INTERNATIONAL CONFERENCE 2026

NexGen Z Bio Resources: Frontiers for Sustainable World

26th & 27th February 2026

Book of Abstracts

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Tel: 011-23256188, 011-45130562, 9971676330, 9582248909

Email: ndpublishers@gmail.com

Website: www.ndpublisher.in

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Editors

Dr. Swati Chakarborty

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Dr. Anand Sharma

Dr. Supriya Ray

Organized by

ASANSOL GIRLS' COLLEGE

ASANSOL

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শ্রম দপ্তর এবং আইন ও বিচার বিভাগ,
পশ্চিমবঙ্গ সরকার

Moloy Ghatak
Minister-In-Charge
Department of Labour and
Departments of Law & Judicial
Government of West Bengal

MESSAGE

It gives me immense pleasure and profound satisfaction to extend my warm greetings to all participants, scholars, researchers, and distinguished guests attending the International Conference on "NexGen Z Bio Resources: Frontiers for Sustainable World, organized by the Department of Sciences, Asansol Girls' College. In an era marked by rapid environmental transformations and unprecedented ecological challenges, the exploration of next-generation bio-resources is not merely an academic pursuit but a global necessity. Sustainable development demands innovative research, interdisciplinary collaboration, and a strong commitment to scientific excellence. This conference provides a vital platform for intellectual exchange, critical reflection, and constructive dialogue among academicians and researchers from diverse domains.

I am confident that the deliberations and scholarly interactions over these two days will generate meaningful insights, inspire young minds, and contribute significantly to building a sustainable and resilient future. Such academic endeavours strengthen our institutional commitment to knowledge creation and societal responsibility.

I congratulate the organizing committee and Prinipal for their dedicated efforts in hosting this important international forum and wish the conference grand success.

With best wishes,

Mghatak 17/02/26
(MOLOY GHATAK)

To
The Principal
Asansol Girls' College
Asansol Court Area, Asansol, PIN - 713304

Labour : **New Secretariat Buildings,** 12th Floor, 1, K. S. Roy Road, Kolkata - 700 001, Telephone : (033) 2262-7189, Fax : (033) 2262-7141, Mobile : 9475639806
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FNA, FASc, FNASc, FASCT
J. C. Bose National Fellow
Alexander von Humboldt Fellow
Former Director, Bose Institute (DST), Kolkata

Message

I am delighted to extend my warmest regards for the International Conference on **"NexGen Z Bio Resources : Frontiers for Sustainable World"** which is being organized by the **Department of Sciences** at **Asansol Girls' College** and scheduled for **February 26th & 27th, 2026.** This relevant project shows a strong commitment to scientific innovation, sustainability, and international collaboration. I am confident that the gathering would encourage researchers, academicians, and young scholars to exchange ideas and think about solutions for a sustainable future. I would like to sincerely thank the organizers on behalf of **Kazi Nazrul University** and wish them even greater success with the event.

Uday Bandyopadhyay

Professor (Dr.) Uday Bandyopadhyay
Vice Chancellor
Kazi Nazrul University

Date : **19th February, 2026**

: Academic & Administrative Campus :
PLOT NO.: 3172, ADMINISTRATIVE BUILDING, NAZRUL ROAD, KALLA MORE, P.O.: KALLA C.H.,
P.S.: ASANSOL (NORTH), DIST.: PASCHIM BARDHAMAN, ASANSOL - 713340, WEST BENGAL
Website : www.knu.ac.in Email : vc@knu.ac.in, ubandyo_1964@yahoo com & office.vc@knu.ac.in
Mobile : 9474003048

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Ref. No.....

Date.....20/02/2026.....

MESSAGE

It gives me immense pleasure to extend my warm greetings on the occasion of the International Conference on NexGen Z Bio Resources: Frontiers for Sustainable World. This conference reflects our collective commitment to scientific innovation, sustainability, and responsible stewardship of bio-resources for a better future.

As we celebrate this academic gathering, may it serve as a vibrant platform for meaningful dialogue, interdisciplinary collaboration, and transformative ideas that address global environmental and biotechnological challenges.

I am confident that the deliberations over these two days will inspire young minds, strengthen research networks, and contribute significantly toward building a sustainable and knowledge-driven world.

I extend my heartfelt thanks to all participating colleges, institutions, distinguished speakers, researchers, and students for their enthusiastic involvement and valuable contributions in making this conference a meaningful academic endeavour.

I wish the conference grand success.

S Chakraborty

Dr. Swati Chakraborty

Principal
Asansol Girls' College

Dr. Swati Chakraborty
PRINCIPAL
Asansol Girls' College
Dr. Anjali Roy Sarani, Asansol- 713304
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26th & 27th Februrary, 2026

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PROGRAM SCHEDULE

International Conference

"NexGen Z Bio-resources: Frontiers for a Sustainable World"

DAY-1 (26th February 2026)

INAUGRUAL SESSION

(Venue: Seminar Hall No. 1)

9:00 AM-10:00 AM	:	Registration
10:00 AM-10:10 AM	:	Watering of plants
10:10 AM-10:20 AM	:	Felicitating the Guests
10:20 AM-10:30 AM	:	Welcome Address by **Dr. Biru Rajak**, IQAC, Asansol Girls' College
10:30 AM-10:40 AM	:	About the Conference by **Dr. Supriya Ray**, Convener, International Conference
10.40 AM-11:50 AM	:	Inaugural Speech by **Dr. Swati Chakraborty**, *Principal*, Asansol Girls' College & Chairperson, International Conference
11.50 AM-12:00 PM	:	Special Address by **Shree Moloy Ghatak**, *Minister*, Department of Labour, Law and Judicial, Government of West Bengal
12:00 PM-12:10PM	:	Special Remark by **Prof. (Dr.) Uday Bandyopadhyay**, *Vice Chancellor*, Kazi Nazrul University
12:10 PM-12:20 PM	:	Conference remark by **Sri. Biswajit Bhattacharya**, *Sub-Divisional Officer*, Asansol
12:20 PM-12:30 PM	:	Vote of Thanks by **Dr. Anand Sharma**, *Organizing Secretary*, International Conference

TECHNICAL SESSION—I

Venue: Seminar Hall No. 1 (ONLINE)

12:10 PM-12:50 PM : **DR. ANJALI ROY MEMORIAL LECTURE**
by **Dr. Swati Neogi**, *Professor*, Department of Chemical Engineering, IIT Kharagpur, India

- **Title of the Lecture: "Development of a Hydrogen Storage and Distribution System using Advanced Composite technology Integrated with Sensors"**
- **Session Chair:** Dr. Chaitali Dutta, *Deputy Registrar*, Kazi Nazrul University

Venue: Seminar Hall No. 2

12:10 PM-12:50 PM : ORAL PRESENTATION **(OFFLINE)**

- **(OP1-OP4)**
- **Session Chair:** Dr. Manika Saha, *Associate Professor*, Asansol Girls' College

Venue: Seminar Hall No. 1 (ONLINE)

12:50 PM-1:30 PM : Keynote lecture by Dr. Bhaskar Roy, Hangzhou, Institute of Medicine, Chinese Academy of Sciences, China

- **Session Chair:** Prof. (Dr.) Asamanja Chattoraj, *Dean*, Faculty of Science, Kazi Nazrul University

Venue: Seminar Hall No. 2

12:50 PM-1:30 PM : ORAL PRESENTATION **(OFFLINE)**

- **(OP5, OP9-OP11)**
- **Session Chair:** Dr. Shrabani Barun, *Associate Professor*, Asansol Girls' College

1:30 PM-2:30 PM : LUNCH BREAK

Venue: Seminar Hall No. 1 (ONLINE)

2:30 PM-3:10 PM : Key Note lecture by Prof. Fred C. Dubee, Senior Advisor, International Affairs BGI Group, Finland

- **Title of the Lecture: "Open Sharing and Borderless Collaboration, Not Just Words, but..."**
- **Session Chair:** Dr. Pradhip Ghanty, *Assistant Professor*, Asansol Girls' College

Venue: Seminar Hall No. 2

2:30 PM-3:10 PM : ORAL PRESENTATION **(OFFLINE)**

- **(OP12-OP15)**
- **Session Chair:** Dr. Vivekananda Sahu, *Associate Professor*, Asansol Girls' College

Poster Presentation

3:10 PM-4:10 PM : SESSION **(PP1-PP18)**

TECHNICAL SESSION—II

Venue: Seminar Hall No. 2 (OFFLINE)

4:10 PM-4:50 PM : **SPECIAL LECTURE ON WETLAND BIODIVERSITY**

- Lecture by Dr. Surabhi Chaudhuri, *Professor*, Department of Biotechnology, NIT Durgapur, India
- **Title of Lecture: "Women, biodiversity and environmental biotechnology: guardians of a sustainable future"**
- **Session Chair:** Dr. Minakshi Chakraborty, *Associate Professor*, Asansol Girl's College

Venue: Seminar Hall No. 1 (ONLINE)

4:10 PM-4:50 PM : **PARALLEL SESSION — ORAL PRESENTATION**

- **(OP6, OP7, OP8, OP19)**
- **Session Chair:** Dr. Leena Bhowmik, *Associate Professor*, Asansol Girls' College

Venue: Seminar Hall No. 2 (OFFLINE)

4:50 PM-5:30 PM : **DR. JANAKI AMMAL MEMORIAL**

- Lecture by Dr. Rajat Pal, *Assistant Director-Biotechnology*, School of Life, Agricultural & Biotechnological Sciences, Sister Nivedita University, India
- **Title of Lecture: "Environmentally Sustainable Phytofabrication of Metal Nanoparticles as Antiglycation Agents for Managing Diabetic Complications"**
- **Session Chair:** Dr. Gautam Jana, *Assistant Professor*, Asansol Girls' College

Venue: Seminar Hall No. 1 (ONLINE)

4:50 PM-5:40 PM : **PARALLEL SESSION- ORAL PRESENTATION**

- **(OP20, OP24, OP28, OP30, OP33)**
- **Session Chair:** Dr. Soma Gorai, *Associate Professor*, Asansol Girls' College

Cultural Program by Asansol Girls' College

5:30 PM- 6:30 PM

DAY-2 (27th February 2026)

TECHNICAL SESSION—1

Venue: Seminar Hall No. 1 (ONLINE)

11:00 AM-11:40 AM : Key Note lecture by Mr. Premjeet Tarafdar, *Director*, ELECSYS LAB LIMITED, New Zealand

- **Title of the Lecture: "Demystifying Hydroponics and CEA: Why It Became "Premium Only"- and How to Scale It for Sustainable Food Security for India and the World"**
- **Session Chair:** Dr. Surojit Jana, *Associate Professor*, Asansol Girls' College

Venue: Seminar Hall No. 2 (OFFLINE)

11:00 AM-11.40 PM : ASHIMA CHATTERJEE MEMORIAL

- Lecture by Dr. Mousumi Poddar Sarkar, *Professor*, Department of Life Sciences, Presidency University, India
- **Session Chair:** Dr. Biru Rajak, *Assistant Professor*, Asansol Girls' College

Venue: Seminar Hall No. 1 (ONLINE)

11:40 PM- 12:20 PM : Keynote lecture by Dr. Millie Taylor, Environment Scientist, Christchurch, New Zealand

- **Title of the Lecture: "A Systems Approach to Environmental Impact and Food Security"**
- **Session Chair:** Dr. Sumana Mukherjee, *Associate Professor*, Asansol Girls' College

Venue: Seminar Hall No. 2 (OFFLINE)

11:40 PM- 12:20 PM : PARALLEL SESSION- ORAL PRESENTATION

- **(OP16-18, OP21)**
- Session Chair: Dr. Kakali Bondopadhyay, *Associate Professor*, Asansol Girls' College

Venue: Seminar Hall No. 1 (ONLINE)

12:20 PM- 1:00 PM : PARALLEL SESSION- ORAL PRESENTATION

- **Session Chair:** Dr. Chandan Bandopadhyay, *Associate Professor*, Asansol Girls' College

Venue: Seminar Hall No. 2 (OFFLINE)

12:20 PM- 1:00 PM : PARALLEL SESSION - ORAL PRESENTATION

- **(OP23, OP25-OP27)**
- Session Chair: Dr. Gautam Jana, *Assistant Professor*, Asansol Girls' College

Venue: Seminar Hall No. 1 (ONLINE)

11:00 AM-11:40 AM : PARALLEL SESSION - ORAL PRESENTATION

- **Session Chair:** Dr. Kakali Bondopadhyay, *Associate Professor*, Asansol Girls' College

Venue: Seminar Hall No. 2 (OFFLINE)

11:40 AM-12.20 PM : PARALLEL SESSION - ORAL PRESENTATION

- **(OP29, OP31, OP32, OP34)**
- **Session Chair:** Dr. Surobhi Gupta, *Associate Professor*, Asansol Girls' College

Venue: Seminar Hall No. 2 (OFFLINE)

11:40 AM-12.20 PM : PARALLEL SESSION- ORAL PRESENTATION

- **(OP35-OP36)**
- **Session Chair:** Dr. Tapas Roy, *Associate Professor*, Asansol Girls' College

1:00 PM-2:00 PM : LUNCH BREAK

TECHNICAL SESSION—2

Venue: Seminar Hall No. 1

2:00 PM-2:40 PM : DR. KAMALA SOHONIE MEMORIAL

- Lecture by Dr. Suparna Mandal Biswas, *Associate Professor*, Agricultural and Ecological Research Unit, Biological Science Division, Indian Statistical Institute, India
- **Title of the Lecture: "Squalene and its derivatives as potential anti-senescence phytotherapeutics: A modern approach for rejuvenation and healthy aging"**
- **Session Chair:** Dr. Chandan Bandopadhyay, *Associate Professor*, Asansol Girls' College

Poster Presentation

2:40 PM-3:30 PM : SESSION- POSTER PRESENTATION

- **(PP19-PP36)**

Venue: Seminar Hall No. 1 (ONLINE)

3:30 PM-4:10 PM : Keynote Lecture by Dr. Jackson de Souza, *Associate Professor*, Sao Paulo State University, Brazil

- **Title of the Lecture: "The Next Bio-resource Frontier: Soil Eco-genomics and Microbial Biotechnology for Sustainable Agriculture and Environmental Remediation"**
- **Session Chair:** Dr. Surovi Gupta, *Associate Professor*, Asansol Girls' College

4:10 PM-4:30 PM : REFRESHMENT COURT - HIGH TEA

Venue: Seminar Hall No. 1 (ONLINE)

4:30 PM-5:10 PM : Keynote lecture by Prof. (Dr.) Michael James Cardwell Crabbe, Consultant on Red Listing, International Union for the Conservation of Nature (IUCN)

- **Title of the Lecture: "How sustainable are coral reefs when 44% of coral species face extinction?"**
- **Session Chair:** Dr. Surojit Jana, *Associate Professor*, Asansol Girls' College

Valedictory Session

5:10 PM-5:20 PM : Prizes Distribution

5:20 PM-5:40 PM : Vote of Thanks by Dr. Anand Sharma, Organizing Secretary, International Conference

CONTENTS

Keynote Speaker and Memorial Lectures

(1) The Next Bio-Resource Frontier: Soil Eco-Genomics and Microbial Biotechnology for Sustainable Agriculture and Environmental Remediation

Jackson de Souza

Associate Professor, MicroBioGenes Research Group
Applied Microbiology and Genetics, Bioremediation – Bioinputs
São Paulo State University, Jaboticabal Campus – Department of Biology

Soil ecosystems represent one of the most complex and underexplored biological frontiers, playing a central role in agricultural productivity, nutrient cycling, and greenhouse gas (GHG) regulation. In this context, soil eco-genomics and microbial biotechnology emerge as strategic tools to advance sustainable agriculture and environmental remediation. This presentation integrates metagenomic, eco-genomic, and culture-based studies conducted across contrasting agricultural systems, with a focus on nitrogen cycling, plant growth-promoting rhizobacteria (PGPR), and the biotechnological valorization of agricultural residues.

