinol. Incorporating MoS₂ nanoparticlessheets increased electroactivity and improved electron transfer, resulting in a stronger electrochemical response than the bare SPCE and improved voltammetry (DPV) for quantitative analysis. The sensor showed a concentration-dependent response from 10 μ M to 1 mM. We assessed analytical performance for sensitivity, detection limit, selectivity, repeatability, reproducibility, and functional stability. The sensor also demonstrated good tolerance to potential interfering species, confirming its selectivity for resorcinol.

The MoS₂/SPCE sensor combines the electrocatalytic properties of two-dimensional MoS₂ with the portability, low sample volume, and disposability of screen-printed electrodes. This platform delivers a rapid, simple, cost-effective, and label-free method for resorcinol detection, with potential applications in quality control of pharmaceutical and dermatological formulations.

Design and Development of an AI-Enabled Wearable Smart Glove for Real-Time American Sign Language Recognition

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Abstract

Communication barriers experienced by deaf and speech-impaired individuals continue to limit accessibility in education, healthcare, and everyday interactions. Existing sign-language translation systems are often expensive, camera-dependent, or unsuitable for portable, real-time use. This work proposes the design and development of a low-cost, AI-enabled wearable smart glove capable of translating American Sign Language (ASL) gestures into text and speech in real time through embedded sensing and machine learning.

The proposed system integrates flex sensors to capture finger-bending patterns with an inertial measurement unit (IMU) to record hand orientation and motion, while an ESP32 microcontroller performs data acquisition and wireless communication. The development methodology follows a phased engineering approach, beginning with hardware selection and circuit design, followed by sensor calibration, signal acquisition, gesture dataset creation, and machine-learning-based gesture classification. The recognized gestures will be transmitted to a mobile application via Bluetooth, where they will be converted into readable text and synthesized speech to enable seamless communication.

The project prioritizes affordability, portability, and ease of use, making it suitable for everyday assistive communication rather than laboratory-only applications. Preliminary development focuses on recognizing a limited set of commonly used ASL gestures, with future scalability toward a larger vocabulary through improved sensor fusion and embedded AI optimization. The proposed system is expected to demonstrate the potential of combining wearable sensors, embedded systems, and artificial intelligence to create accessible healthcare technologies that support inclusive communication for individuals with hearing and speech impairments. This work aligns with emerging trends in connected healthcare, biomedical sensors, and AI-driven assistive technologies.

Graphical Abstract





Keywords: American Sign Language (ASL); Wearable Smart Glove; Gesture Recognition; Biomedical Sensors; Embedded Artificial Intelligence; ESP32; Human–Computer Interaction; Assistive Technology; Connected Healthcare; Sensor Fusion.

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Electrochemical Sensing of Catecholamines by NiO/MXene ($\text{Ti}_3\text{C}_2\text{T}_x$): A Potential Technique for Multiple Non-Communicable Diseases (NCDs) Detection

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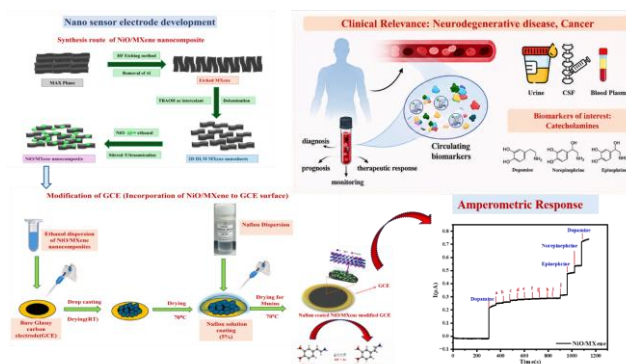
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Abstract

Catecholamines (CAs: dopamine, epinephrine, and norepinephrine) secreted by the endocrine system regulate essential metabolic, cardiovascular, and neurological functions in the human body [1]. Their dysregulation in biofluids serves as a clinically relevant biomarker for the early detection of multiple NCDs, such as pheochromocytoma, neuroblastoma, Alzheimer's disease, and Parkinson's disease which generally remain asymptomatic until advanced stages [2, 3]. Analytical techniques such as HPLC-ECD and LC-MS serve as the clinical gold standards for CA quantification in the pM- μM range during medical diagnosis but are constrained by expensive instrumentation and prolonged analysis time. For deployment in remote clinical settings, home care, and commercial applications in sports, wellness, and occupational health, it is important to reliably track these stress hormone patterns even with moderate accuracy; here, CA stability and interference from biological matrix components become critical, alongside cost-effective device designs [4].

Nano-sensitized electrochemical platforms are often projected as viable and economical for sensitive detection of CAs within relevant ranges [5, 6], and we present here results on Nafion-coated NiO/MXene (NM) nanocomposite electrodes with favorable electron-transfer kinetics for CA detection in aqueous media. The structure of the electroactive nanocomposite was established using X-ray diffraction, electron microscopy, and various spectroscopic tools. Under rigorous electrochemical testing and optimized amperometry, the nano-sensor achieved a linear detection range of 3-100 nM with an ultralow detection limit of 0.92 nM, useful for early detection of the above NCDs. Comprehensive selectivity studies demonstrated exceptional resilience to common ionic species, electroactive interferences, and amino acids found in human urine. We are testing synthetic samples that simulate healthy conditions, along with spiked samples to establish a recovery ratio. Our results establish NM nanocomposite electrodes as a potential candidate and reliable platform for CA sensing towards early diagnosis of multiple NCDs.

Graphical Abstract :



Keywords: NiO/MXene nanocomposite; Electrochemical sensor; Catecholamine detection; Non-communicable diseases; Point-of-care diagnostics

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A Step towards Establishing the Electrochemical Detection of Bosutinib using Engineered Composites based on $Ti_3C_2T_x$

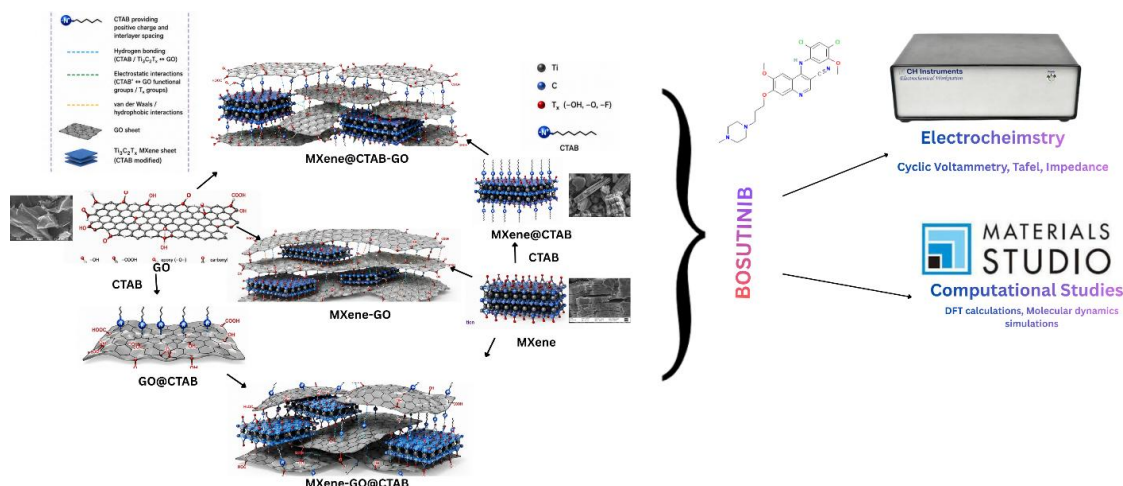
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Abstract

By the end of the last century, the discovery of chronic myeloid leukemia (CML) made way for the design of a novel class of targeted therapeutic drugs, opening a new era of anti-cancer drugs, like Tyrosine Kinase inhibitors (TKIs). Bosutinib is classified as the second-generation inhibitors (TKI) and being used as both a first in line as well as replacement drug for imatinib. However, it has high inter-patient pharmacokinetic variability, making dosage personalization and sensing crucial. In this research, we report the design and synthesis of composites based on MXene and GO for the sensing of bosutinib through electrochemical techniques. The composites, CTAB-modified $Ti_3C_2T_x$ with GO, were found to be the most efficient amongst the three composites (M-GO, M@C-GO and M-GO@C), with the highest current value; the multi-step reduction mechanism gave prominent peaks up to 1 pM concentration of bosutinib. The composite was effective in sensing bosutinib in aqueous medium and also in the blood plasma of Wistar rats. Finally, DFT and MD simulations were performed to understand the interaction at the molecular level, and they corroborate the experimental results.