Using large-scale metagenomic datasets from soil and agro-industrial residues, we nitrogen metabolic pathways were reconstructed with emphasis on nitrification, denitrification, and nitrogenated GHG emissions. Functional annotation revealed ecosystem-specific configurations of nitrogen metabolism, highlighting how agricultural management practices – particularly in sugarcane systems – can stimulate microbial pathways associated with nitrogen oxide production, while other environments favor nitrogen immobilization and assimilation.

Complementarily, eco-genomic analyses of garlic and sugarcane soils demonstrated that soil physicochemical properties and cultivation practices strongly shape microbial diversity, network complexity, and functional potential. Garlic-cultivated soils, richer in nutrients and clay content, supported higher microbial diversity and a greater abundance of genes related to phosphorus metabolism and plant growth promotion, with key taxa from Actinobacteriota and Pseudomonadota. These findings were coupled with bioprospecting efforts that identified efficient PGPR isolates capable of enhancing plant growth under greenhouse conditions.

Finally, targeted isolation and evaluation of nitrifying and denitrifying bacteria tolerant to raw vinasse revealed the strong potential of *Bacillus, Paenibacillus*, and *Brevibacillus* species as bioinoculants for sugarcane cultivation. These strains combined physiological robustness, growth promotion under greenhouse and field conditions, and compatibility with agro-industrial byproducts, reinforcing circular bioeconomy strategies.

Together, these studies illustrate how integrative soil eco-genomics, allied with microbial biotechnology, can inform climate-smart agriculture, optimize nutrient use efficiency, mitigate environmental impacts, and drive the next frontier of sustainable bio-resources.

Keywords: Nitrogenated GHG emissions, Bioprospecting, Garlic-cultivated soils, Immobilization

(2) A Systems Approach to Environmental Impact and Food Security

Millie Taylor

Environmental Scientist, Millie Taylor Sustainability, Christchurch, New Zealand

Agriculture is operating in an increasingly complex environment, shaped by climate change, evolving policy frameworks, and growing societal expectations. In this context, farmers must move beyond reactive compliance and become future-focused, adaptive decision-makers, balancing food production, environmental integrity, and economic resilience.

This presentation explores a systems-based, data-driven approach to sustainable agriculture, drawing on applied environmental science and spatial analysis (GIS) to translate complex environmental data into practical, place-based decisions. Using examples from New Zealand, it highlights how interventions such as strategic wetland placement, land-use optimisation, and biodiversity enhancement can align environmental outcomes with farm profitability.

Rather than promoting singular solutions, the talk acknowledges the trade-offs and nuances inherent in land-use decisions. It argues that empowering farmers with actionable data and transparent communication can bridge the gap between science, policy, and practice. By positioning farmers as proactive leaders in environmental stewardship, this pathway offers a constructive model for navigating environmental, political, and social change in modern food systems.

Keywords: Agriculture, Daptive decision-makers, Balancing food production, Environmental integrity

(3) How Sustainable are Coral Reefs when 44% of Coral Species Face Extinction?

Michael James and Cardwell Crabbe

Wolfson College, Oxford University

Before the 1980s, mass coral bleaching and mortality events due to heat stress were rare. In the last four decades, these events have become increasingly frequent and severe.

Analysis of 15,066 reef surveys during 2014-2017 revealed that 80% of surveyed reefs experienced significant coral bleaching and 35% experienced significant coral mortality.

Our observations demonstrate that global warming's widespread damage to coral reefs is accelerating and underscores the threat anthropogenic climate change poses for the irreversible transformation of these essential ecosystems.

The climate crisis has brought humans to a crossroads of survival and development, and it is urgent to break the deadlock. The concept of "carbon equality" starts from the balance of rights and responsibilities and directly targets the crux of carbon emissions. The whole process requires consumption-driven, international cooperation, and public participation.

It is hoped that the whole world will work together and persevere in implementing the carbon equality strategy to solve the climate crisis, protect the ecological environment of the Earth, and determine the future fate of mankind.

Keywords: Consumption-driven, International cooperation, Public participation, Mass coral bleaching

(4) Demystifying Hydroponics and CEA: Why It Became "Premium Only" - and How to Scale It for Sustainable Food Security for India and the World

Premjeet Tarafdar

ELECSYS LAB LIMITED, New Zealand

Fresh water is running out. Arable land is shrinking. Climate volatility is turning "normal seasons" into a gamble. In this context, Controlled Environment Agriculture (CEA) and hydroponics can become a practical resilience tool for food and water security. Yet across the world (and especially in India), CEA repeatedly gets trapped in "premium-only" economics—serving high-margin crops and niche markets instead of mainstream nutrition.

This lecture unpacks the real reasons behind that gap. The biggest impediments are not hype or intent—they are physics, engineering, and economics: the energy burden of cooling and dehumidification, high capex per square metre, reliability demands, skills and maintenance overhead, input-quality dependence, and the risk profile of tightly controlled systems where small failures can cascade into crop loss. We then examine how to lower these barriers so CEA can shift from niche deployment to broader impact. Importantly, CEA is not presented as a universal replacement for field agriculture (yet!), but as a targeted solution where water, climate, and supply-chain constraints are binding.

Using a practical science-and-systems lens (psychrometrics, heat/mass transfer, water/nutrient balance, and unit economics), the talk presents transition pathways: protected cultivation → low-cost full/partially recirculating hydroponics → semi-controlled microclimate zones → full CEA only where the numbers justify it. We cover circular bio-resource strategies—nutrient recirculation and recovery, safer water reuse, bio-based substrates (cocopeat/bio fibre-mat), and renewable/thermal-storage-linked climate control—along with modular automation and local manufacturing to reduce cost and complexity.

Attendees will leave with a grounded deployment playbook and decision metrics (₹/kg, kWh/kg, L/kg, yield stability, food safety).

Keywords: Controlled Environment Agriculture, Psychrometrics, Dehumidification, Supply-chain

(5) Environmentally Sustainable Phytofabrication of Metal Nanoparticles as Antiglycation Agents for Managing Diabetic Complications

Rajat Pal

Department of Microbiology, Sister Nivedita University, Kolkata, India

Chronic hyperglycemia promotes non-enzymatic glycation of proteins and accumulation of advanced glycation end-products (AGEs), which drive vascular and tissue complications in diabetes. This study evaluated the antiglycation potential of green-synthesized copper (Cu), silver (Ag), and iron oxide (Fe□O□) nanoparticles (NPs) prepared using leaf extracts of *Hibiscus rosa-sinensis*, *Costusigneus*, *Dracaena trifasciata,* and*Spathiphyllumcochlearispathum*. Metal salts were reduced by aqueous or DMSO plant extracts, and the resulting NPs were characterized by UV–

Vis spectroscopy, FTIR, dynamic light scattering (DLS), SEM, zeta potential, and EDX to confirm formation and size distribution. DLS analysis showed AgNPs from *H. rosa-sinensis* with an average diameter of 84.6 nm (PDI 0.772, zeta potential −13.6 mV), CuNPs from *D. trifasciata*and *C. igneus* of 403.9 nm (PDI 0.304) and 177.9 nm (PDI 0.429), respectively, and Fe□O□ NPs from *S. cochlearispathum* with broad aggregates around 709 nm. The particles have also been characterized by several spectroscopic and microscopic studies as well. *In vitro* antiglycation activity was assessed by incubating isolated hemoglobin with glucose in the presence of NPs or corresponding crude extracts and monitoring AGE formation. CuNPs derived from *C. igneus* and *D. trifasciata* produced the highest inhibition of glycation (77.95% and 75.76%), followed by AgNPs (72.58%), markedly surpassing the modest inhibition achieved by the crude plant extracts (37.1–61.6%). These findings indicate that plant-mediated, green-synthesized metal NPs—particularly Cu-based formulations—effectively suppress protein glycation, likely through radical-scavenging and AGE-pathway blocking mechanisms, and highlight their promise as eco-friendly nanotherapeutic candidates for managing diabetic glycation and its complications.

Keywords: Chronic hyperglycemia, Plant-mediated, Green-synthesized metal, Nanotherapeutic

(6) Squalene and Its Derivatives as Potential Anti-senescence Phytotherapeutics: A Modern Approach for Rejuvenation and Healthy Aging

Suparna Mandal Biswas

Agricultural and Ecological Research Unit, Indian Statistical Institute, Kolkata

Cellular senescence is a critical hallmark of aging that contributes to tissue dysfunction, chronic inflammation, and the progression of age-associated disorders. Targeting senescence through bioactive natural compounds has emerged as a modern strategy for rejuvenation and healthy aging. In this context, squalene and its derivatives have gained increasing attention due to their antioxidant, cytoprotective, and membrane-stabilizing properties. The present study explores a novel squalene derivative isolated from *Cocos nucifera* (coconut) leaves—an underutilized plant resource enriched with valuable phytoconstituents—and evaluates its anti-senescence potential.

Spectral characterization of the purified pentane fraction of *Cocos nucifera* leaves confirmed the presence of 4,4'-Diapophytofluene ($C_{30}H_{46}$), a more unsaturated structural analog of squalene, herein referred to as coconut squalene analog (CSQa). Comparative cytotoxicity analysis revealed that pure squalene standard (PSQ) exhibited cytotoxic effects beyond 8 µM, whereas CSQa showed no cytotoxicity up to 16 µM, indicating superior biocompatibility. In senescence-induced WI38 fibroblasts, CSQa significantly enhanced cell viability (164.5% at 24 h, 159.4% at 48 h, and 148% at 72 h) compared to PSQ and bio-source squalene (BSQ). Similar protective effects were observed in HaCaT keratinocytes.

Senescence-associated β-galactosidase (SA-β-gal) staining demonstrated a marked reduction in β-gal-positive cells following CSQa treatment relative to PSQ and BSQ, confirming its senomorphic activity. Oxidative stress induction using olaparib elevated intracellular reactive oxygen species (ROS) levels to 60% in WI38 cells. Subsequent treatment with PSQ, BSQ, and CSQa for 48 h reduced ROS levels to 39.3%, 45.6%, and 19.3%, respectively, highlighting the superior antioxidant and ROS-scavenging capacity of CSQa.

Molecular docking analyses further revealed strong and stable interactions of 4,4'-Diapophytofluene with key senescence-associated regulatory proteins, including SIRT1, Bcl-XL, Mcl-1, Hsp90, Mdm2, and mTOR, surpassing interactions reported for several established anti-aging phytotherapeutics.

Collectively, these findings position 4,4'-Diapophytofluene as a potent squalene-derived senotherapeutic candidate with enhanced safety, antioxidant efficacy, and molecular targeting capacity. This study underscores the translational potential of squalene derivatives as modern bioactive interventions for rejuvenation strategies, pharmaceutical development, and dermatological applications aimed at promoting healthy aging.

Keywords: Squalene; 4,4'-Diapophytofluene (4,4'-DPE); Cellular senescence; Cytotoxicity, Reactive oxygen species (ROS); Senotherapeutic agent, Molecular docking analysis.

(7) Development of a Hydrogen Storage and Distribution System using Advanced Composite technology Integrated with Sensors

Swati Neogi

Professor, Department of Chemical Engineering, Indian Institute of Technology Kharagpur, India

To combat global warming and achieve net zero, Prime Minister of India announced National Hydrogen Energy Mission (NHEM). NHEM cannot be successful without the proper storage and distribution system of hydrogen energy which are important components of energy square, namely production of green hydrogen, storage, distribution and utilization. Currently, the team of Composite Applications Lab (CAL) is working under supervision of Dr. Swati Neogi to develop a composite storage and /or distribution system which will not be embrittled by hydrogen, will be able to withstand working pressure up to 100 MPa and burst pressure up to 240 MPa, will be light weight so that the weight performance requirement set by Department of Transport (DOT) can be achieved. The team also developing a suitable sensor which can be integrated with the composite hydrogen storage structure. This will alert the user about the leakage and/or rupture before a catastrophic accident can happen.

Keywords: Department of Transport (DOT), Composite Applications Lab (CAL), Hydrogen Energy Mission (NHEM), Hydrogen, Composite hydrogen storage

(8) Women, Biodiversity, and Environmental Biotechnology: Guardians of a Sustainable Future

Surabhi Chaudhuri

Department of Biotechnology, National Institute of Technology Durgapur, Durgapur, West Bengal, India

As the cornerstone of a sustainable future, this study examines the crucial nexus among environmental biotechnology, women's leadership, and biodiversity protection. It describes biodiversity as a fabric of life that is currently in danger due to human-caused crises, including industrial pollution, habitat fragmentation, and climate change. The study emphasizes environmental biotechnology, nature's own toolset, which uses biological processes like carbon capture and bioremediation (including in-situ, ex-situ, and phytoremediation) to mitigate waste and restore ecosystems. The acknowledgement of women as the primary caregivers and as the link between traditional ecological knowledge

and contemporary scientific leadership is at the heart of this approach. The report highlights notable rights and representation gaps, such as systemic bias in STEM sectors and inequities in land rights, despite their crucial importance. The document presents a strategic roadmap for a "Green Bio-Revolution" driven by "Nari Shakti" (Women's Power), aligned with India's Viksit Bharat 2047 vision. This strategy combines grassroots projects such as Biotech-KISAN and the GOBARdhan circular economy model with high-tech advances such as artificial intelligence and nanoremediation. In the end, the source imagines a tech-feminist future in which the intersection of equality, ecology, and innovation propels a bioeconomy expected to reach $300 billion by 2030, guaranteeing a path for the planet that is both inclusive and climate-resilient.

Keywords: Environmental biotechnology, Green Bio-Revolution, Nanoremediation, Ecological knowledge

Oral Presentations

OP1. Use of Foot Cells and Cells of Digestive Organs of Freshwater Molluscs as Reliable Tools for Assessing Water Pollution

Srikanta Guria*, Sakim Biswas, Sayani Kar and Debnath Palit

Post Graduate Department of Zoology, Krishnagar Government College, Krishnagar, West Bengal, India

***Presenting Author:** guriasrikanta@gmail.com

Here the value of using biomarker approaches in gastropod models has been discussed. Invertebrate cells are important tool for assessing water pollution. Most of the time, the effects of contaminants on cellular mortality can be used as an easier tool for studying environmental health. Freshwater molluscs Pila sp. were manually collected from selected aquatic bodies (sampling sites A and B) of Nadia district of West Bengal. Tissues of foot and digestive organs were removed and mashed in presence of trypsin- EDTA. Cell suspension on glass slides was stained by giemsa and neutral red. Results showed cells from foot and digestive organs in molluscs collected from the sites associated with human habitats, human effluents and agricultural fields (sites B) were necrotic showing vacuolization of cells, lysosomal damages and rupture of cell membrane when compared to sites A which were not associated with human habitats, human effluents and agricultural fields. Mean number of digestive cells showing membrane rupture in sites B was significantly increased when compared to sites A (two tailed P value was 0.0041). Deteriorative changes of tissues during histological analysis like disintegration of cellular boundaries, presence of cellular debris in the luminal space and disappearance of cellular integrity were noted in the samples of sites B. The major part of digestive tubules was damaged beyond any possibility of recovery. These degenerative changes may result in the impairment of physico-metabolic processes of molluscs. Collection sites B associated with human effluents and agricultural fields may alter the environment of aquatic bodies and induce morphological and behavioral changes of cells of gastropods. Studies on the behavioral changes of cells of snail to pollutants in environment could open a new window for environmental monitoring researches.

Keywords: Agricultural fields, Gastropod models, Disappearance, Morphological, Invertebrate cells

OP2. Advancements and Consequences of Artificial Photosynthesis

M. Chakraborty* and S. Sen

Department of Physics, Asansol Girls' College, Asansol, India

Department of Physics, Triveni Devi Bhalotia College, Raniganj, India

***Presenting Author:** bminakshi@yahoo.com

Artificial photosynthesis is one of the latest emerging interdisciplinary studies which attempt to imitate the natural reaction process of photosynthesis to transform sunlight, water, and carbon dioxide into chemical fuels – such as hydrogen or hydrocarbons. By harnessing the efficiency of sunlight and the capacity of photosynthesis for such reactions as water splitting and carbon dioxide reduction, artificial photosynthesis provides a promising road map into sustainable energy development and carbon neutrality for the future. In this paper, we analyze basic principles of artificial photosynthesis, fundamental material structures used for light harvesting and catalysis, recent technological advancements, and the significant challenges to be overcome in the light harvesting systems for large-scale use. The possibility of artificial photosynthesis in the future development of renewable energy systems is further considered.

Keywords: Artificial photosynthesis, Water splitting, CO_2 reduction, Renewable energy

OP3. Maximum Entropy Principle and Its Application to Biological Systems

Kakali Bandyopadhyay

Department of Physics, Asansol Girls' College, Asansol, West Bengal, India

Presenting Author: kbagca14@gmail.com

The maximum entropy principle (MEP) is a statistical inference tool that has originated from information theory. MEP provides a framework to get the least-biased probability distribution about a system when relevant information is insufficient. In most physical situations, we usually have limited data about a system, and any rational discourse must make use of this knowledge. There is thus a need for a method of assigning probabilities without overlooking any available information. MEP was developed by Jaynes (1957) to get the best probability distribution for a system with the largest possible Shannon entropy consistent with known constraints. Shannon entropy gives a quantitative measure of lack of information about a system. The guiding philosophy is to make optimum use of the accessible data, avoiding any unwarranted assumption about the missing information. MEP has wide range of applications in Statistical Physics, Engineering, Economics, Social Science, Biology and Ecology. Biological systems are, in general, complex, and known constraints there, are generally averages and not the microscopic details. Therefore, MEP methodology becomes a useful tool for making statistical inference for various systems in biology. This review focusses on the basics of MEP methodology for obtaining the most unbiased probability distribution with partial knowledge about the system. The application of MEP methodology for assessing the impacts of climate change on some medicinal and economically important plants has been discussed. Finally, a method for the prediction of the abundance and distribution of biological species has been proposed.

Keywords: Maximum entropy principle, Engineering, Economics, Social Science, Biology and Ecology

OP4. Philosophical Underpinnings of Science: Historical Evolution and Contemporary Relevance

Tapas Roy

Department of Philosophy, Asansol Girls' College

Presenting Author: tapas.agc@gmail.com

The connection between philosophy and science has been a driving force in progress for a long time. It determines how we conduct research, what we consider knowledge, and the ethical principles that govern scientific research. This paper examines the role of philosophy in influencing science from ancient times to the present day. It contends that philosophy is more than just providing the fundamental assumptions for science; it also catalyses major shifts in thinking and solves difficult conceptual puzzles. Drawing on ancient Greek thinkers, such as Aristotle's teleological views, which influenced early natural thinking, the paper traces the development of ideas through the Enlightenment period. It was here that Descartes' rationalism and Locke's and Hume's views on experience provided the foundation for the scientific method.

The essay examines 20th-century concepts such as Karl Popper's notion of scientific growth through the rejection of false theories and Thomas Kuhn's concept of paradigm shifts, which transform our understanding of scientific revolutions. It also examines contemporary connections, such as the role of ontology (the study of existence)

within quantum mechanics. Various interpretations, such as the Copenhagen and many-worlds theories, illustrate contemporary debates about realism and determinism. It also examines the ethics of bioethics in genetic engineering, drawing on Kantian notions of moral obligation and utilitarian principles. Through historical and analytical means, the essay employs case studies from physics, biology, and cognitive science to illustrate how philosophical concepts have refined scientific theories. For instance, Einstein's theory of relativity was influenced by Mach's positivist scepticism about the existence of absolute space. Conversely, Darwin's evolutionary theory was challenged by questions of purpose beyond the physical realm. The essay concludes that neglecting philosophical concepts can lead to dogmatic thinking within scientific communities, as illustrated by contemporary disputes over the testability of string theory. Ultimately, it argues that interdisciplinary dialogue between philosophers and scientists can facilitate scientific progress, particularly in rapidly evolving fields such as AI and climate modelling, where questions of causality, evidence, and value judgment remain pertinent.

In conclusion, philosophy assists in the development of science, not only in its history but also in shaping how reliable and extensive science can be. Science, when it employs sound philosophical thinking, can better address uncertainties and moral issues.

Keywords: Philosophy of Science, Epistemology, Scientific Method, Paradigm Shifts, Ethical Frameworks, Interdisciplinary Dialogue

OP5. Role of Gen Z in the Sustainability of Small Indigenous Aquatic Organisms

Supriya Ray

Department of Zoology, Asansol Girls' College, Asansol, West Bengal, India

Presenting Author: ray.supriya@gmail.com

Small Indigenous Aquatic Organisms (SIAOs), including native fish species, molluscs, crustaceans, plankton, and amphibians, form the backbone of India's freshwater and coastal ecosystems. These organisms play a crucial role in maintaining ecological balance, supporting food webs, ensuring water quality, and sustaining the livelihoods of local fishing communities. However, rapid urbanization, water pollution, climate change, invasive species, and unsustainable fishing practices have led to a significant decline in indigenous aquatic biodiversity across India. In this context, Generation Z emerges as a key stakeholder in promoting sustainability and conservation.

Gen Z, characterized by digital connectivity, environmental awareness, and social activism, has the potential to drive positive change at both grassroots and national levels. Through social media and digital platforms, Gen Z can raise awareness about endangered indigenous species and advocate for the protection of rivers, wetlands, and coastal habitats. Furthermore, Gen Z's involvement in climate action initiatives contributes to mitigating the adverse effects of climate change on aquatic biodiversity.

In India, Gen Z can also support sustainable fisheries by promoting responsible consumption and strengthening traditional conservation practices followed by indigenous communities. Engagement in citizen science, environmental education, and policy advocacy enables youth to influence conservation strategies and governance. Overall, Gen Z plays a transformative role in ensuring the sustainability of small indigenous aquatic organisms in India, thereby safeguarding biodiversity, food security, and ecological resilience for future generations.

Keywords: Small Indigenous Aquatic Organisms, Gen Z, Environmental education, Policy advocacy

OP6. Litter Production and Decomposition Dynamics of Selected Tree Species in a Forest Area of Bardhaman, West Bengal

Chittaranjan Das

Department of Botany, Kulti College, Kulti, Paschim Bardhaman, West Bengal, India

Presenting Author: crdcmsbdn@gmail.com

Litterfall and decomposition are key processes that recycle nutrients in forest soils. The aims of the present study investigated litterfall, decomposition, and nutrient dynamics across tree species. A field study was conducted to examine patterns of leaf litter production, degradation, and nutrient release in selected deciduous tree species (Tectona grandis, Shorearobusta, S. oleosa, Albizia lebbeck) in a forest area of Bardhaman, West Bengal. The study used standard litter-trap and litter-bag methods to measure litter production and decay rates over two years. Standard procedures were used to analyze the chemistry of leaf litter samples. Results showed that annual leaf litter production varied seasonally among the species, ranging from 8.52 to 12.45 Mg ha-1 yr−1 and being highest for S. robusta. In contrast, T. grandis exhibited the highest mass loss, while S. robusta exhibited the lowest during decomposition. The annual decay constant (k) was decreased in the order: T. grandis > S. oleosa> A. lebbeck> S. robusta. Moreover, mass loss and initial litter quality were positively correlated with nitrogen and phosphorus, and negatively correlated with lignin, lignin/nitrogen, and carbon/nitrogen ratios. The movement of nutrients during decomposition followed this order: Potassium > Nitrogen > Phosphorus. Among the studied macronutrients, potassium was released very rapidly from all species. Furthermore, T. grandis decomposed the fastest and released more nutrients than the other species. The study's insights into leaf litter chemistry are essential for understanding the overall dynamics of litter breakdown in forest systems.

Keywords: Decomposition, Macronutrients, Nitrogen, Phosphorus

OP7. Recent Trends and Relevance of Sport Fisheries in Psychosocial Development of Fisherman in Northern West Bengal, India

Dr. Mainak Banerjee[1]* and Dr. Arghya Mandal[2]

[1] Department of Zoology, RKDF University, Ranchi, Jharkhand, India

[2] Department of Environmental Studies, Mankar College, Mankar, West Bengal, India

***Presenting Author:** mainak.bio@gmail.com

Recreational fishing is one of the most common methods for people to engage with aquatic life and ecosystems. It is a fantastic way to relax and have fun, and even health care specialists recommend it for this reason. Sport fishing, sometimes referred to as recreational fishing, is done only for enjoyment as opposed to fishing for food or money. Fishing is mentioned in ancient Greek, Assyrian, Roman, and Jewish sources, demonstrating its antiquity. In the entire world, sport fishing is one of the most daring pastimes. Most industrialized and developing nations have access to cutting-edge fishing equipment and methods. Because sport fishing activities are region- and species-specific, there is a significant information and scientific knowledge gap concerning sport fish in developing nations like India. Even though just a few states in India adhere to government norms and regulations, there is a dearth of knowledge on recreational fishing practices that might help protect fish species that are now in risk of extinction. Additionally, through generating cash and promoting ecotourism, the activity will aid in reducing the unemployment

crisis. For the management and sustainable growth of India's sport fishing industry, government intervention is also essential. The lack of standard, sound regulatory measures for the holistic management of recreational fishing has been caused by a significant gap in scientific knowledge and cooperation between the government and recreational fishers. This gap must be closed as soon as possible. Rural residents of such well-known fishing places must participate significantly for India's recreational fishing business to remain viable. Two strategies that might actively support critical scientific inquiry in recreational fishing are citizen science initiatives and fisheries management. The significance of recreational fisheries, significant sport fish, and recreational fishing locations is discussed in this article along with the main threats to sport fishing and potential solutions to the issue at hand.

Keywords: Ecosystems, Unemployment, Ecotourism, Demonstrating, Sport fishing, Recreational fishing

OP8. Traditional Ecological Knowledge and Biodiversity Conservation in Mahasweta Devi's Aranyer Adhikar

Shampa Mondal

Department of English, Asansol Girls' College, Asansol, Paschim Bardhaman, West Bengal, India

Presenting Author: shampa.agc@gmail.com

This paper explores Aranyer Adhikar (1977) by Mahasweta Devi through the lens of Traditional Ecological Knowledge, focusing on its relevance to biodiversity conservation. These traditional knowledge systems support the conservation of forest biodiversity and maintain balance between human and non-human life. Colonial forest policies, as depicted in the novel, disrupt these practices, leading to ecological degradation and loss of biodiversity.

The study argues that the Munda community's relationship with the forest in Aranyer Adhikar reflects a holistic ecological worldview grounded in interdependence, ethical restraint, and sustainable interaction with nature. Through close textual analysis, the paper demonstrates how colonial forest policies and exploitative land practices disrupt these indigenous systems of knowledge, resulting in both cultural dislocation and the erosion of forest biodiversity. Through a close reading of the text, the study reinterprets Birsa Munda's resistance as not only a political struggle but also an ecological response to environmental exploitation. The paper highlights Aranyer Adhikar as an important literary text that foregrounds indigenous ecological knowledge and environmental responsibility.