Keywords: Bosutinib sensing, Electrochemical sensor, Real sample analysis, Theoretical analysis, Density Functional Theory, Molecular Dynamics

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Experimental and Computational Investigation of ZnO/Graphene Hybrid Structures for Electrochemical Detection of Ethanol in Low Concentration

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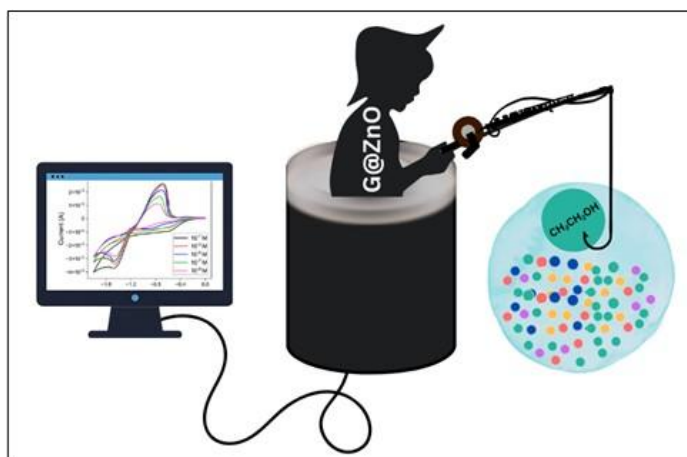
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Abstract

Ethanol is one of the most widely used chemicals like in food industries, pharmaceutical companies, biofuel industries, disinfectants. Therefore, there is a need to detect the presence of ethanol in low to high concentration. In this work, authors have reported the synthesis of composites of ZnO or doped ZnO with graphene and characterized them by x-ray diffraction, scanning electron microscopy (SEM). Introducing graphene with ZnO has enhanced the conductivity, surface area that will provide sufficient active sites for the oxidation of ethanol on passing the electron in aqueous medium. Various electrochemical techniques like cyclic voltammetry (CV), tafel, and electrochemical impedance spectroscopy (EIS) have been explored in sensing of ethanol at high to low concentration, varying the time, number of scans. A synergistic interaction between ZnO and graphene is observed with better charge transfer and ability to oxidise ethanol. The results obtained indicated that ZnO/graphene as a promising material for the sensing of ethanol in aqueous environment, that is, in diagnosis of lung cancer in early stage. Further, computational calculations were performed to understand the electronic properties of the material and mechanism for the oxidation of ethanol over the surface of the composite at molecular level has been determined computationally. It energetically validates the oxidation of ethanol to acetic acid, thus strengthening the experimental results.



Keywords: Sensing; ZnO based materials; Graphene; Computational calculations; Electrochemical studies

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Synthesis and Characterization of Transition Metal Dichalcogenides for Biomedical Applications

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Abstract

Two-dimensional transition metal dichalcogenides (2D TMDs) have received significant attention in biomedical research due to their unique physical and chemical characteristics, large surface area, and tunable structural properties. TMDs are promising candidates for a wide range of biomedical applications, including drug delivery, tissue engineering, biosensing, and antimicrobial applications. The present study aims to contribute to the synthesis and preliminary structural characterization of the TMD nanomaterial as a possible foundation for biomedical applications. We have synthesized a library of TMDs and characterized them using XRD, TGA-DSC, HRSEM, and HRTEM. Then we functionalized the surface of the TMDs with multiple biocompatible polymers, and different drugs were loaded. The drug-loading and encapsulation efficiencies were correlated with polymer functionalization, and the in vitro release kinetics were studied using the USP dissolution method. This study provides a fundamental understanding of TMDs and polymer physicochemical characteristics to enhance drug-loading potential. Further studies will be conducted to understand the parameters that control drug release kinetics by tuning the physicochemical properties. This will lay the foundation for controlled drug delivery using TMDs.

Keywords: Transition metal dichalcogenides, advanced nanomaterials, drug delivery, biomedical application, nanotechnology.

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A Portable LIG Chip for On-Site Surveillance of Metal-Driven AMR Co-Selection in Water

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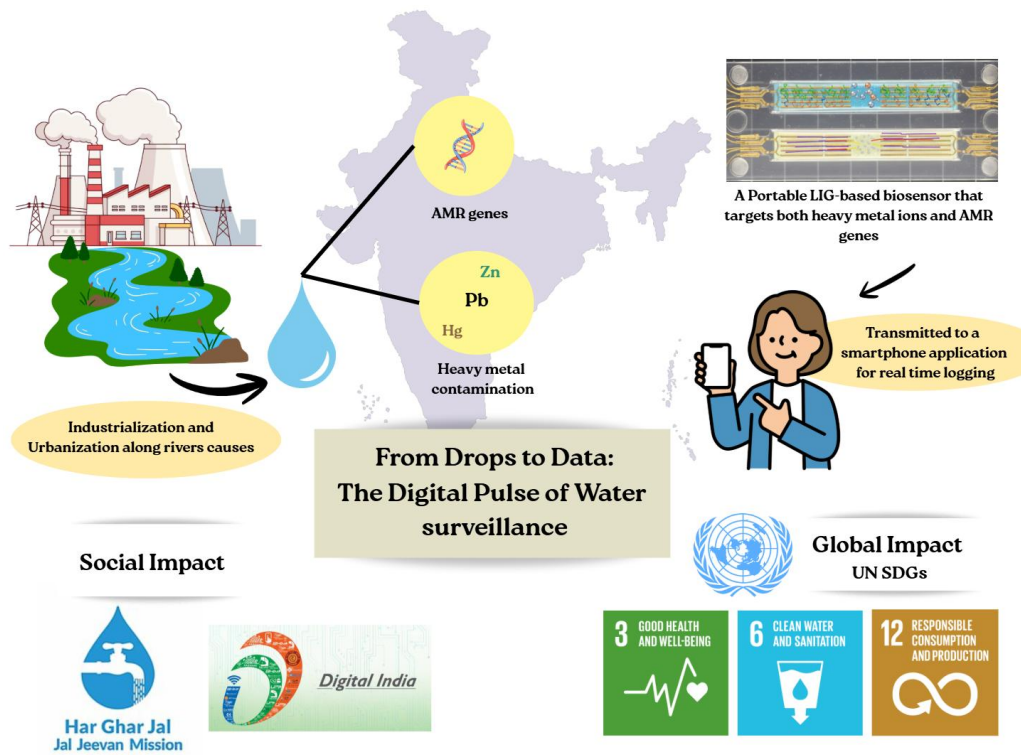
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Abstract