Keywords: Munda community's relationship, Environmental exploitation, Traditional Ecological Knowledge

OP9. 'Ecopoiesis' as a Roadmap to Ecological Civilization

Dr. Arpita Chakrabarti

Department of English, Asansol Girls' College

Presenting Author: arpitachakrabarti@agc.ac.in

The word sustainability has various approaches and dimensions. But in order to create a sustainable civilization, it is vital that a change be brought about in the way people live and the society is organized. For ecological sustainability, there are more to it than just 'technological' aspects. A worldview that points towards ecological civilization provides a basis for rethinking ethics and politics at multiple levels. Drawing upon Alexander Kopytin and Arran Gare, the

concept of 'ecopoiesis' or 'home making' has the potential that involves functioning in such a way that augments the life of all broader communities, including the whole of humanity and the global eco-system of which each community is a part. The paper argues that through a conscious practice of the ecopoietic vision, it is possible to establish the notion of eco-humanity and attempt a revision of human relations with the environment, affirming the principles of equal communication, partnership and co-creation.

Keywords: Broader communities, Ecopoietic vision, Ecopoiesis, Sustainable civilization

OP10. Efficacy of Coriandrum sativum L. essential Oil as Food Preservative against Food Borne Fungi and Aflatoxin B1 Contamination

Akash Kedia

Department of Botany, Government General Degree College Mangalkote,
P.O. Majhigram, PurbaBardhaman, West Bengal, India

Presenting Author: akashkedia28@gmail.com

The study reports efficacy of Coriandrum sativum L. essential oil (EO) extracted from the dry fruits as antimicrobial against food borne fungi and aflatoxin B1 contamination on stored food grains. The minimum inhibitory concentration (MIC) and minimum aflatoxin B1 inhibitory concentration (MAIC) of EO were recorded to be 3.0 and 2.5 µl/ml respectively against Aspergillus flavus LHP(W)-B5, a toxigenic strain isolated from chickpea seed mycoflora analysis. The EO also showed toxicity against 19 food spoiling fungi in vitro at its MIC. Microscopic observations at sub lethal (1.5 µl/ml) and lethal concentrations (3.0 µl/ml) of EO using Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) revealed its mode of action on plasma membrane. To confirm the mode of action of EO on plasma membrane, the ergosterol content in the plasma membrane and leakages of Ca+2, K+ and Mg+2 ions from EO treated cells of A. flavus LHP(W)-B5 was also determined. The EO completely inhibited the production of aflatoxin B1 in vivo at a concentration of 3.0 µl/ml in chickpea grains as analyzed through HPLC without affecting the viability. EO thus has the possibility to provide complete protection of food commodities against quantitative and qualitative losses during post harvest storage based on efficacy as inhibitor to fungal growth, aflatoxin secretion and efficacy in food system.

Keywords: Microscopic observations, Scanning Electron Microscopy, Transmission Electron Microscopy

OP11. Effect of Fermentation Technique on the Antinutritional Factors Reduction of Cowpea Seeds

Anand Sharma

Department of Botany, Asansol Girls' College

Presenting Author: anandagc2023@gmail.com

The nutritional significance of cowpeas (Vigna unguiculata L. Walp), a food legume, has long been acknowledged as an affordable source of proteins, carbohydrates, minerals, and vitamins. Cowpeas are grown and valued throughout

Sub-Saharan Africa, certain parts of Asia, and the Americas, and they are used in a variety of cuisines, prepared and consumed as side dishes and snacks. However, because of the existence of antinutritional constituents, the use of cowpea nutrition falls short of its full potential. Cowpea contains many antinutritional agents such as tannins, phytic acid, protease inhibitors, lectins, saponins, oligosaccharides, and biogenic amines. Since raw legumes have significantly higher quantities of these elements than processed counterparts, processing is essential before introducing raw grains into human or animal diets. Fermentation is one of the most effective strategies for reducing them before they are consumed as food. The current study aims to evaluate the efficiency of traditional and controlled fermentation in lowering antinutritional factors in cowpea, in order to improve nutrient availability, nutrient quality, and product acceptance. Study further highlights the potential of cowpea to aid low-income communities in developing countries by improving nutritional value and overall health.

Keywords: Cowpeas, Antinutritional constituents, Protease inhibitors, Lectins, Saponins, Oligosaccharides

OP12. Exploring The Effect of Purothionin on Membrane Mimics in the Light of Molecular Docking

Lopamudra Das

Department of Zoology, Kulti College

Presenting Author: lopamudradas100@gmail.com

Plants do not possess a well-formed immunity systems like higher vertebrates. However, to protect themselves from various bacterial, fungal, viral or other kind of microorganism attack, they produce some special kind of peptides which help them to fight against these microorganisms and survive and these are called ‘anti-microbial Peptides’ or AMP. There are several kinds of AMPs discovered in plants and categorized under different groups and families according to their structural and functional specifications. Thionin, being the largest family in this category possess several kinds of AMPs, among which Purothionin marks itself as a significant AMP for exhibiting antimicrobial toxicity. According to studies, Purothionin is a low molecular weight, highly basic and positively charged peptide, which interacts with the microbial membrane and kills it by demolishing the negative charge of the membrane and further destroying the membrane integrity. In our study, we tried to explore the molecular details of the interaction of Purothionin with three different membrane mimics, ie., POPS (negatively charged), POPC (charge neutral) and SDS micelle (negatively charged) by incorporating molecular docking. The study unwraps how different amino acids and sequences of Purothionin attach and interact with different parts of the membrane mimics exerting different outcomes. As, AMPs might play a key role to replace conventional antimicrobials to fight back ‘antimicrobial resistance’, our study tries to focus on the molecular detailing of the effect of the peptide on different membrane mimics.

Keywords: Purothionin marks, Antimicrobials, Antimicrobial resistance, Charge neutral, Negatively charged

OP13. Ultracold Atoms for Precision Sensing: Applications in Medicine, Ecology, and Bioresource Management

Budhaditya Chatterjee

Department of Physics, Asansol Girls' College

Presenting Author: budhaditya@agc.ac.in

The maturation of ultracold atom technologies has enabled a transition from laboratory platforms to deployable precision sensing systems with applications in medicine, ecology, and bioresource management. Operating in the quantum degenerate regime, atomic ensembles exhibit exceptional sensitivity to electromagnetic, gravitational, and inertial perturbations, enabling detection capabilities that surpass conventional sensors in key regimes. This work outlines a unified quantum sensing framework linking human health, environmental monitoring, and sustainable resource stewardship.

In medical diagnostics, atom-interferometric sensors and optically pumped magnetometers enable femto-tesla-scale detection of neural and cardiac biomagnetic activity, supporting non-invasive functional imaging without cryogenic infrastructure. Rydberg atom-based electrometry further provides ultra-sensitive spectroscopic detection of trace biomarkers and volatile organic compounds for early disease diagnostics and metabolic monitoring.

Beyond clinical applications, quantum sensors link environmental quality to public health by quantifying factors that directly impact human wellbeing. Cold-atom gravimeters facilitate non-destructive mapping of subsurface water, soil carbon, and biomass distribution, while precision spectroscopy enables sensitive detection of greenhouse gases, airborne pathogens, and environmental pollutants. Advances in miniaturized vacuum systems and integrated photonics are accelerating the development of portable, field-deployable instruments.

The convergence of ultracold atom quantum metrology with life and environmental sciences provides a high-resolution sensing infrastructure for precision medicine, ecosystem assessment, and resilient bioresource management in a changing climate.

Keywords: Magnetometers, Environmental sciences, Cold-atom, Airborne pathogens, Biomass distribution

OP14. Urbanization and Loss of Native Flora and Fauna: A Case Study of Kolkata, West Bengal, India

Ananda Let

Department of Geography, Asansol Girls' College, Asansol

Presenting Author: anandalet2@gmail.com

Urbanization denotes the general demographic processes by which cities are expanding. By the process of urbanization reshaping of landscape, socio-economic system, ecological network etc. are happening. Rapid growth of urban population accentuates the demand for natural resources which affects the local flora and fauna. Now-a-

days Kolkata facing loss of such type of native flora and fauna. Day by day increasing population threats the native ecosystem and biodiversity which destroy the native flora and fauna. Rapid growth of economy, cultural exchange, unplanned urbanization etc. lead to habitat destruction, biodiversity loss and ecological imbalance. This paper explores the interlinked challenges of urbanization and the consequent decline of native flora and fauna in Kolkata. With the help of lots of secondary data, field survey and Geographic Information System(GIS) I identify the key divers of biodiversity loss including land use change, pollution, invasive species and infrastructural development. The result focusses on significant reduction of urban green spaces, wetlands and biodiversity habitats which ultimately losses flora and fauna in Kolkata. In this situation some policies like proper urban planning, Government policies, biodiversity conservation policies and community engagement are needed to solve the problems.

Keywords: Geographic Information System(GIS), Pollution, Infrastructural development, Government policies

OP15. Conformational Adaptations of the Intrinsically Disordered Protein Alpha-Synuclein under Membrane-Mimicking Conditions

Animesh Mondal[1]* and Sandip Dolui[2]

[1] Dept. Of Zoology, Government General Degree College-Mangalkote, PurbaBardhaman, West Bengal

[2] Eminent College of Pharmaceutical Technology, Barasat, West Bengal

***Presenting Author:** animeshpresiz@gmail.com

Misfolding and aggregation of Alpha-Synuclein (αS) into Lewy bodies are central events in the pathogenesis of Parkinson's disease (PD). αS is an intrinsically disordered protein that lacks a stable tertiary structure and displays remarkable conformational plasticity, enabling it to interact with diverse biomolecular and environmental factors. Understanding how αS responds structurally to different conditions is crucial for elucidating its aggregation mechanism. In the present study, the influence of short-chain alcohols, particularly methanol, on the conformational dynamics of αS was investigated. Molecular dynamics simulations revealed that native αS in an aqueous environment exhibited an RMSD increase up to 4 nm around 50 ns, stabilizing near 3.8 nm. In contrast, lower methanol concentrations maintained relatively low RMSD values, rising to about 3.2 nm after 30 ns, indicative of partial destabilization, while higher alcohol concentrations caused sustained RMSD elevation, suggesting significant structural instability. The RMSF value at low methanol concentration was measured at 1.1 nm, confirming localized flexibility changes. Complementary AFM and CD analyses corroborated these results, showing protofibrillar formation at lower alcohol levels and spheroidal oligomers at higher concentrations. Collectively, these findings provide detailed insights into αS structural remodeling under membrane-mimetic conditions and highlight how environmental perturbations modulate its aggregation pathway, offering potential implications for therapeutic intervention in PD.

Keywords: Parkinson's disease, Alpha-Synuclein (αS), Partial destabilization, Spheroidal oligomers

OP16. Balancing Growth and Nature: A Historical Study of Atal Bihari Vajpayee's Vision Towards India's Development

Malyaban Chattopadhyay[1]* and Amrita Sett[2]

[1] Department of History, Asansol Girls' College, Asansol, West Bengal, India

[2] Department of History, Khandra College, Khandra, West Bengal, India

***Presenting Author:** malyabanchattopadhyay@agc.ac.in

Atal Bihari Vajpayee (1924–2018) is an important figure in Indian political scenario. He was an iconic leader and visionary and placed India on the path of growth and sustainable development. He served as the Prime Minister of India, first for a term of 13 days in 1996, then for a period of 13 months from 1998 to 1999, followed by a full term from 1999 to 2004. He was the first non-Congress Prime Minister to serve a full term in office. It was during his tenure that India successfully conducted the nuclear tests at Pokhran. In a bid to promote friendship across the border, he inaugurated a bus service from Delhi to Lahore in Pakistan in 1999. He also set out a number of economic reforms and emphasised the development of roadways. His birthday, December 25th, is observed as 'Good Governance Day', and he tried to link good governance with the theory of sustainable development. His thoughts on poverty also help us to understand his ideas on sustainable development. He was interested in using science for the development of society. To him, rural India is the backbone of our economic development. He placed India on the path of glory in many fields and was clearly a man of the massesHe had an interest in protecting wildlife. The National Wildlife Action Plan started its journey during the tenure of Atal Bihari Vajpayee. To disseminate this idea of sustainability, sometimes he followed the lines of M.K. Gandhi too. In this regard, he was also influenced precisely by India's ancient heritage.

He placed his faith in Mahatma Gandhi's philosophy. At the inauguration of the Sustainable Development Summit in 2002, he concluded his speech by saying:

"My only advice while inaugurating this major event is to recall Mahatma Gandhi's principle of 'Antyodaya', which means taking care of the last, of the most underprivileged and deprived."

(It is noteworthy that this concept of Antyodaya profoundly guided him. During his tenure, the Antyodaya Anna Yojana was launched in India in 2000, with the objective of providing subsidized food to poor families. This was not the only initiative; several other equality-promoting social schemes were also introduced during his time.In reality, he thought innovatively about removing social inequality, as he believed that equal opportunities must be created for everyone. For this reason, he had special consideration for underdeveloped regions, as well as a strong desire to implement various schemes for the poor.

In his Independence Day speech on 15 August 2001, he said:"We shall make necessary modifications in the policy to remove regional imbalances and social inequalities. We are determined to ensure that the new economic policy becomes a promoter of social justice and that its benefits reach our brothers and sisters belonging to Dalit, Adivasi, backward, and most backward sections of our society."

It is worth noting that the year was being observed in India as the Year of Women's Empowerment. Giving importance to this, Atal Bihari Vajpayee announced:"We have taken yet another major decision for women's economic empowerment. Over the next three years, all public sector banks will lend five percent of the net bank credit to women entrepreneurs."

In this way, he envisioned a sustainable development that included every section of society by bringing them all together. In the main article his ways of thinking towards sustainable development of India will be discussed in detail.

Keywords: Sustainable development, Emphasised, Women's Empowerment, Antyodaya profoundly

OP17. Environmental Awareness in Abhijnanasakuntalam

Ranjit Bhakat

Department of Sanskrit, Asansol Girls' College

Presenting Author: ranjitb.web@gmail.com

This paper examines the ecological consciousness reflected in Abhijnanasakuntalam, a classical Sanskrit drama by Kalidasa. The play presents nature not merely as a background but as an integral and living entity within the narrative. Through the depiction of forest life, hermitage culture, and human–nature relationships, Kalidasa conveys a profound environmental ethic that resonates strongly with contemporary ecological thought.Environmental awareness in ancient Indian literature reveals a deep-rooted respect for nature. In Abhijnanasakuntalam, Kalidasa portrays a harmonious relationship between humans and the natural world. The hermitage of Sage Kanva serves as an ecological model where coexistence, conservation, and compassion toward all living beings are central values. The forest hermitage (āśrama) is depicted as a self-sustaining and balanced ecosystem: trees, creepers, animals, and birds coexist peacefully. The sages nurture plants as if they were family members. Violence and exploitation are restricted within the sacred forest boundary. This reflects the concept of eco-spirituality, where nature is revered and protected rather than dominated.Shakuntala, raised in the forest, symbolizes purity and natural harmony. She waters plants and cares for trees affectionately. She bids farewell to the forest as if leaving her own family. Her emotional bond with plants and animals highlights ecological sensitivity. Through her character, Kalidasa emphasizes that human identity is deeply connected with nature.King Dushyanta initially enters the forest for hunting. However, the hermitage is treated as a sanctuary. Hunting is prohibited within sacred boundaries. Animals are portrayed as innocent beings deserving protection. This demonstrates an early awareness of wildlife conservation and ethical limitations on human actions.In the play, trees are personified. Rivers and seasons influence the mood and events of the story. Nature participates emotionally in Shakuntala's departure. Such literary techniques elevate nature from a passive setting to an active participant, reflecting a holistic worldview.The environmental values in Abhijnanasakuntalam align with modern ecological principles: sustainable coexistence, respect for biodiversity, and moral responsibility toward nature. In an age of climate change and ecological crisis, Kalidasa's vision encourages a return to balanced living and environmental ethics.Abhijnanasakuntalam embodies a profound environmental philosophy rooted in Indian tradition. Kalidasa presents nature as sacred, nurturing, and inseparable from human life. The drama teaches that ecological harmony is not merely practical but spiritual and cultural.

Keywords: Abhijnanasakuntalam, Ecological, Kalidasa's vision, Sustainable coexistence, Environmental

OP18. Environmental Influences on Ramayana and Mahabharata and Current Relevance

Jiban Kumar Tudu

Department of Sanskrit, Asansol Girls' College, Asansol, West Bengal, India

Presenting Author: tudujiban5@gmail.com

Ramayana and Mahabharata are the two major epics of India. Most of the events of the epic took place in the natural environment and are based on environmentalism which is a symbol of environmental awareness in the present day. This epic depicts a world where nature is not just an environment, but a sacred, living entity interconnected with human life. The teachings of these two epics are highly relevant to contemporary environmental challenges, such as climate change, biodiversity loss and pollution. Environmental influences on epics can be attributed to a number of factors – nature as a divine entity, forest-centric narrative, ecological balance, concept of sacred forest, representation of biodiversity, conservation initiatives etc. Here there is a deep engagement with the natural world, portraying an ecological consciousness where nature is not just a backdrop but a character, a deity and an essential part of life. Reflecting a time when human existence was in tune with cosmic rhythms, it provides lasting, relevant lessons to address the modern environmental crisis through the principles of dharma (duty) and the sanctity of nature. Sustainable Development, Conservation of Biodiversity, Conservation of Resources, Environmental Ethics, Moral Responsibility, serves as an ancient, guiding text for environmental awareness, emphasizing that human well-being is inseparable from environmental health.

Keywords: Environmental awareness, Biodiversity loss, Pollution, Environmental influences

OP19. Crop-Specific Modulation of Urease Activity and Soil Microbial Dynamics in Spinach (Spinacia oleracea) and Maize (Zea mays) Rhizospheres of the East Calcutta Wetlands: Role in Nitrogen Transformation

Indrani Banerjee Chakraborty[1]*, Mohit Acharjee[1] and Swati Chakraborty[2]

[1] Guru Nanak Institute of Pharmaceutical Science and Technology, 157/F, Nilgunj Road, Panihati, Kolkata

[2] Asansol Girls' College, Asansol

***Presenting Author:** indrani.banerjeechakraborty@gnipst.ac.in

Excessive application of conventional urea fertilizer as a nitrogen source has emerged as a critical factor influencing soil physicochemical stability, rhizospheric microbial diversity, and nitrogen cycling in intensive agricultural systems. The present study evaluates the physicochemical and microbiological responses of conventional urea fertilizer on the rhizospheric soils of spinach (Spinacia oleracea), a high nitrogen-demand leafy vegetable, and maize (Zea mays), a major cereal crop, cultivated in the ecologically sensitive East Kolkata Wetlands, a Ramsar-designated wetland. The findings elucidate understanding the structure and functional potential of rhizospheric microflora, focusing on ureolytic bacterial proliferation, urease hyperactivity, physicochemical degradation in wetland-based agricultural systems with the ecological importance in sustaining productivity. Antibiotic profiling

of the rhizospheric bacterial microbiota revealed strain-specific resistance and dose-dependent sensitivity, with pronounced susceptibility to amoxicillin but widespread resistance to cephalexin and cefixime, indicating fertilizer-driven adaptive stress selection and a probable β-lactamase-mediated resistance mechanism within the rhizosphere microbiome. UV tolerance variability among isolates, coupled with elevated urease activity and increased ammonia release, indicates fertilizer-induced stress adaptation, accelerated nitrogen mineralization, and heightened risk of volatilization-driven nitrogen imbalance. The data revealed that conventional urea application in spinach and maize rhizospheres drives fertilizer-driven microbial proliferation compromising long-term rhizospheric microbial equilibrium, and promoting dominance of hyper-ureolytic and stress-adapted bacterial populations, and alters soil structural and chemical integrity, coupled with physicochemical alterations, enzymatic hyperactivity, salinity accumulation, localized compaction, and accelerated nitrogen turnover. Integrated nitrogen management strategies, including controlled-release formulations and organic amendments, are essential to maintain soil microbial functionality and long-term ecosystem sustainability.

Keywords: Proliferation compromising, Organic amendments, Amoxicillin, Soil microbial functionality

OP20. Estimation of Tree Biomass and Carbon Stocks in the Darjeeling Himalaya, India

Samjetsabam Bharati Devi[12]* and Suratna Sur Shan Sher Sherpa[3]

[1] Department of Ecology and Environmental Sciences, School of Life Sciences, Pondicherry University, Kalapet, Puducherry, India

[2] Department of Botany, School of Basic Sciences, SRM University Sikkim, 5th mile, P.O.: Tadong, Gangtok, Sikkim, India

[3] West Bengal Forest Department, New C.I.T. Building, P-16, India Exchange Place Extn. Kolkata, West Bengal, India

***Presenting Author:** samjetsabambharatidevi.d@srmus.edu.in

The present study was conducted to estimate the forest biomass of four forest stands within three protected areas representing three forest types using the non-destructive method in the Darjeeling Himalaya, India. The inventory variables such as Diameter at Breast Height (DBH) and Height (H) were fitted into the species-specific standard volume equations for all the tree species. The biomass density for above ground (AGBD), below ground (BGBD), and total (TBD), as well as carbon density for above ground (AGCD), and overall total (TCD) were calculated based on standard methods. Across the different forest types in the three protected areas, the AGBD (76.16 - 430.20 Mg ha-1) was highest in MWLS, followed by SNPU, SNPL, and lowest in NVNP. A similar pattern was observed for BGBD (39.61 - 178.77 Mg ha-1), TBD (115.77 - 608.97 Mg ha-1), AGCD (34.28 - 193.59 Mg C ha-1), and TCD (52.10 - 274.04 Mg C ha-1), as they depend on AGBD. Across the DBH class distribution, the AGBD for Shorearobusta (in MWLS) and Abies densa (in SNPU), peaked at the mid-DBH classes of 50-60 cm, and 60-70 cm, respectively. However, Rhododendron arboreum and Rhododendron falconeri (in NVNP) and Rhododendron arboreum and Rhododendron barbatum (in NVNP and SNPU) showed a decline in the AGBD with increasing DBH classes (where DBH had a very narrow range of 5-10 cm to 20-30 cm). The AGB, BGBD, AGCD, and TCD observed in the different forest types of Darjeeling Himalaya falls within the range reported previously from the Himalaya and other parts of India and the world across the tropical, temperate, and sub-alpine forests. In the present study, AGBD, BGBD, TBD, AGCD, TCD differed across the forest type, elevation and dominant tree species.

Keywords: Elevation, Dominant tree species, Darjeeling Himalaya falls, Forest biomass

OP21. The Impact of Place of Residence in the Early Onset of Menarche: A Cross-Sectional Study

Payel Banerjee* and Purushottam Pramanik

Post Graduate Department of Physiology, Hooghly Mohsin College, Chinsurah, Hooghly, West Bengal, India

***Presenting Author:** payelbanerjeebanik@gmail.com

Background: Menarche is the indication of initiation of reproductive age of girls. The average age of menarche has decreased significantly in last 100 years. Early onset of menarche has significant impact on health. Place of residence influences the age of menarche.

Objectives: The aims of this study was to evaluate the influence of place of residence in the early onset of menarche among adolescent girls of West Bengal, India.

Methods: This is a cross-sectional questionnaire-based study conducted among school girls having age limit 10–14 years who experienced menarche not more than previous three months. Onset of menarche before 12 years is considered as early menarche. Quantitative data were presented as percentage and/or mean + standard deviation. T-test was done to determine significant of difference. The significance level of the tests was considered at a level of 0.05.

Results: Average age at menarche was significantly higher in rural girls in respect to urban counterpart (age at menarche in month: Rural = 150.53 + 11.85; Urban = 145.12 + 9.62). 29.6% of rural girls and more than 45% of urban girls attained menarche before 12 years. BMI was significantly higher in urban girls than rural one [BMI (kg/m^2): Rural = 22.16 + 5.20; Urban = 24.65 + 5.25]. Level of socioeconomic status (SES) of urban girls was comparatively higher than rural counterpart.

Conclusion: Girls from urban places of residence attend menarche earlier. Higher BMI, SES and maternal education of urban girls may be considering as contributing factor for earlier menarche.

Keywords: Socioeconomic status, Quantitative data, Menarche, Maternal education

OP22: Assessing the Microbial Safety of Sewage Fed Aquaculture in Kolkata and Associated Wetlands

Suchita Mukherjee and Tapti Sengupta*

Department of Microbiology, West Bengal State University, Barasat, 24 Pgs (N), Kolkata, West Bengal, India

***Presenting Author:** tapti.sg@gmail.com

Sewage-fed aquaculture is a unique wastewater-recycling system. The nutrient-rich water promotes fish growth, supports sustainable aquaculture, and helps reduce environmental pollution. In the Kolkata metropolitan region, this system is extensively practiced within urban wetlands, yet escalating inputs of untreated domestic, hospital, agricultural, and industrial sewage raise serious concerns regarding microbial safety and public health. The present study assesses the microbial quality of sewage-fed aquaculture systems in Kolkata and North 24 Parganas, with particular emphasis on the East Kolkata Wetlands, the world's largest sewage-fed aquaculture ecosystem. Four representative sites were selected based on sewage composition and contamination intensity. A total of fifty-two

bacterial isolates were recovered and initially characterized using conventional microbiological methods. Dominant taxa included Bacillus spp., coliforms such as Escherichia coli, Enterobacter spp., and Klebsiella spp., along with opportunistic pathogens including Pseudomonas spp., Shigella spp., Vibrio cholerae, and Staphylococcus spp. Phylogenetic analysis using neighbor-joining methods revealed close evolutionary relationships with clinically and environmentally relevant reference strains, including E. coli O157:H7–related lineages, Klebsiella pneumoniae complex, Pseudomonas aeruginosa, Vibrio cholerae El Tor biotype, and Staphylococcus aureus. Sites receiving higher domestic and industrial sewage loads showed significantly elevated total bacterial and coliform counts, with a strong positive correlation between coliform density and overall microbial load, indicating increasing fecal contamination pressure. The integration of culture-based and molecular evidence highlights the persistence of potentially pathogenic bacteria in sewage-fed aquaculture systems. These findings emphasize the urgent need for continuous microbial surveillance and a One Health–oriented management strategy to safeguard environmental integrity, fish health, and human well-being in urban wetland ecosystems.

Keywords: Staphylococcus aureus, Safeguard environmental integrity, Fish health, *E. coli*, Pseudomonas aeruginosa

OP23. Small Organisms, Larger Impacts: Algae at the Frontline of Climate Driven Biodiversity Change

Somnath Banerjee

Department of Biological Sciences, IISER Kolkata

Presenting Author: somnathbotany98@gmail.com

Climate change is rapidly altering aquatic ecosystems through rising temperatures, ocean acidification, altered nutrient dynamics, and increased frequency of extreme events. Algae, despite their microscopic size, play a foundational role in these ecosystems as primary producers, regulators of biogeochemical cycles, and key drivers of food web dynamics. This presentation explores how climate change induced environmental stressors influence algal communities and, in turn, reshape biodiversity and ecosystem functioning.

Warming oceans accelerate algal metabolic rates, shift species composition, and promote the expansion of harmful algal blooms, leading to hypoxia, toxin production, and declines in aquatic biodiversity. Increased atmospheric CO_2 absorption by oceans causes acidification, affecting calcifying algae and coral associated symbiotic algae, thereby contributing to coral bleaching and reef degradation. Changes in precipitation patterns and nutrient runoff further intensify eutrophication, altering algal bloom dynamics and destabilizing ecosystem balance. These algal driven changes cascade through food webs, impacting zooplankton, fish populations, and higher trophic levels, ultimately threatening ecosystem resilience and services.

By synthesizing recent research, this study highlights algae as early indicators and active mediators of climate driven ecosystem change. Understanding algal responses to climate stressors is essential for predicting biodiversity loss, managing aquatic ecosystems, and developing effective climate adaptation and mitigation strategies. Recognizing the disproportionate ecological influence of algae emphasizes the need to integrate algal dynamics into climate change models and conservation frameworks.

Keywords: Coral bleaching, Reef degradation, Biogeochemical cycles, Toxin production

OP24. Phyto beneficial biocontrolling Bacteria for Sustainable Management of Bacterial Diseases in Potato: A Comprehensive Review

Srinjoy Ghosh[12]*, Nandita Sahana[2] and Krishnendu Pramanik[1]

[1] Department of Botany, Cooch Behar Panchanan Barma University, Panchanan Nagar, Vivekananda Street, West Bengal, India

[2] Department of Biochemistry, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

***Presenting Author:** srinjoy.ghosh96@gmail.com

Potato (Solanum tuberosum L.) is one of the most important food crops globally and plays a crucial role in food and nutritional security, particularly in developing countries. However, bacterial diseases such as bacterial wilt, brown rot, common scab, soft rot, and black leg severely constrain potato productivity and quality. Conventional management strategies relying on chemical bactericides and resistant cultivars have shown limited effectiveness and pose environmental and sustainability concerns. In this context, phytobeneficialbiocontrolling bacteria (PBB) have emerged as a promising eco-friendly alternative for the sustainable management of bacterial potato pathogens. This review synthesizes research published over the last two decades on the isolation, diversity, and biocontrol potential of PBB against major bacterial diseases of potato. Beneficial bacterial genera, including Bacillus, Pseudomonas, Streptomyces, Enterobacter, Paenibacillus, and Rhizobium, have demonstrated significant antagonistic activity against pathogens such as Ralstonia solanacearum, Streptomyces scabies, Pectobacterium spp., and Dickeya spp. The mechanisms underlying disease suppression include antibiosis through the production of lipopeptides and secondary metabolites (surfactin, iturin, fengycin, bacilysin), competition for nutrients and niches, induced systemic resistance, and modulation of pathogen virulence genes. Despite promising laboratory and greenhouse results, large-scale field validation, mechanistic understanding, and formulation of stable bacterial consortia remain limited. This review critically identifies existing knowledge gaps and outlines future research directions aimed at strengthening the scientific foundation, field applicability, and translational potential of PBB-based biocontrol strategies for sustainable management of bacterial diseases in potato.