Indian waterbodies are facing a serious threat from the ongoing buildup of toxic heavy metals caused by urbanization and industrialization. There is also a troubling increase in living pollutants, particularly Antimicrobial Resistance genes from active pathogens. Rapid industrial growth along the Ganga, Yamuna, and Kaveri rivers has led to a complex mix of pollutants that traditional water quality tests cannot effectively measure. The main challenge in current water monitoring is the cost and the delay between sampling and reporting when using conventional methods like ICP-MS, qPCR and sequencing technology. Additionally, heavy metals such as lead, zinc and cadmium often create conditions that promote the spread of Antimicrobial Resistance (AMR) genes, including *bla_{NDM-1}* (New Delhi metallo-beta-lactamase 1). There is currently an absence of a portable, low-cost, point-of-need (PON) platform capable of dual-recognition detection of metal ions as well as AMR genes while withstanding the high-turbidity and varying thermal conditions of tropical environmental samples. The development of a flexible biosensing platform utilizing Laser-Induced Graphene (LIG) can be utilized to characterize the co-existence of metal ions and AMR genes. Instead of using expensive and rigid materials like ITO glass, Polyimide Kapton sheets can be used, the surface of which can be converted into a porous graphene network photothermally using a CO₂ laser. The design contains a three-electrode system in which the LIG working electrode's conductivity can be enhanced by the deposition of gold nanoparticles on its surface. The sensing mechanism is doubled where the chemical sensing uses Differential Pulse Anodic Stripping Voltammetry to pre-concentrate and then strip the specific metal ions from the electrode surface. For the biological sensing, it uses Electrochemical Impedance Spectroscopy to monitor the hybridization of thiolated DNA probes specific to the AMR gene. The signal is then processed via a portable Sensit BT potentiostat which is transmitted to a smartphone application for real-time data logging. This technology has a global impact as it addresses the UN Sustainable Development Goals 3 (Good health and well-being), 6 (Clean water and Sanitation) and 12 (Responsible Consumption and Production). It also supports the *Jal Jeevan Mission (2019)* and the *Digital India (2015)* initiative by reducing the cost of environmental testing. This biosensor would serve as an early warning system to prevent outbreaks of drug-resistant infections and chronic heavy metal toxicity by allowing municipal bodies to detect AMR genes and heavy metals at their source using their smartphones and identify AMR hotspots.

Keywords: Antimicrobial Resistance, Heavy Metal surveillance, Flexible Electronics, PON-Testing, Indian Waterbodies



Clinical Validation of Pd- Ti₃C₂T_x Composite based Point-of-Care Biosensor for Luteinizing Hormone Testing Against COBAS 600

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Abstract

Central laboratory immunoassay analyzers offer high diagnostic accuracy for measurement of serum luteinizing hormone (LH) in reproductive disorders; however, centralized sample processing can delay clinical decision-making. In this work, we investigated the clinical performance of a portable Pd-Ti₃C₂T_x composite-based electrochemical point-of-care (PoC) biosensor and compared its performance with the reference Roche COBAS 6000 analyzer. A double-blind validation study was performed at the Department of Endocrinology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, in which 250 human serum samples and four laboratory quality controls (Bio-Rad) covering an LH range of <0.10–72.15 IU/L were analyzed; samples below the lower limit of quantification (<1 IU/L) were excluded, and agreement between the two methods was assessed using Bland-Altman analysis, Spearman correlation, and Deming regression. As LH concentrations were not normally distributed, results are summarized using medians. A total of 232 samples with values ≥1 IU/L were included in the final analysis, and the PoC biosensor showed closely matching LH concentrations to the COBAS 6000 (median 7.8 vs 7.8 IU/L), with strong correlation between the two methods (Spearman's $\rho = 0.982$) and close agreement on both Bland-Altman and Deming regression, with no systematic bias observed across the concentration range tested. Taken together, these findings demonstrate that the electrochemical PoC biosensor based on MXene Pd-Ti₃C₂T_x achieves excellent agreement with the reference method for LH measurement across the clinically relevant range, and its 60-second response time and portability establish it as a promising tool for real-time point-of-care LH testing in reproductive and fertility care.

Keywords: Luteinizing hormone; Point-of-care testing; Clinical validation; Biosensor; Method comparison

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AR-Assisted Bystander CPR Mat for Medically Underserved Areas: A Low-Cost and Portable Way to Make Basic Life Support Training More Accessible.

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Abstract

Sudden cardiac arrest is one of those emergencies where immediate action matters a lot, but practical CPR and Basic Life Support (BLS) training is still not easily available everywhere, especially in medically underserved and low-resource areas. High-fidelity CPR manikins are useful for training, but they are expensive, bulky and sometimes difficult to maintain or carry for large-scale community training. Because of this, what we put forth is an AR-Assisted Bystander CPR Mat, which is basically a portable and low-cost approach that aims to make practical CPR training more accessible without depending completely on expensive high-fidelity resuscitation manikins.

In our proposed model, we aim to combine a sensor-integrated CPR training mat with Augmented Reality (AR) guidance so that a learner can practice important CPR parameters such as correct hand placement, compression depth, compression rate and chest recoil. The mat can use force/pressure sensing and motion-sensing elements connected with a microcontroller-based data acquisition unit, while the collected information can be communicated to a smartphone application. Through the AR interface, the learner can receive real-time visual, auditory and haptic feedback while performing CPR, which can help them understand what they are doing correctly and where improvement is required.

The main idea is to make the whole system lightweight, rollable, affordable and easy to carry so that CPR training is not limited only to well-equipped simulation laboratories. We aim to make this approach useful in schools, rural health centres, NGOs, community programmes, disaster-response training and other resource-constrained environments. Multilingual guidance can also be included so that people from different communities can understand and follow the training more comfortably.

What we aim to achieve through this system is a shift from an equipment-heavy CPR training approach towards a more accessible and technology-assisted training method. By bringing together low-cost sensing, smartphone accessibility and AR-based feedback, the proposed mat could support more frequent and wider BLS training at the community level. Further work would involve prototype development and validation against established CPR training systems, along with evaluation of feedback accuracy, usability and learning outcomes. Overall, what we put forth is not simply a mat, but an attempt to bring practical lifesaving education closer to the people who may not otherwise have access to it, because the opportunity to learn CPR should not depend on where a person lives or how expensive the available training equipment is.

Keywords: Augmented Reality, Cardiopulmonary Resuscitation, Basic Life Support, Bystander CPR, CPR Training Mat, Biomedical Engineering, Medically Underserved Areas, Sensor-Based Training, Digital Health.

Physicochemical Characterization and Antimicrobial Evaluation of Green Synthesized Apple Pectin-Capped Silver Nanoparticles

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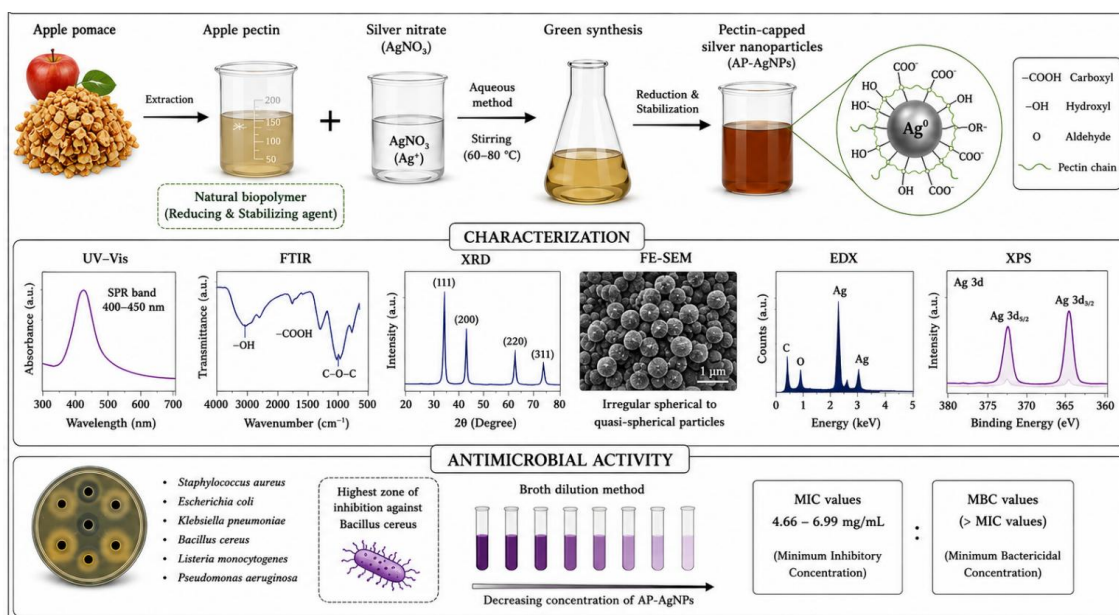
Abstract