Keywords: Potato, Biocontrol strategies, Pseudomonas, Streptomyces, Enterobacter, Paenibacillus

OP25. Management of Filariasis through Control of 3rd Instars Culex Quinquefasciatus Larvae: a Green Approach

Kuntal Bhattacharya

Department of Zoology, Government General Degree College, Mangalkote; PurbaBardhaman, West Bengal

Presenting Author: kbbjoy@gmail.com

Vector borne diseases aims at vector management through novel botanicals to improve the specificity, safety, and long-term viability of disease-vector control. This study evaluated the larvicidal efficacy of a plant-derived compound against Culex quinquefasciatus larvae in a laboratory setting. After initial screening, bioactive fractions

were extracted from the plant's leaves using three solvents: n-hexane, ethyl acetate, and absolute alcohol. Bioassays were conducted on third-instar Cx. quinquefasciatus larvae. LC50 and LC90 values were determined using log-probit analysis, and mortality data was statistically validated via regression analysis. The effects on non-target organisms were also assessed. The chemical structure of the purified compound was characterized using TLC, infrared spectroscopy and GC-MS. Changes in larval protein content were measured after 72 hours of exposure. The ethanol extract (absolute) was the most effective solvent tested, inducing 100% mortality in third-instar larvae. Regression analysis confirmed a clear dose-dependent mortality. The pure compound isolated with Rf value 0.84. Notably, the tested extract and pure compound had minimal effects on non-target organisms. A decrease in larval protein content after exposure to a phyto-insecticide derived from the leaves of Operculinaturpethum L. was noted. The IR and GC-MS analyses confirmed the presence of Phenol derivatives in the pure compound.

Keywords: Safety, Operculinaturpethum L., Spectroscopy, Culex quinquefasciatus larvae

OP26. Soil Physicochemical Properties and Heavy Metal Accumulation in the Raniganj Coalfield, India

Mr. Pintu Ghosh* and Dr. Angana Ghoshal

Department of Zoology, Triveni Devi Bhalotia College, Raniganj

***Presenting Author:** pintughosh056@gmail.com

The Raniganj Coalfield, one of the oldest and most intensively exploited coalfields in India, has experienced prolonged mining and associated anthropogenic activities that have significantly influenced soil quality. The present study evaluates the physicochemical properties of soils collected from five representative sites within the Raniganj Coalfield and assesses the concentration of selected heavy metals. Soil samples were analyzed for pH, electrical conductivity (EC), organic carbon, available macronutrients (N, P_2O_5, K_2O, and S), and heavy metals (Fe, Mn, Pb, and Cd) using standard analytical protocols. Soil pH varied from slightly acidic to moderately alkaline, reflecting heterogeneity in overburden composition, mine residues, and site-specific land management practices. EC values indicated low to moderate salinity across the sites, while organic carbon content showed marked spatial variation, suggesting differences in organic matter input and decomposition dynamics. Available macronutrients exhibited considerable variability, indicating uneven nutrient status influenced by mining disturbances. Heavy metal analysis revealed relatively higher concentrations of iron and manganese compared to lead and cadmium. Although Pb and Cd levels were generally low, localized enrichment at certain sites points to potential contamination from mining operations, coal transportation, vehicular emissions, and nearby industrial activities. Overall, metal concentrations remained within permissible limits; however, the persistent and non-biodegradable nature of heavy metals underscores the need for continuous monitoring. This study provides baseline information on soil quality and heavy metal status in the Raniganj Coalfield, supporting future environmental monitoring, risk assessment, land reclamation, and sustainable management of coal mining regions.

Keywords: Macronutrients, Coal transportation, Vehicular emissions, Organic carbon

OP27. Host-Directed Identification of Antileishmanial Phytochemicals through Integrated Host–Pathogen Network Pharmacology

Monojit Banerjee* and Arun Mukherjee

Department of Zoology, Triveni Devi Bhalotia College, Raniganj, India

***Presenting Author:** monojeno@gmail.com

Leishmaniasis, including both cutaneous and visceral forms, remains challenging to treat because available drugs can be toxic, resistance is rising, and the parasite survives by reshaping immune responses inside host macrophages. These limitations have encouraged interest in host-directed therapies that enhance protective immunity while limiting intracellular persistence. In this study, we used an integrated host–pathogen bioinformatics strategy to investigate five plant-derived compounds—berberine, quercetin, resveratrol, betulinic acid, and piperine—as potential multitarget antileishmanial agents. Pharmacokinetic screening suggested that most compounds possess acceptable drug-like properties. Likely host and parasite targets were identified using Swiss Target Prediction alongside updated chemogenomic resources such as ChEMBL and BindingDB and were compared with genes reported to change during infection. This approach helps to construct the interaction networks linking phytochemicals with immune pathways exploited by the parasite. Primary regulators, including TNF, IL10, TP53, CASP3, STAT1, and AKT1, emerged as key nodes associated with inflammatory control, apoptosis, and parasite survival. Functional enrichment analysis suggested effects on Toll-like receptor signaling, cytokine networks, and T-helper cell differentiation, consistent with immune reprogramming toward parasite clearance. Molecular docking further supported stable interactions between compounds and these hub proteins. In this work, we have shown selected phytochemicals as promising host-directed candidates for both cutaneous and visceral leishmaniasis. This offers a computational framework for discovering multitarget therapies against intracellular pathogens as host-directed therapy.

Keywords: Leishmaniasis, Visceral forms, Immune reprogramming, Hub proteins, Intracellular pathogens

OP28. Metabolic Profiling and Enzymatic Characterization of Microbial Isolates: Assessing Functional Competence for Bioremediation Systems

Monisha Mukherjee

Department of Microbiology, Asansol Girls' College, Asansol, West Bengal

***Presenting Author:** monishamukherjee83@gmail.com

The efficacy of microbial-mediated bioremediation is fundamentally governed by the metabolic plasticity and enzymatic repertoire of the colonial isolates. Systematic biochemical characterization is essential to delineate the degradative pathways and physiological resilience of microorganisms tasked with mitigating environmental pollutants.

This study objective was to execute a comprehensive biochemical and enzymatic screening of indigenous microbial strains to evaluate their functional suitability for the degradation of complex organic substrates.

A multiphasic diagnostic approach was employed to map the physiological landscape of the isolates. Carbon utilization patterns and fermentation end-products were elucidated through the IMViC (Indole, Methyl Red, Voges-Proskauer, and Citrate) series. To assess oxidative stress tolerance and aerobic respiratory efficiency, Catalase activity was quantified. Furthermore, the extracellular hydrolytic capacity—critical for the breakdown of high-molecular-weight polymers—was determined via Protease secretion (Casein hydrolysis) and Amylolytic activity (Starch hydrolysis) assays.

The isolates exhibited a robust metabolic profile characterized by significant enzymatic diversity. Positive outcomes in Citrate utilization and Catalase assays indicate an advanced capacity for carbon sequestration and survival under oxidative stress—key traits for persistence in toxic environments. The detection of extracellular Protease and Amylase confirms the isolates' ability to depolymerize complex organic matrices into simpler, bioavailable intermediates. This collective biochemical signature suggests an optimized metabolic "toolkit" capable of sustained degradative activity.

The integration of systematic biochemical profiling provides a predictive framework for microbial performance in situ. These findings confirm that the evaluated isolates possess the necessary enzymatic machinery to navigate nutrient-variable ecosystems, establishing a rigorous baseline for their application in targeted bioremediation strategies.

Keywords: Microbial Metabolism, Enzymatic Hydrolysis, IMViC Profiling, Bioremediation, Oxidative Stress Tolerance, Bio-catalysis

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OP29. Impact of Climate Change on Biodiversity and Ecosystem Balance

Beauti Gorai

Asansol Girls' College

Presenting Author: goraibeauti20012005@gmail.com

Environmental biosciences play a crucial role in understanding the complex interactions between climate change and ecosystem functioning. This study focuses on modeling the impacts of climate change on biodiversity and ecosystem while examining the role of biogeochemical cycles and sustainable practices. Climate change, driven primarily by increasing greenhouse gas emissions, has resulted in rising global temperatures, altered rainfall patterns, melting glaciers, and frequent extreme weather events. These changes significantly affect biodiversity by altering habitats, disrupting food chains, and forcing species migration, extinction, thereby threatening ecosystem balance.

Biogeochemical cycles, including the carbon, nitrogen, and water cycles regulate nutrient flow and energy transfer within ecosystems. Climate change disrupts these cycles by accelerating carbon release, altering nutrient availability, and influencing soil and water quality, ultimately affecting ecosystem functioning and resilience. Modeling these interactions helps predict ecological responses and supports decision-making for environmental management.

The study also emphasizes conservation strategies and the need for sustainable ecosystem management to mitigate climate change impacts. Practices such as habitat restoration, sustainable resource use, afforestation and biodiversity conservation help maintaining ecological balance and support long-term environmental sustainability. Integrating scientific modeling with conservation planning allows better prediction and protection of vulnerable ecosystems.

Overall, understanding climate ecosystem interactions through environmental biosciences is essential for developing effective conservation policies and promoting sustainable ecosystems. This approach highlights the importance of protecting biodiversity while ensuring ecosystem services that are critical for human well-being and environmental stability in a changing climate.

Keywords: Environmental biosciences, Sustainable ecosystems, Protecting biodiversity, Climate change

OP30. Characterization of Microbial Resistance and Growth Inhibition in Bioremediation Systems via Minimum Inhibitory Concentration (MIC) and Agar Cup Diffusion

Nabanita Biswas* and Godhuli Dutta

Department of Microbiology, Asansol Girls' College, Asansol, West Bengal

***Presenting Author:** nabanitabiswas951@gmail.com

The success of bioremediation—the use of microorganisms to degrade environmental contaminants—is heavily dependent on the metabolic resilience and tolerance of the microbial strains involved. Characterizing the interaction between potential bioremediation agents and pollutants (or co-contaminants like heavy metals) is essential for predicting field performance.

This study aims to characterize the sensitivity and degradative potential of isolates against contaminants using standardized microbiological assays: Minimum Inhibitory Concentration and Agar Cup Assay.

The study successfully established the susceptibility profile of the isolate, identifying a definitive Minimum Inhibitory Concentration (MIC) that marks the threshold of its metabolic tolerance. Furthermore, the Agar Cup diffusion assay demonstrated a clear correlation between contaminant concentration and growth suppression. The observed sensitivity patterns confirm that while the contaminant exerts selective pressure at elevated levels, the isolate maintains robust viability within sub-lethal concentrations. This balance of tolerance and growth suggests high potential for the organism to function effectively in contaminated environments where pollutant levels fluctuate.

The integration of MIC and Agar Cup characterization provides a robust baseline for selecting robust microbial strains. These methods ensure that chosen isolates can survive the toxicity of the contaminated site while performing degradative functions.

Keywords: Minimum Inhibitory Concentration, Microorganisms, Toxicity, Agar Cup characterization

OP31. Smart Healing: The Future of Wound Care

Pritam Das[1]*, Dipankar Das[2] and Sriparna De[2]

[1] Medical Lab Technology, Department of Allied Health Sciences, Brainware University, Kolkata

[2] Department of Allied Health Sciences, Brainware University

***Presenting Author:** bwubmt23027@brainwareuniversity.ac.in

The clinical management of diabetic foot ulcers (DFUs) is frequently compromised by persistent inflammation, susceptibility to bacterial colonization, and impaired angiogenesis. Real-time diagnostic feedback and the simultaneous treatment of deep-tissue complications are frequently not possible with current therapeutic approaches. This presentation describes the engineering of a multipurpose wound dressing that uses a "theranostic" technique to close this gap. Using a matrix of polyurethane (PU) combined with a collagen-grafted copolymer, Col-g-Poly (NIPAM-co-AA), we electrospun a thermoresponsive nanofibrous scaffold. The scaffold was loaded with Europium Hydroxide Nanorods (EHNR) to promote angiogenesis and scavenge reactive oxygen species (ROS) and Tetracycline Hydrochloride (TCH) for broad-spectrum antimicrobial control in order to accomplish dual-action therapy. Furthermore, phenol red was incorporated into the matrix to serve as a colorimetric pH sensor for tracking the degree of wound infection. With a fiber diameter of 350–400 nm, the scaffold closely resembles the extracellular matrix (ECM), and its thermoresponsive drug release profiles are adjusted to physiological temperatures, according to physicochemical characterization. The EHNR-enriched scaffold outperformed control groups by achieving a 95% wound closure rate in 21 days, according to in vivo studies conducted using a diabetic murine model. According to mechanistic analysis, the dressing alters the wound microenvironment by upregulating the expression of collagen-I and vascular endothelial growth factor (VEGF) and downregulating inflammatory cytokines (TNF-α, IL-6). Additionally, the patch provided visual indicators of the physiological state of the wound by effectively differentiating pH changes between 6.0 and 8.0. According to these results, there is a great deal of promise for this bioactive, intelligent scaffolding system as a revolutionary approach to the treatment of chronic wounds.

Keywords: Vascular endothelial growth factor, Downregulating, Tetracycline Hydrochloride, Treatment

OP32. Uranium Mining and Sustainable Development in India — A Sociological Perspective

Pankaj Kumar

Department of Sociology, Asansol Girls' College, Asansol, West Bengal, India

Presenting Author: pankajhlc@gmail.com

Uranium mining occupies a critical position in India's pursuit of energy security and nuclear power development, yet it also generates complex social and environmental challenges. From a sociological standpoint, uranium extraction—largely undertaken by Uranium Corporation of India Limited—reveals deep contradictions between economic development and social justice. Mining regions such as Jaduguda have become emblematic of these tensions, where marginalized tribal and rural communities disproportionately bear the costs of industrial progress.

This examines uranium mining through the lens of sustainable development, emphasizing issues of displacement, livelihood insecurity, health risks, and environmental degradation. While mining projects promise employment and infrastructural growth, empirical studies indicate persistent problems related to land alienation, inadequate compensation, limited community participation, and long-term exposure to radioactive waste. These impacts are further intensified by structural inequalities, weak institutional accountability, and uneven power relations between the state, corporations, and local populations.

Drawing on sociological theories of development and environmental justice, the paper argues that sustainability cannot be reduced to economic indicators alone. Instead, it must incorporate social equity, cultural rights, and participatory governance. The experiences of affected communities highlight the need for transparent environmental impact assessments, continuous health surveillance, and inclusive decision-making processes.

This study focuses on uranium mining in India reflects a broader development paradigm that prioritizes national growth over grassroots well-being. For uranium extraction to align with sustainable development goals, policies must move beyond technocratic solutions and adopt a people-centered approach that safeguards ecological integrity while ensuring dignity, rights, and social security for vulnerable populations.

Keywords: Institutional accountability, Technocratic solutions, Ecological integrity

OP33. Comparing different Fish Fermentation Techniques in North Eastern Part of India

Sudarshana Nandi

Department of Zoology, SRM University Sikkim, Gangtok

Presenting Author: sudarshana.s@srmus.edu.in

Fermentation is a metabolic process that obtains energy from organic compounds without using any external oxidizing agent. Fermentation is ancient food preservative method where microorganisms are ingested together with the fermented food. This technology is safe, environmental-friendly and poor energy consuming, presenting advantages for future applications.

Fish fermentationis a popular traditional method followed in North Eastern part of India. The people of the Eastern Himalayan regions of Nepal, Bhutan, Darjeeling hills, Sikkim, Assam, Arunachal Pradesh, Meghalaya, Tripura, Mizoram and Manipur follow different methods for fish fermentation.Preservation is the main aim for fermentation of fish as some species may not be available throughout the year. Additionally, it also has the added benefits of enhancing flavor, increasing digestibility, and improving therapeutic values. North-east India carries maximum diversity of the small indigenous fish species (SIFs) where the fermentation is carried out through generation after generation in a household level with different techniques. In north eastern part of India fermentation of SIFs is done like *Puntius* sp., *Amblypharyngodon mola*, *Tricogaster* sp., *Channa* sp., *Mystus* sp. etc. with indigenous production technology. The traditional fermented fish items include ngari, hentak, tungtap, shidal etc. The current study is focused to explore the different fish fermentation techniques and to compare their benefits.

Keywords: Fermentation, *Tricogaster* sp., Small indigenous fish species, Traditional fermented fish

OP34. Next-Generation Biological Resources at the Sustainability–AI Nexus: Computational Intelligence, Predictive Analytics, and Applied Perspectives

Shilanjana Majumder

Department of Zoology, School of Bioengineering and Biosciences, Lovely Professional University, Phagwara

Presenting Author: shilanjanamajumderdgp@gmail.com

Interest in next-generation biological resources has increased as a consequence of the growing requirement for sustainable solutions in biotechnology, environmental management and agriculture. Simultaneously, artificial intelligence (AI) has become an efficient instrument for the efficiency of resources as well as the analysis of intricate biological systems. This review examines the relationship between AI and biological resources, specifying how predictive analysis and computational analysis are altering research and applications with a sustainability focus.

In this article, important AI-driven techniques for bioprospecting, precision farming, ecosystem monitoring, and bio-based environmental solutions- including machine learning, data modelling and prediction tools are highlighted. It is specially focused to how AI integrates biological, ecological and environmental data to support informed decision-making and optimize sustainable practices. The study also examines practical applications, demonstrating how computational methods help translate biological discoveries into scalable and successful solutions.

Recent concerns like data quality, model reliability and ethical implications are also mentioned in brief in order to present a fair perspective. By emphasizing latest advancements and proposing future research areas, this study highlights the significance of biological resources enabled by AI in getting sustainability for a long time. The paper overall provides a clear and thorough overview of how biological innovation and artificial intelligence (AI) could complement one another to advance sustainability development goals.

Keywords: Environmental management, Biotechnology, Next-generation, Ecosystem monitoring

OP35. Addressing the Global Food Security by Cutting Edge Tools of Biotechnology

Madhab Chandra Roy*, Soumyadeep Sardar, Soumyadeep Dey and Soumyabrata Roy

Department of Biosciences, JIS University, Kolkata, West Bengal, India

***Presenting Author:** madhabchandraroy660@gmail.com

The global food security addresses the challenge of supplying food to everyone to mitigate hunger and poverty. The advent of biotechnology has redefined the approach in the recent past and has been a transformative force to address global nutritional and sustainability needs. Using the advanced cutting-edge tools of genomics and proteomics, the science of biotechnology has enhanced food production, without compromising on functional quality. This field utilizes advanced techniques of genetic engineering, microbial fermentation, and enzyme technology to modify biological processes and organisms for enhanced food production and quality.

Noteworthy milestones include the development of genetically modified (GM) crops with resilience to pests and drought, such as Bt cotton and drought-tolerant wheat. Enviable progress has also been made in the arena of bio-

fortification, exemplified by "Golden Rice," engineered to combat vitamin A deficiency. In food processing industry, various recombinant enzymes (e.g., chymosin for cheese) and specialized yeast strains have been used to augment fermentation, improving flavor and shelf life. Furthermore, technologies like smart packaging and rapid PCR-based diagnostics now enable real-time monitoring of food safety and pathogen.

We focus our presentation on the various facets of food biotechnology keeping in mind that the future of food industry may increasingly shift towards an amalgamation of synthetic biology, Nano biotechnology and emerging concepts like cellular agriculture. We will highlight on key research areas like lab-grown meat, alternative proteins to reduce reliance on traditional livestock and personalized nutrition, where diets are tailored to individual genetic profiles using AI and omics technologies.

Keywords: Genetically modified, Recombinant enzymes, Food biotechnology, Synthetic biology

OP36. Green Remediation of Industrial Dyes and Hydrocarbons using Crown Flower

Utkalika Parida, Subhadipa Sadhu and Dibyarupa Pal*

Department of Biosciences, JIS University, Kolkata, West Bengal, India

***Presenting Author:** utkalikaparida0@gmail.com

Green remediation is the most sought after technique to restore ecosystem health. The industrial dyes and hydrocarbon pollutants impart cellular toxicity, persistence, and non-biodegradability. Crown Flower (Calotropis) of Apocynaceae family has remarkable prospect for integrated green remediation solutions because it has phyto-chemical factory that offers synergistic sorbents of surfactants, absorbers, catalytic agents, and enzymatic degraders. Flavonoids/Polyphenols in the flower composition and its dried porous biomass aids in adsorption of dye molecules. Polyphenols act as photo-sensitizers for Photocatalytic degradation and presence of oxidoreductase enzymes breaks dye chromophore groups. Latex components initiates coagulation by aggregation of dye colloids. Similarly, Cardenolides (Biosurfactants), Hydrophobic Terpenoids, Fibrous Cellulose assists in hydrocarbon removal. Cardenolides reduce oil-water interfacial tension and helps in Emulsification and Dispersion whereas hydrophobic fibres selectively uptake oil by absorption. The current study investigates processed dried flower biomass of Calotropis for removal of methylene blue (MB), a cationic dye. The flower removes 70-75% of the dye from aqueous surface after 12 hrs and complete removal after 24 hrs. The surface active structures of flower like hydroxyl, carbonyl, and aromatic rings facilitate the removal of MB dye through adsorption and complexation reaction. The porous structure of the fibrous matrix (cellulose, hemicellulose, and lignin) increases active adsorption regions. The findings posit that Crown Flower is biodegradable and can substitute synthetic chemical adsorbent options in the treatment of wastewater and management of oil spill contaminants.

Keywords: Absorbers, Catalytic agents, Enzymatic degraders, Flavonoids/Polyphenols

Poster Presentations

PP1. A Comprehensive Investigation of Water Soluble Poly-aniline Co-polymer

Leena Bhowmik

Asansol Girls' College

Presenting Author: leenabhawmik@yahoo.in

The co-polymer of m-aminobenzene sulfonic acid with o-anisidine (POABSA) and o-toluidine (POTBSA) have synthesized by oxidative polymerization technique. These polymers are water soluble and self -doped. The IR peak appeared at 1100 -1160 cm-1 mindicates the presence of SO3 group in the polymer back bone. Self –doped copolymer exhibit a strong and wide range of polaron absorption at 772 -943 nm in m-cresol, due to the conformational changes induced by polymer solvent interaction. Co-polymer also displays a strong polaron transition in m-cresol with LiCl. Salt acts as a pseudo-doping agent and extends coil-like conformations. The highest thermal activation is monitored at 700C, but above the temperature 1000C overcompensation of thermal activation effect is observed. The electrical conductivity of co-polymer is low 10-4 to 10-5 S cm-1), caused by strong steric effect between SO3 and OMe/Me groups.

Keywords: Copolymer, Strong polaron, Sulfonic acid, Polymer solvent

PP2. Shape Engineering of Copper Sulphide Nanostructures through Water-alcohol Ratio Variation in Surfactant Solution

Soma Gorai

Department of Chemistry, Asansol Girls' College, Asansol

Presenting Author: somaagc1@gmail.com

Copper sulphides with varying stoichiometries have attracted significant interest as p-type semiconductors for applications such as solar cells, optical filters, and superionic conductors[1-2]. Owing to their favourable optical and electrical characteristics, these materials are also extensively employed in thin-film technologies and composite systems[3-4]. In this study, Cu_2S nanostructures with different morphologies were synthesized through a simple gas–solid reaction route using different solvent compositions. The morphology of the nanostructures was effectively tuned by adjusting the water-to-alcohol ratio in the surfactant solution. A 'tree-branch' like structure was observed when the surfactant was dissolved only in water. As the alcohol content increased relative to water, a gradual changes in shape was noted. At a high alcohol proportion, where the alcohol volume was ten times that of water, the Cu_2S nanostructures predominantly exhibited a wire-like morphology.

Keywords: Stoichiometries, Superionic conductors, Nanostructures, Alcohol

PP3. Application of Micro/Nanorobots in Medicine

Dr. Surajit Jana

Department of Chemistry, Asansol Girls' College

Presenting Author: surajit.jana@gmail.com

The rapid advancement of micro/nanorobots (MNRs) has opened new frontiers in modern medicine, offering transformative possibilities for disease diagnosis, monitoring, and treatment. Micro/nanorobots, typically ranging from 1 nm to 1 mm in size and constructed using nanoscale materials, possess unique physical and functional properties that enable them to operate within complex biological environments. Their extremely small dimensions allow deep tissue penetration and precise interaction at the cellular and molecular levels, making them superior to many conventional diagnostic and therapeutic approaches. Also referred to as nanobots, nanoids, nanites, or nanomites, these devices can penetrate deep or otherwise inaccessible regions within our bodies, conducting various medical procedures and showcasing great promise in biomedical imaging, biosensing, minimally invasive surgery, and targeted drug delivery. Recent advances in fabrication techniques, actuation mechanisms, and navigation strategies represent critical steps toward real-world medical applications within human body. However, significant engineering, biological, and ethical challenges—such as biocompatibility, safety, control, targeting accuracy, and clinical translation—must be addressed before widespread clinical adoption becomes feasible. This review presents a comprehensive overview of the design principles, operational mechanisms, and medical applications of micro/nanorobots, while also highlighting current limitations and future prospects. The integration of micro/nanorobotic technologies into healthcare has the potential to revolutionize precision medicine and significantly improve patient outcomes.

Keywords: Biological environments, Biocompatibility, Biological, Operational mechanisms

PP4. Recycling of Waste Rubber by Dibenzyl Disulfide, A Devulcanizing Agent

Dr. Goutam Kumar Jana

Department of Chemistry, Asansol Girls' College, Asansol

Presenting Author: goutamkumarjana@agc.ac.in

Devulcanization of waste rubber poses a challenging environmental, economical and disposal problem in the world due to their cross-linked three-dimensional network structure. If it is used as landfill it helps for breeding of mosquitoes, rodents, create westnile virus for flu1. If it is used as fuel it produces toxic gases and large amount of chars which requires additional disposal. Devulcanization of waste tyre was carried out in 1000C for 15 minutes with the help of open two-roll cracker cum mixing mill in presence and absence of dibenzyl disulfide as a devulcanizing agent. The vulcanizate properties markedly depended on disulfide concentration and also devulcanization techniques2.

Revulcanized rubber obtained by devulcanizing with disulfide offered better mechanical properties. Decrease in scorch time and increase in rheometric torque were observed for revulcanized rubber containing disulfide. The onset degredation temperature largely depended on presence of disulfide. IR spectroscopic results revealed that the main polymeric chain did not oxidize at the time of above room temperature milling3. Increase in storage modulus and loss modulus were observed for revulcanized rubber from DMA study4. The SEM was considered in order to study the failure mechanism and homogeneity of the vulcanizate. By adopting this devulcanization technique more than 80% mechanical property of vulcanized natural rubber was retained.

Keywords: Devulcanization, Challenging environmental, Economical, Disposal problem, Natural rubber

PP5: Temperature Increment and Mosquito Life Cycle: Adaptations to Disease Transmission with Global Climate Change

Dr. Shreya Brahma[1,2]*, Soujita Pramanik[1], Sampa Banerjee[1]

[1]Department of Zoology, University of Calcutta, 35 Ballygunge Circular Road, Kolkata, India

[2] Department of Zoology, Kulti College, Kulti, Paschim Barddhaman, India

***Presenting Author:**shreyabrahma@gmail.com

Climate change is recognized as human activity linked modification of the global atmosphere in addition to the natural variability. Temperature is one of the fundamental indicators of the global climate change, since it acts as an energy gauge for the entire Earth system. An increment of 0.06°C in the global surface temperature per decade since the nineteenth century is known, with the year 2024 recording the highest average surface temperature of 13.5°C. Among the various predictions, the increment in the temperature may provide an opportunity for the transmission of the mosquito-borne diseases. Such possibilities would require the adaptations of the mosquito with the increment in the temperature. An empirical study supported that the mosquitoes Culex quinquefasciatus Say, 1823, Aedes aegypti (Linnaeus, 1762) and Aedes albopictus (Skuse, 1894) developed faster, with smaller size adult with the ambient temperature between 30°C and 35°C, compared to lower temperatures (15°C and 25°C). The short development time and the small sized adult would mean faster transmission of the diseases and range expansion of these mosquitoes. Owing to the climate change, increased rainfall may facilitate the abundance of mosquitoes in different regions of the globe. The prevalence of the mosquito borne diseases will be higher in the endemic regions as well as several other regions with increment in the temperature. However, a lower survival and increased mortality may be observed for the mosquitoes at high temperatures. A possible range expansion of the mosquitoes will also require the parasites and pathogens to coevolve to cause the menace. The life cycle adaptation of the mosquitoes to temperature increment is suggestive of the amplification of mosquito borne epidemics in different parts of the Earth.