The biogenic synthesis of metal nanoparticles mediated by naturally derived biopolymers has emerged as a compelling eco-compatible paradigm for engineering next-generation antimicrobial and therapeutic nanomaterials. In the present investigation, apple-derived pectin was employed as a bifunctional reducing and stabilizing agent for the aqueous-phase fabrication of pectin-capped silver nanoparticles (AP-AgNPs) via a sustainable, reagent-minimal green synthesis route. Successful nanoparticle formation was corroborated by UV-Visible spectroscopy, which revealed a characteristic surface plasmon resonance (SPR) absorption band within the 400-450 nm spectral region, consistent with the optical signature of colloidal silver [1].

Comprehensive physicochemical characterization was conducted through a multi-technique analytical framework encompassing Fourier Transform Infrared spectroscopy (FTIR), X-ray diffraction (XRD), Field Emission Scanning Electron Microscopy (FE-SEM), Energy Dispersive X-ray spectroscopy (EDX), and X-ray Photoelectron Spectroscopy (XPS). FE-SEM morphological analysis disclosed irregular spherical to quasi-spherical particle architectures predominantly distributed in the micro-scale regime. The proposed reduction mechanism involves sequential oxidation of pectin hydroxyl moieties and hemiacetal bond cleavage, generating reactive aldehyde intermediates that mediate Ag^+ ion reduction [2,3]. Subsequent particle stabilization occurs through coordinative and cycloaddition-type interactions between the nascent silver surface and the carboxyl and hydroxyl functionalities of the polysaccharide scaffold, as corroborated by FTIR spectral shifts and XPS binding energy data[4]. The biosynthesized AP-AgNPs demonstrated broad-spectrum antibacterial activity against clinically and foodborne relevant pathogens, including *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Bacillus cereus*, *Listeria monocytogenes*, and *Pseudomonas aeruginosa*, as assessed by the disk diffusion method. Notably, *Bacillus cereus* exhibited the most pronounced susceptibility, recording the highest zone of inhibition among the tested strains. Quantitative antimicrobial profiling yielded MIC values ranging from 4.66 to 6.99 mg/mL, while Minimum Bactericidal Concentration (MBC) determinations confirmed potent bactericidal rather than merely bacteriostatic action. These findings substantiate the translational relevance of pectin-mediated silver nanoparticles as multifunctional bioactive agents with prospective applications in antimicrobial therapeutics and anti-inflammatory biomaterial development.

Keywords: Apple pectin, Green synthesis, Nanotechnology, Natural biopolymer, Biomedical applications

Graphical Abstract



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Impact of Molecularly Imprinted Polymers on Graphene Oxide-Coated Screen-Printed Electrodes for Selective Immune-Sensing of Gastric Cancer-Causing Bacteria *Helicobacter pylori*

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Abstract

Helicobacter pylori (*H. pylori*) infection continues to be a major public health issue worldwide. The prevalence of *H. pylori* infection exceeds 50 % worldwide and reaches 70–80 % in developing countries because of inadequate sanitation and restricted healthcare services. The gram-negative bacterium *H. pylori* hold Group 1 carcinogen status according to the World Health Organization (WHO) because it directly causes chronic gastritis, mucosa-associated lymphoid tissue (MALT), peptic ulcer disease, and gastric adenocarcinoma. This calls for an immediate need for better diagnostic approaches. The gastric mucosa colonization of the bacterium depends on outer membrane proteins, including BabA, OipA, and SabA, which facilitate both adhesion and pathogenicity. The current diagnostic approaches, including biopsy, histology, endoscopy, fecal antigen tests, ELISA, serology, western blotting, urea breath tests, and PCR, face challenges related to complexity, high costs, and low sensitivity. The development of electrochemical biosensors represents a promising diagnostic solution because they provide fast results at affordable prices and portable devices for on-site testing. The incorporation of molecularly imprinted polymers (MIPs) as synthetic receptors with predefined recognition sites for target analytes improves both selectivity and stability of these biosensing platforms. The research introduces an innovative electrochemical biosensor system that detects BabA antibodies (BabA-Ab), which serve as important immunological indicators of *H. pylori* infection. The sensor platform consists of graphene oxide (GO) that integrates with a BabA-Ab-imprinted polymer matrix. A non-imprinted polymer (NIP) sensor device was constructed simultaneously with the BabA-Ab-imprinted polymer sensor to function as a control reference. The research demonstrates how GO/MIP-based electrochemical sensors can function as advanced clinical diagnostic instruments for fast and precise medical testing.

Prolactin-Induced Protein Imprinted Polymer-Based Targeted Electrochemical Detection of Early Keratoconus

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Abstract

Keratoconus (KC) is a progressive degenerative corneal ectatic disorder characterised by stromal thinning and irregular astigmatism, often leading to significant visual impairment and ultimately vision loss. The unavailability of molecular-level diagnostic tools limits early detection and clinical management of the disease. Prolactin-Induced Protein (PIP), a tear-associated glycoprotein involved in immune regulation and ocular homeostasis, has recently emerged as a potential biomarker due to its significant downregulation in patients with keratoconus. This study aimed to develop a sensitive electrochemical biosensor for PIP detection in tear samples. A molecularly imprinted (MIP) based electrochemical sensor was fabricated on gold nanoparticles (AuNPs) modified screen-printed carbon electrodes (SPCEs). Analytical performance was evaluated under optimised temperature and pH conditions, assessing linearity, detection limit, response time, and reproducibility. The AuNPs enhanced signal sensitivity, while the MIP provided selective recognition of PIP. The developed biosensor platform offers a rapid and sensitive platform for PIP detection, supporting its potential application in point-of-care diagnosis for keratoconus.

Keywords:

Biomarker, Electrochemical biosensor, Molecularly Imprinted Polymer, Prolactin-Induced Protein, Keratoconus

Electrochemical Detection of Cardiac Troponin I using Atomically Thin Borophene-Engineered In-House Flexible Screen-Printed Electrodes for the Early Diagnosis of Acute Myocardial Infarction

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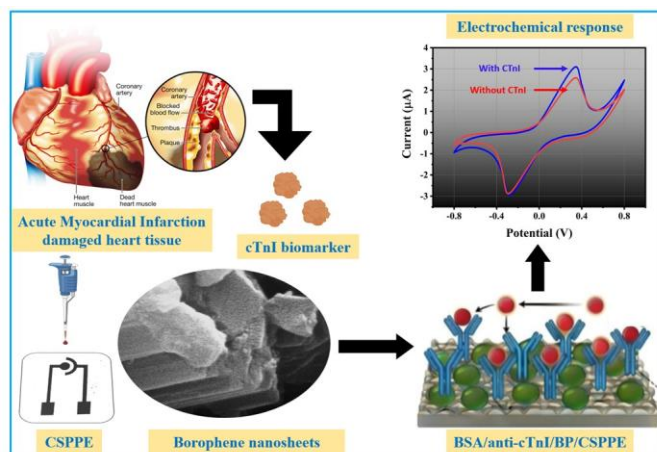
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Abstract

Borophene (BP), a recently discovered two-dimensional (2D) nanomaterial, remains relatively underexplored in the domain of electrochemical biosensing despite its unique electron-deficient structure, high surface reactivity, and tunable semiconducting properties. Herein, we report the development of few-layer BP-engineered in-house flexible carbon screen-printed paper electrodes (CSPPEs) as an advanced electrochemical platform for cardiac biomarker, Cardiac Troponin I (cTnI) detection in biofluids. Few-layer BP nanosheets were synthesized via an acetone-assisted solvothermal liquid-phase exfoliation method and comprehensively characterized using Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS), and electron microscopy (TEM and SEM), confirming their crystalline structure, surface chemistry, and ultrathin morphology. An EDC-NHS immobilization strategy was employed to achieve stable and strong anti-cTnI antibody conjugation via covalent immobilization method, thereby enhancing bio-recognition efficiency and interfacial charge transfer. Integration of BP with flexible, in-house fabricated CSPPEs demonstrated a highly active electrochemical interface, as evidenced by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS), facilitating efficient electron transport and signal amplification. The resulting nanoengineered platform demonstrated sensitive detection of cTnI over a wide dynamic range (0.01–50 ng/mL) with a low limit of detection of 0.001 ng/mL, along with excellent reproducibility, repeatability, and shelf-life of 35 days. The selectivity of the developed immunosensor was evaluated in the presence of potential interfering proteins, confirming its specific response toward cTnI with negligible cross-reactivity. Furthermore, the sensor performance was validated using serum-spiked samples, where cTnI was successfully detected in a complex biological matrix. These findings demonstrate the reliability and analytical robustness of the proposed platform, highlighting its potential for sensitive and precise detection of cTnI in clinical diagnostics of acute myocardial infarction (AMI).

Graphical Abstract



Keywords: Acute Myocardial Infarction, Cardiac Troponin I, Borophene Nanosheets, Electrochemical Immunosensor, Point of Care technology

An Automated Multi-Omics Machine Learning Pipeline for *Aedes aegypti* Vector-Control Therapeutics

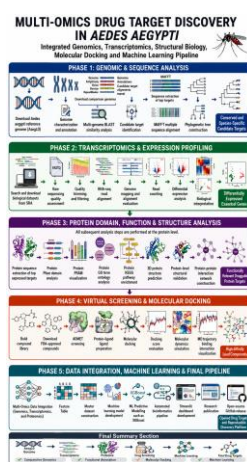
Mr. Mayank Singh^{1*}, Dr. Jyoti Sharma¹

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Abstract

The escalating burden of arboviral diseases transmitted by *Aedes aegypti*, compounded by widespread insecticide resistance urgently demand novel vector-control therapeutics. To accelerate this discovery process, we have developed a scalable, multi-omics computational pipeline that seamlessly integrates comparative genomics, transcriptomics, structural bioinformatics, and predictive modeling into a connected, stepwise framework. The pipeline begins with comparative genomics, employing sequence alignment and phylogenetic analyses across multiple proteomes to isolate conserved, essential mosquito-specific genes strictly filtering against human homologs to mitigating the risk of human off-target toxicity. Once candidate genes are identified, transcriptomic data undergoes differential expression analysis to prioritize targets constitutively active across embryonic, larval, and adult stages. To further characterize these filtered targets, we map domain annotations, metabolic pathways, and protein-protein interaction networks to pinpoint essential biological hub proteins. With the core target receptors established, high-fidelity 3D structural models are generated to enable structure-based screening. A curated library of approved and natural compounds, pre-filtered for optimal ADME pharmacokinetic profiles, is then subjected to high-throughput molecular docking against these models. The thermodynamic stability of the resulting protein-ligand complexes is subsequently confirmed via molecular dynamics simulations. Finally, all multi-dimensional data, spanning expression, structural, network, and thermodynamic metrics, feed directly into a Machine Learning (such as XGBoost) model. Interpreted via functional contribution features, this model ranks the ultimate lead candidates. By systematically bridging these interconnected phases, our scalable methodology yields a highly refined cohort of thermodynamically robust, high-affinity compounds, providing a reproducible avenue to overcome insecticide resistance.

Graphical Abstract



Keywords: *Aedes aegypti*; Multi-omics; Structure-based drug design; Machine Learning (such as XGBoost); High-throughput virtual screening; Transcriptomics.

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A p-Value Weighted Ensemble Machine Learning Framework for Polygenic Association

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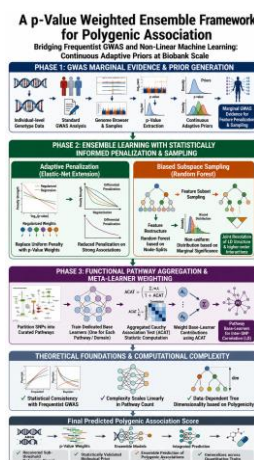
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Abstract

Conventional Genome-wide Association Studies evaluate single-variant models against strict significance thresholds, systematically discarding substantial sub-threshold polygenic heritability. While non-linear predictive modeling captures linkage disequilibrium and epistasis, it typically ignores marginal association priors and faces computational intractability at biobank scales without information-lossy dimensionality reduction. To resolve these limitations, we introduce a p-Value Weighted Ensemble framework that repositions marginal association evidence from binary inclusion filters into continuous adaptive priors across a tiered predictive architecture. The framework operates through three mutually reinforcing stages. First, at the penalization stage, uniform penalties in regularized regression are replaced with adaptive weights derived from marginal significance, retaining conditionally robust sub-threshold variants. Second, ensemble construction is restructured using biased subspace sampling, wherein node-splitting distributions are proportional to marginal association strength, prioritizing biologically validated variants without imposing hard exclusion boundaries. Finally, at the aggregation stage, variants are partitioned into independent functional pathways serving as base learners. These pathway contributions are weighted using robust, correlation-adjusted aggregation statistics computed from constituent marginal p-values, seamlessly accommodating linkage disequilibrium. The pathway-level decomposition reduces quadratic computational complexity to linear scaling, making biobank-scale joint optimization feasible. By integrating statistically validated biological information into regularized and ensemble-based predictive modeling, this scalable architecture recovers missing polygenic signals and generalizes robustly across quantitative traits.

Graphical Abstract



Keywords: Genome-wide Association Studies; Polygenic Score Prediction; Adaptive Regularization; Ensemble Learning; Epistasis; Linkage Disequilibrium.

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Can ChatGPT Be Trusted for Nutrition Advice? A Comparative Analysis of AI-Generated versus Dietitian and Guideline-Based Nutritional Recommendations

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Abstract

Background

Poor diet is a cause of non-communicable diseases such as obesity, cardiovascular disease and type 2 diabetes. These diseases are responsible for 74% of deaths, around the world. Good nutrition advice plays a role in preventing and controlling these issues. However, it is not always easy or quick to get help from a dietitian. ChatGPT has become one of the popular sources of free health information. By October 2025 it had 800 million active users.. The question remains whether ChatGPT can be trusted to provide safe, accurate and personalized nutrition advice. The question remains whether ChatGPT can be trusted to provide accurate and personalized nutrition advice.

Aim

To determine whether ChatGPT can be relied upon to provide proper general nutrition advice according to the existing evidence, particularly with respect to its dietary recommendations and meal plans compared to registered dietitians, expert knowledge-based systems, and international clinical guidelines.

Methodology

Results from six peer-reviewed papers were assessed and summarised. The first four compared diets or advice produced by ChatGPT to those of the diet representatives or based on guidelines on particular health conditions: Papastratis et al (2024) on obesity, cardiovascular and type 2 diabetes; Ponzio et al (2024) for seven NCDs; Niszczoła and Rybicka (2023) on food-allergy management; and Katsigiannis et al (2026), who assessed ChatGPT data against the practices of three dietitians on obesity, hypertension and type 2 diabetes, taking into account gender and ethnicity. The fifth study, by Onay et al (2025), compared dietitian and ChatGPT created meals for a number of chronic diseases. The sixth paper, Motevalli et al. (2026) reviewed a huge amount of literature on ChatGPT experience in obesity and weight, which allows to compare the results obtained in all above papers.

Results

According to a number of studies, ChatGPT has an accuracy that is fairly close, but does not always match that of dietitians. Papastratis et al. show that a nutrition-expert based system reaches 91% nutritional accuracy and only 0.8% caloric error, while ChatGPT obtains 81–82% and 19–28% respectively (81-82% accuracy rate rises to 86% when caloric targets are given). Ponzio et al. showed that ChatGPT matches guidelines in 55–73% of advice given, with contradictions happening in some instances, and lower accuracy given by ChatGPT for patients with overlapping conditions. Niszczoła and Rybicka located a dangerous recommendation as the system advised almond milk within a nut-free diet. Katsigiannis et al. revealed that the accuracy of ChatGPT's compliance to the guidelines (55–83%) is more or less equal to that of dietitians (especially 50–100%), but the plans offered by ChatGPT were consistently lower in energy, fibre, sodium, and a few micronutrients, never encouraging the use of Mediterranean diet, and even presenting more energy-based plans for men compared to women in some ethnic groups. In the context of the review performed by Motevalli et al., it has been observed that during 37 studies ChatGPT performed well in 75% of lifestyle/nutrition studies and in 50% of bariatric surgery studies with regard to the accuracy of ChatGPT as compared to the experts or guidelines thus presenting

better results than other chat-bots, although only 27% of the studies demonstrated the high confidence when it comes to the research quality, while the accuracy decreased in complex and multi-condition cases.

Conclusion

Overall, these research findings suggest that ChatGPT offers nutritionally sound recommendations pertinent to the established dietary guidelines and in some instances, achieved a level of accuracy comparable with professional dietitians. Nevertheless, the recalled studies revealed some weaknesses in terms of dietary micronutrient calculations, cultural and individual adjustments of diet, and understanding of complex medical disorders. The model generates unsafe recommendations from time to time. The model's performance improves significantly when it receives comprehensive patient data and clear dietary recommendations. At this stage of the research, it is reasonable to conclude that ChatGPT can be used as an adjunct tool for dietary information with the understanding that it cannot replace qualified nutritionists in providing personalized advice.

Keywords

ChatGPT; Artificial Intelligence; Nutrition; Non-Communicable Diseases; Dietitian; Meal Planning; Diet Accuracy

Integrative Ecological Profiling Framework Characterizes Intratumoral Microbial Signatures in Lung Adenocarcinoma

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Abstract

Background: Intratumoral microbial communities may contribute to biological heterogeneity in lung adenocarcinoma, yet their ecological variation across tumor and adjacent non-tumor tissues remains incompletely characterized.

Objective: This study aims to characterize tissue-associated and vital-status-stratified microbial patterns in The Cancer Genome Atlas Lung Adenocarcinoma cohort.

Methods: Microbial taxonomic profiles will be integrated with corresponding clinical metadata using sample-level identifiers. Primary Tumor and Solid Tissue Normal specimens will be categorized as Tumor and Healthy tissue, respectively, while samples with missing or unverified vital-status information will be excluded. Taxon-level abundance distributions will be examined through stratified boxplots and non-parametric statistical testing. Within-sample microbial complexity will be evaluated using the Shannon Diversity Index and observed taxonomic richness. Between-sample community variation will be characterized using an abundance-appropriate distance metric followed by Principal Coordinate Analysis. Permutational multivariate analysis of variance will be used to determine whether overall microbial community composition differs between Tumor and Healthy tissues and across recorded vital-status groups. **Expected significance:** This study will establish a reproducible ecological-statistics framework for characterizing the LUAD-associated tissue microbiome. It will determine whether tumor tissues exhibit altered microbial complexity or community structure relative to Solid Tissue Normal controls and whether intratumoral microbial profiles vary according to patient vital status. The findings may prioritize candidate bacterial taxa for future validation and integration with longitudinal survival, host genomic, and transcriptomic information.

Graphical Abstract

TCGA-LUAD microbial profiles	→	Clinical stratification	→	Alpha and beta diversity analysis	→	Ecological patterns and candidate taxa
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Keywords: Lung adenocarcinoma; Intratumoral microbiome; TCGA-LUAD; Microbial ecology; Alpha diversity; Beta diversity; Shannon Diversity Index; Principal Coordinate Analysis; PERMANOVA

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An In Silico Approach for Epitope Prediction of Enolase Protein from *Mucor circinelloides*

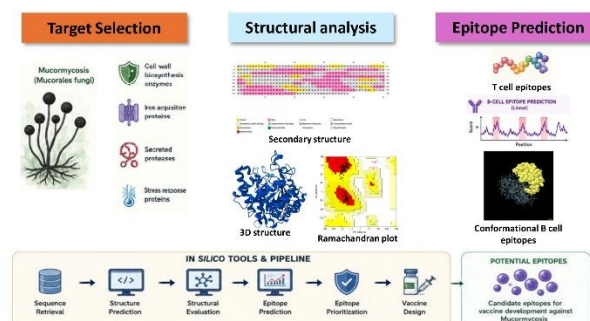
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Abstract

Fungi in the order Mucorales are the cause of the invasive fungal infection known as mucormycosis. During COVID-19 a worldwide spike in mucormycosis cases was seen. The mucormycosis infection affects many organs of human body. Based on the location of infection, mucormycosis types comprise of cutaneous, orbital, rhino-orbital, rhino-cerebral, pulmonary, and gastrointestinal. Immunocompromised individuals or patients having underlying diseases such as diabetes, hyperglycemia, and diabetic ketoacidosis are at higher risk of contracting the mucormycosis infection. The early diagnosis is performed by culture and biopsy. However, species specific identification is performed by molecular assays and MALDI-TOF. For treatment, various antifungal drugs such as Amphotericin B, Posaconazole, Isavuconazole along with surgical debridement may be employed. Both diagnosis and treatment are costly which poses a considerable burden of mucormycosis management in lower middle-income countries. As per WHO, currently there are no vaccines available against mucormycosis. Therefore, in this study, immunoinformatic approaches were employed to identify Linear B cells, discontinuous/conformational B cells, helper T cells, and cytotoxic T cells epitopes of *Mucor circinelloides* Enolase. Enolase is a glycolytic enzyme which also functions as an immunodominant antigen. In pathogenic fungi, it is expressed in cell walls and found in secretions. Using various online tools, the predicted Enolase epitopes were selected according to their non-toxicity, non-allergenicity, and probable antigenicity. The predicted epitopes may be utilized in designing a potential multi-epitope-based vaccine against mucormycosis.



Keywords: mucor, fungi, vaccine, epitope, antigen, disease, treatment

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A Random Forest-Based Predictive Model for Vitamin D Deficiency Classification Using Age and Gender: A Preliminary Study

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Abstract

Vitamin D deficiency remains a widespread public health concern, with significant implications for bone health, immune function, and chronic disease risk. Early identification of individuals at risk of deficiency can support timely intervention and personalized clinical management, yet routine biochemical testing is not always feasible at scale. This study presents a preliminary machine learning-based approach to classify Vitamin D status — deficient versus sufficient — using easily accessible demographic variables, specifically age and gender, derived from hospital patient records. A random forest classification model was developed and trained on retrospective hospital data comprising 500 patient records, with Vitamin D deficiency status defined based on standard clinical serum threshold levels. The model's performance was evaluated using standard classification metrics, including accuracy, sensitivity, and specificity, with preliminary results indicating promising discriminative performance in distinguishing deficient from sufficient cases based solely on age and gender inputs. While the current model is limited in scope, given the exclusion of other established risk factors such as sun exposure, dietary intake, and BMI, the findings suggest that demographic-only screening tools may offer a low-cost, readily deployable first-pass risk stratification method in resource-constrained clinical settings. Future work will focus on expanding the feature set and validating the model across larger and more diverse patient populations to improve predictive robustness and clinical applicability. This study contributes to the growing body of work applying predictive analytics to personalized, data-driven preventive healthcare strategies.

Keywords: *Vitamin D deficiency; Random forest; Predictive analytics; Personalized medicine; Machine learning classification*

In silico* identification of Putative Antimicrobial Peptides from *Clogmia albipunctata

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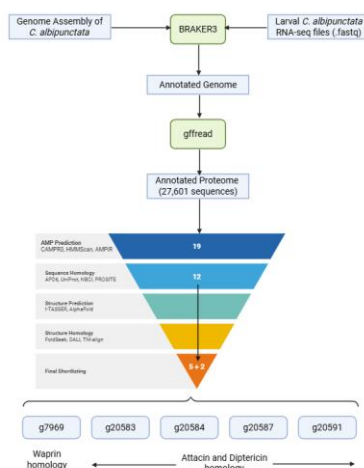
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Abstract

Antimicrobial peptides (AMPs) are natural components of the innate immunity of organisms across all kingdoms of life. They are an emerging class of antimicrobial agents with potential applications in medicine, material science, and biotechnology. The mothmidge (*Clogmia albipunctata*), a dipteran synanthrope inhabiting unsanitary areas including sewers, STPs, and hospitals. Given the high exposure of AMR pathogens in its habitat, we hypothesize that the mothmidge has in turn evolved to express more potent AMPs to fight infection. This unpublished computational study explores this hypothesis by developing an AMP discovery pipeline utilizing genomic and transcriptomic data. A selected high-quality genome assembly was integrated with larval RNA-seq data and annotated via the BRAKER3 software hosted by the Galaxy platform. The annotated genome, further converted to a proteome dataset containing 27,601 sequences, was analyzed using ML classifier-based and HMM-based AMP-prediction tools for preliminary screening. The shortlisted candidates were further assessed for sequence and structural homology using a combination of AMP-specific and global protein databases, structure prediction tools (AlphaFold and I-TASSER), and structure homology tools (TM-align, DALI, FoldSeek). Consecutive screening of candidates revealed five AMP candidates: four of which express homology to attacins and dipterocins, and one with moderate similarity to waprins. Additionally, two sequences with strong lectin homology were discovered, which may possess antimicrobial properties despite lacking AMP homology. With promising *in silico* results, further experimental validation may provide promising AMP candidates for clinical and industrial applications.

Graphical Abstract



Keywords: Antimicrobial Peptides, *Clogmia albipunctata*, BRAKER3, Galaxy, Therapeutic peptide discovery

Translating NMF-Based Anomaly Detection from CMS Pixel Detector Data to Medical Imaging

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Abstract

Modern High-Energy Physics (HEP) experiments rely heavily on unsupervised learning techniques to monitor detector performance and identify rare or unexpected behavior in extremely large and complex datasets. One such approach, based on Non-negative Matrix Factorization (NMF), has been successfully deployed within the CMS experiment to detect anomalous patterns in data from the silicon pixel detector. In this work, we explore the translation of this anomaly-detection paradigm from HEP to the domain of medical imaging. Using publicly available, annotated open source imaging datasets we adapt the same NMF-based framework to identify abnormal image regions associated with pathological features such as tumors. Despite the very different physical origins of the data, both CMS pixel detector outputs and medical images share a key characteristic: they are high-dimensional and densely structured, with strong correlations among features. We demonstrate that by carefully matching preprocessing strategies—such as per-sample normalization, low-rank model selection via saturation analysis, and localized (patch-wise) reconstruction error metrics—the NMF model can be made sensitive to subtle, spatially localized anomalies in medical images, while remaining robust to global intensity variations. This mirrors the logic used in detector monitoring, where local instabilities must be identified against a backdrop of otherwise stable global behavior. The broader aim of this project is to illustrate the portability of data-analysis tools developed in HEP community to other data-intensive scientific domains. Looking ahead, further studies will focus on developing streamlined data processing, storage, and analysis pipelines for medical imaging, inspired by the highly scalable frameworks used to handle petabyte-scale datasets in modern particle physics experiments.

Keywords - Anomaly detection, High Energy Physics, Medical Imaging, and interdisciplinary research.

AI-Guided Discovery and Computational Prioritization of Novel Antimicrobial Peptides Against Carbapenem-Resistant *Pseudomonas aeruginosa*

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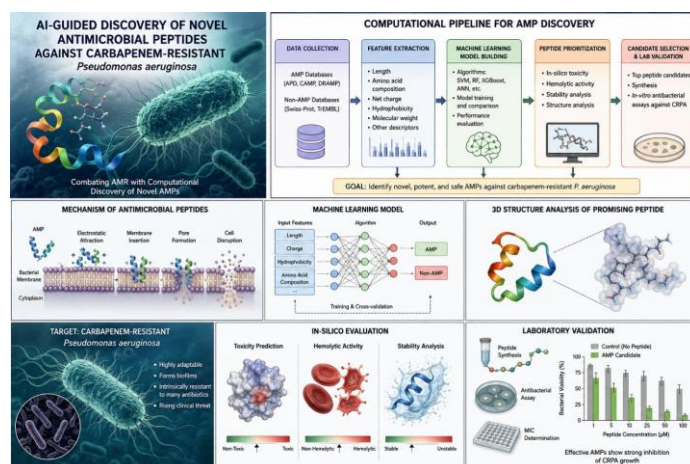
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Abstract

Antimicrobial resistance is becoming a serious threat to human health and complicates the treatment of bacterial infections since it renders many existing antibiotics ineffective. In particular, carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) is a clinical concern which requires the development of alternative antimicrobial agents. Antimicrobial peptides (AMPs) are promising short molecules with antibacterial activity that can serve as an alternative to conventional antibiotics. However, the experimental screening of potential AMPs is laborious and time-consuming. The current research is going to propose an innovative computational method based on machine learning algorithms for the discovery of novel antimicrobial peptides. The antimicrobial and non-antimicrobial peptides will be extracted from the corresponding databases for further analysis. Particular attention will be paid to the analysis of peptides' length, amino acid composition, net charge, hydrophobicity, and other characteristics. Using this data, several machine learning models will be constructed and compared to identify the best-performing algorithm. The obtained results will be used to prioritize peptides for further in-silico toxicity, hemolytic activity, and stability analysis. In addition, the structure of the most promising peptides will be studied to extract additional features. Based on the results of computational experiments, a pool of candidate antimicrobial peptides will be selected for further laboratory validation. The proposed method is going to minimize the number of peptides to be tested in the laboratory and serve as a valuable computational framework for finding novel antimicrobial agents against CRPA.



Keywords: Antimicrobial peptides; Antimicrobial resistance; Carbapenem-resistant *Pseudomonas aeruginosa*; Machine learning; Bioinformatics; Peptide screening; Computational biology; Drug discovery.

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A Systems-Level Metabolomics and Machine Learning Approach for Early and Predictive Detection of Uropathogens in Urinary Tract Infections

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Abstract

UTIs are a significant worldwide health issue and among the most common infectious diseases that impact around 150 million people each year. Despite urine culture being the diagnostic gold standard, its 48-72hours turnaround time delays clinical decision-making and promotes empirical antibiotic use, accelerating antimicrobial resistance (AMR). To solve these issues, the present study embraces a systems-level approach that integrates microbiological analysis with high-resolution metabolomics, and reinforced with machine learning (ML)-based decision support to achieve higher diagnostic precision and predictive powers.

Midstream urine samples were collected from symptomatic (~40) and asymptomatic (~40) UTI patients where the causative pathogens were determined using the VITEK-2 automated system. Meanwhile, antimicrobial susceptibility testing (AST) was performed following the CLSI guidelines. The most common uropathogen identified in our study were *Escherichia coli* (42%) and *Klebsiella spp.* (25%), followed by *Pseudomonas spp.* (18%), *Proteus spp.* (6%), *Enterococcus spp.* (6%), and *Staphylococcus spp.* (3%). High resistance was observed to commonly used antibiotics, including ciprofloxacin, gentamicin, levofloxacin, amikacin, imipenem, and colistin, highlighting the urgent need to strengthen antibiotic stewardship.

Building on these results, the metadata, metabolic biomarkers with bacterial pathways will be used to train machine learning models to identify whether a patient has a UTI and to predict antibiotic resistance patterns. Metabolic profiles give a clear overall understanding of how the host and pathogen interact and how the disease progresses.

This strategy provides a potent basis of early diagnosis, individualized treatment plans, and enhanced clinical decision-making, which eventually lead to enhanced patient outcomes and effective control of antimicrobial resistance in urological infections.

Key words: Urinary Tract Infections, Metabolomics, Machine Learning, VITEK, UPEC

AI-Driven Transfer Learning for Polygenic Risk Scores to Mitigate Ancestry Bias in South Asian Populations

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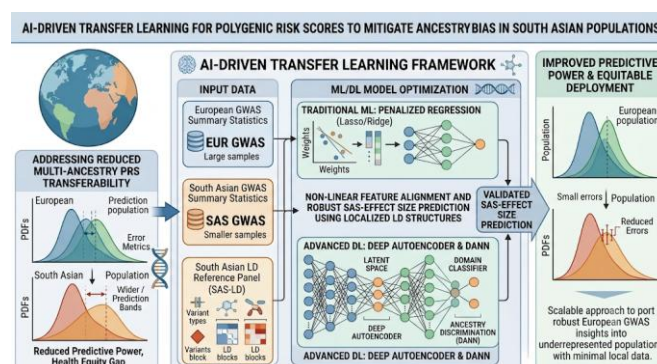
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Abstract

Despite the rapid expansion of genomic medicine, over 80% of Genome-wide Association Study (GWAS) data remains of European descent. Consequently, standard Polygenic Risk Scores (PRS) exhibit significantly reduced predictive power when applied to Indian and South Asian populations, driven by high genetic diversity, endogamy, and shifted allele frequencies. This ancestry bias presents a major health equity challenge in the clinical translation of genetic risk prediction. To address this disparity, a machine learning-driven transfer learning framework has been developed to adapt European GWAS summary statistics for South Asian cohorts. Utilizing Coronary Artery Disease (CAD) data as the source domain and corresponding OpenGWAS South Asian data as the target domain. We established a strict data harmonization pipeline to align variant effect alleles. We compared traditional penalized regression models (Lasso/Ridge) against deep learning architectures, including deep autoencoders and domain-adversarial neural networks (DANN), to re-weight European single nucleotide polymorphisms (SNPs) by integrating local South Asian linkage disequilibrium (LD) reference panels. By predicting optimal South Asian effect sizes based on the complex, non-linear relationships between European baseline data and local LD structures, our transfer learning pipeline aims to significantly improve cross-ancestry PRS accuracy. This computationally validated approach provides a scalable method to resolve ancestry bias, enabling more accurate, equitable disease risk prediction for underrepresented demographics without waiting for massive de novo sequencing efforts.

Graphical Abstract



Keywords: Polygenic Risk Scores; South Asian populations; Transfer learning; Deep learning; Ancestry bias; Coronary Artery Disease

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Integrative Pan-Cancer Multi-Omics Framework for Explainable Cancer Drug Response Prediction

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Abstract

Cancer drug resistance remains one of the greatest challenges in precision oncology, limiting therapeutic efficacy across diverse cancer types. Although recent artificial intelligence (AI) approaches have improved drug-response prediction, most rely on individual molecular modalities and therefore fail to capture the complex biological interactions underlying therapeutic resistance. To address this limitation, we developed a scalable and modular computational framework for harmonizing and integrating multi-omics and pharmacogenomic data to enable interpretable cancer drug-response prediction. The framework integrates genomic, transcriptomic, proteomic, phosphor-proteomic, epigenomic, and pharmacogenomic data from publicly available resources, including TCGA, CCLE, CPTAC, ProteomicsDB, and DepMap, within a unified multi-omics architecture.

As an initial proof of concept, we established the integrated genomic layer by combining somatic mutation and copy number variation data from TCGA and CCLE with pharmacogenomic drug-response profiles. The resulting machine-learning dataset comprised 1,170 matched samples with 38,931 genomic features, which were reduced to 5,000 informative features using variance-based feature selection prior to model development. A prototype Random Forest regression model was evaluated on an independent test set (RMSE=0.1783; $R^2=0.0216$). Although predictive performance was modest, the prototype successfully demonstrated the feasibility of an integrated genomic-pharmacogenomic AI framework. Feature Importance and SHAP analyses identified biologically relevant candidate biomarkers, including PDS5B, MUC4, COL5A1, CACNA1C, ABCA7, and SETD2, all supported by published evidence linking them to cancer drug resistance.

This work establishes a scalable computational foundation for future multi-omics integration and interpretable deep learning approaches, with the long-term objective of enabling biologically informed and clinically relevant precision oncology.

Keywords: Precision Oncology, Multi-Omics Integration, Cancer Drug Resistance, Explainable Artificial Intelligence, Machine Learning

Lead Optimization for the Identification of New Benzoxazine Analogues as Dual PDE1B/PDE10A Inhibitors for Schizophrenia: A Computational Approach Using Classical and Steered MD Simulations

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Abstract

Schizophrenia is a complex neuropsychiatric disorder characterized by positive, negative, and cognitive symptoms that remain inadequately addressed by currently available antipsychotic therapies. Phosphodiesterase 1B (PDE1B) and phosphodiesterase 10A (PDE10A) have emerged as promising dual therapeutic targets owing to their critical roles in regulating dopaminergic signalling pathways implicated in schizophrenia. In this study, a Topliss-strategy-driven computational pipeline, integrating molecular docking, ADMET profiling, classical and steered molecular dynamics (SMD) simulations, and MM-GBSA binding free energy calculations, was employed to systematically design and evaluate benzoxazine-based dual PDE1B/PDE10A inhibitors, using the previously reported dual inhibitor compound 2 as the lead scaffold. From Topliss-inspired structure-activity relationship studies of electronic, hydrophobic, and steric effect of substituents, three derivatives, 5a, 5g, and 6d were identified as most promising candidate, having docking scores ranging from -9.8 to -10.2 kcal/mol in PDE1B and -10.1 to -10.2 kcal/mol in PDE10A, with engagement of important catalytic residues such as F424, L388, L409, Q421 in PDE1B; F729, I692, L635, Q726 in PDE10A. All three derivatives exhibited MM-GBSA binding free energies range exceeding lead compound 2 for PDE1B (-29.39 ± 2.28 to -33.26 ± 1.77 kJ/mol) and PDE10A (-20.66 ± 1.43 to -28.83 ± 1.92 kJ/mol). The SMD derived rupture force showed similar results to compound 2 and PDE1B standard, but slightly lower for PDE10A, suggesting mechanical stability of these three derivatives with both proteins. Collectively, these results establish a validated and multi-tiered computational approach for designing and identification of dual PDE1B/PDE10A inhibitor which warrant further experimental validation for treatment of schizophrenia.

Keywords Schizophrenia, PDE1B, PDE10A, Benzoxazine, Molecular docking, Molecular dynamic simulation

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