Keywords: Temperature, Mosquitoes Culex, Amplification, Transmission, Mosquito borne epidemics

PP6. Comparative Evaluation of Coincubation and Postincubation Approaches Using Cell Free Supernatant of Lactic Acid Bacteria Against Klebsiella pneumoniae Biofilms

Parama Das Gupta[1]*, Shilpa Ghosh[2] and Tapti Sengupta[3]

[1] Department of Microbiology, Bidhannagar College, Kolkata, West Bengal, India

[2] Kolkata Biotech Park (Parasmoni Organic &Agri Product Pvt. Ltd.), Kolkata, West Bengal, India

***Presenting Author:** paramadasguptamicro@gmail.com

Klebsiella pneumoniae is a clinically significant multidrug-resistant (MDR) opportunistic pathogen responsible for various healthcare-associated infections. Its ability to form robust biofilms on abiotic surfaces, particularly on indwelling medical devices such as catheters and ventilators, contributes to persistent infections and treatment failure. Biofilm-associated cells exhibit enhanced tolerance to antimicrobial agents and host immune defenses due to extracellular polymeric substance (EPS) production, reduced metabolic activity of persister cells, and the expression of antibiotic-inactivating enzymes, including carbapenemases and extended-spectrum β-lactamases (ESBLs). These factors greatly limit the effectiveness of conventional antibiotic therapies, necessitating alternative antibiofilm strategies. In this study, the antibiofilm potential of cell free supernatants (CFS) derived from three lactic acid bacteria (LAB) strains—BNCDGG1, BNCDGG2, and BNCDGG3—isolated from curd was evaluated against Klebsiealla pneumoniae. Two experimental approaches were employed: a coincubation strategy to assess inhibition of early biofilm formation, and a postincubation strategy to evaluate effects on established mature biofilms. Biofilm structure and integrity were examined using bright-field and fluorescence microscopy. Microscopic observations revealed significant disruption of biofilm architecture following treatment with LAB-derived CFS, evidenced by reduced biofilm density and altered organization. The coincubation approach exhibited stronger inhibitory effects than postincubation treatment, indicating greater efficacy during early biofilm development. Among the tested strains, BNCDGG3-derived CFS showed the highest antibiofilm activity, causing notable reduction of EPS and biofilm-associated proteins and pronounced disintegration of the biofilm matrix. Overall, these findings highlight the potential of LAB-derived CFS as promising alternative or adjunctive strategies for managing MDR Klebsiella pneumoniae biofilm-associated infections.

Keywords: Multidrug-resistant, Conventional antibiotic therapies, Extended-spectrum β-lactamases

PP7. A Little Pond? It's Worthy. Study of Pond Biodiversity and Physico-Chemical Properties of Budhha Talab, Asansol, West Bengal

Anamika Kumari

Department of Zoology, Asansol Girls' College

Presenting Author: kumarianamika726@gmail.com

Pond ecosystems are small, shallow, lentic, freshwater bodies that host great biodiversity and play important role in biogeochemical cycles.

Ponds are useful in many ways. It plays significant ecological roles and also used for domestic purposes. In many areas of India pond water is also used for drinking and other household works and for animals.

In India, very few studies have been made to understand the physico-chemical properties of pond. The pond ecosystems are definitely under threat. Biological oxygen demand, eutrophication, siltation, sedimentation and deterioration in water quality and shrinking of ponds are major problems in India due to various man- made activities. Anthropogenic nutrient enrichment and water pollution causes serious changes in the physical and chemical properties of aquatic water bodies. All these properties have effect on the biodiversity of the pond ecosystems because different species live within specific range of each specific factor.

The following study is designed to assess the quality of pond water of Budhha Talab, in Paschim Bardhaman district of West Bengal with respect to the physico-chemical parameters including temperature, pH, Dissolve Oxygen, Free Carbon dioxide, turbidity, presence of chloride, sulphate, nitrate, calcium etc.

In this investigation, a brief attempt has been made to study the extent of change in the quality of water in comparison to water quality standards of World Health Organization. We also studied the biodiversity of the pond Budhha Talab and tried to take steps to conserve the pond water quality and its biodiversity.

Keywords: Physico-chemical properties, World Health Organization, Biodiversity, Investigation

PP8. Assessment of Withdrawal Period of Antimicrobial Sulfadimethoxine in Edible Tissues of Striped Catfish (Pangasianodonhypophthalmus) (Sauvage, 1878)

Sohini Chatterjee[1,2]*, Tapti Sengupta[2], Sanjib Kumar Manna[1], Nilemesh Das[1], Asit Kumar Bera[1], Basanta Kumar Das[1], Ranjith Kumar Nadella[3], Rajisha Ravindran[3] and Prasanna Kumar Patil[3]

[1]ICAR- Central Inland Fisheries Research Institute, Barrackpore, West Bengal

[2]West Bengal State University, North 24 Parganas, Malikapur, Berunanpukuria, Barasat, Kolkata, West Bengal

[3]ICAR- Central Institute of Fisheries Technology, CIFT Junction, Willingdon Island, Matsyapuri P.O., Cochin, Kerala

[3]ICAR- Central Institute of Brackishwater Aquaculture, Santhome High Road, RA Puram, MRC Nagar, Chennai, Tamil Nadu

***Presenting Author:** sohinisc14@gmail.com

With the boom in aquaculture sector worldwide, various types of antimicrobials, chemicals, pesticides find its substantial use to prevent disease progression. Imprudent use of antimicrobials, sometimes ignoring national and international regulations can promote disease resistance, environmental perturbations and other adverse impacts, overall hampering consumer health. Accumulation and depletion of the widely used sulfonamideSulfadimethoxine (SDM) was studied in catfish Pangasianodonhypophthalmus, a finfish with increasing commercial significance, for consumer health safety. Approved by USFDA to treat furunculosis in salmon and trout as well as enteric septicemia in catfish, it is one of the three drugs allowed for food fish. Fish with average body weight of 25±1.8 g was in-feed administered at the therapeutic dose of 42mg kg -1body weight for 10 days and its residue in fish flesh and liver were monitored in LC-MS/MS for another 20 days. Results revealed that, post one day of drug cessation, residue level of SDM sharply fell in muscle from 2440±243.5 µg kg-1 to 55.3±5.51 µg kg-1 on day 6, quite lower than the Maximum Residue Limit (MRL) value assigned by EU commission i.e., 100 µg kg-1. Regression equation analysis estimated a withdrawal period of 8 days and projected value of 17 days (tolerance and confidence level 95%) on the

basis of total drug residue in muscle. As the water temperature was estimated to be 28±1.7°C, 476 degree days can be recommended as withdrawal.

Keywords: Antimicrobials, Chemicals, Pesticides, Environmental perturbations, Pangasianodonhypophthalmus

PP9. Exploration of Antibacterial Rhizospheric Microbes from Soil: A Step Towards Novel Bioactive Agents

Arpan Roy*, Aditya Bhattacharya and Rajat Pal

Department of Microbiology, Sister Nivedita University, Kolkata, WestBengal

***Presenting author:** arpanroy5270@gmail.com

Antimicrobial Resistance (AMR) is a global threat that is rising rapidly over the past few decades with billions of lives being affective annually mainly due to the declining efficacy of both traditional and conventional antibiotics. This escalating therapeutic crisis demands the discovery of novel bioactive compounds. Soil, in particular, the rhizosphere, harbours a wide variety of microorganisms that have been known to produce bioactive secondary metabolites as part of their survival mechanism in harsh conditions. These metabolites are highly effective against harmful microorganisms. This study highlights rhizospheric soil as a valuable habitat for isolating microorganisms capable of producing new bioactive agents with potential therapeutic applications. For this study, soil samples were collected from rhizospheric regions of Mangifera indica in two ecologically distinct environments – Nagerbazar(urban) and Kalyani(semi-urban). Multiple bacterial isolates were obtained, from the soil sample and the antagonistic activity of these isolates was evaluated against four bacterial strains – Escherichia coli, Pseudomonas sp., Staphylococcus gallinarum and Klebsiella sp., using further screening procedures. The results showed that multiple isolates of both the soil samples are capable of producing potential novel bioactive agents. This study also opens avenues for future research aimed at identification of the novel bioactive compounds, their mechanism of action and comparison of their efficacy with existing bioactive compounds in regards to therapeutic treatments.

Keywords: Antimicrobial Resistance, Bioactive, Screening procedures, Mangifera indica

PP10. Evaluation of the Biochemical Effects of Cuminaldehyde in Enhancing the Efficacy of Vancomycin Against Methicillin-Resistant *Staphylococcus aureus*

Payel Ghosh* and Ranojit Kumar Sarker

[1] Department of Biotechnology, The Neotia University, South 24 Parganas, West Bengal, India

***Presenting Author:** payelghosh5555@gmail.com

Methicillin-resistant Staphylococcus aureus (MRSA) poses a serious public health challenge due to its formidable resistance to antibiotics and its ability to form resilient biofilms. Our study investigates the combined antibacterial and antibiofilm effects of cuminaldehyde, a naturally occurring phytochemical, and vancomycin against MRSA strains. While both agents demonstrate individual antimicrobial activity, their combination markedly enhances

effectiveness, producing superior additive effects. We utilized response surface methodology (RSM) to optimize the concentrations of the combined treatment, resulting in significant inhibition of MRSA growth ($p < 0.05$). Notably, sub-minimum inhibitory concentration (subMIC) levels of this combination effectively hindered biofilm formation by curtailing bacterial adhesion, reducing the production of extracellular polysaccharides, and lowering the content of biofilm-related proteins. Through mechanistic analysis, we observed heightened oxidative stress, evidenced by a 2.5-fold increase in intracellular reactive oxygen species and a 2.3-fold decrease in membrane integrity. Additionally, this combination significantly diminished key virulence factors such as protease, hemolysin, and coagulase activity while lowering overall metabolic activity in MRSA. These compelling findings suggest that the cuminaldehyde–vancomycin combination presents an innovative and effective strategy for enhancing antimicrobial and antibiofilm interventions, offering new hope in the fight against MRSArelated infections.

Keywords: Methicillin-resistant Staphylococcus aureus, Enhancing antimicrobial, Antibiofilm interventions

PP11. When Celebrations Pollute: Wedding-Season Firecrackers and Acute Spikes in $PM_{2.5}$, PM_{10}, and Carbon Monoxide

Shilpi Show Mandal*, Abhipsa Paul and Amit Biswas

[1] Department of Physics, BanwarilalBhalotia College, Asansol, West Bengal, India

***Presenting Author:** sssurosa@gmail.com

Air pollution remains one of the most pressing environmental health challenges globally, with particulate matter (PM) and carbon monoxide (CO) posing serious risks to human health. While vehicular emissions, industrial activities, and biomass burning are well-recognized sources of air pollution, episodic yet intense emissions from firecracker use during wedding seasons remain underexplored. This study examines the contribution of wedding-season firecracker activities to acute spikes in $PM_{2.5}$, PM_{10}, and CO concentrations and their potential implications for public health.

$PM_{2.5}$, due to its ability to penetrate deep into the alveolar regions of the lungs and enter systemic circulation, and PM_{10}, which primarily affects the upper respiratory tract, are associated with a wide range of adverse health outcomes. Short-term exposure to elevated levels of these pollutants has been linked to respiratory irritation, asthma exacerbation, chronic obstructive pulmonary disease (COPD), cardiovascular stress, and increased hospital admissions. Carbon monoxide exposure further compounds these risks by impairing oxygen delivery in the body, leading to headaches, dizziness, and in severe cases, cardiovascular and neurological effects.

Observational evidence indicates that wedding-season celebrations involving extensive firecracker use lead to sharp, short-duration elevations in ambient PM_{10}, PM_{10}, and CO levels, often exceeding national and World Health Organization air quality guidelines. Such pollution episodes disproportionately affect vulnerable populations, including children, the elderly, and individuals with pre-existing respiratory or cardiovascular conditions.

The findings highlight the need for targeted regulatory measures, improved air-quality monitoring during festive periods, public awareness campaigns, and promotion of cleaner celebration practices. Addressing culturally driven yet environmentally harmful practices is essential for mitigating acute pollution episodes and safeguarding public health while maintaining social traditions.

Keywords: Chronic obstructive pulmonary disease, Observational evidence, Cardiovascular, Pollution episodes

PP12. Biofuels: Renewable Energy from Biological Resources

Dipendrani Banerjee, Somashri Mukherjee, Swati Gupta, Indrani Sarkar, Priyanka Bauri, Epil Baskey, Anjali Kumari[1] and Firdoshiya Afrin[1]

Department of Botany, Asansol Girls' College, Asansol, West Bengal, India

Biofuels are renewable energy sources derived from biological materials such as plants, agricultural residues, algae, and organic wastes. They are considered an eco-friendly alternative to fossil fuels because they are biodegradable, produce fewer greenhouse gas emissions, and help reduce dependence on non-renewable energy resources. The major types of biofuels include bioethanol, biodiesel, and biogas. Bioethanol is commonly produced by fermenting sugar- or starch-rich crops such as sugarcane, corn, and wheat, and is often blended with petrol to power vehicles. Biodiesel is obtained from vegetable oils, animal fats, or used cooking oil through a chemical process called transesterification, and can be used as a substitute for diesel fuel. Biogas is produced through the anaerobic digestion of organic waste materials like animal manure, food waste, and sewage, and is mainly used for cooking and electricity generation.

Biofuels are classified into different generations based on their sources. First-generation biofuels are derived from food crops, while second-generation biofuels use non-food biomass such as agricultural waste and lignocellulosic materials. Third-generation biofuels are produced from algae, which have high productivity and do not compete with food crops for land.

Despite their advantages, biofuels also face challenges such as high production costs, land use concerns, and potential impacts on food security. However, ongoing research and technological advancements aim to improve efficiency and sustainability. Overall, biofuels represent a promising renewable energy option for reducing environmental pollution and promoting sustainable development.

Keywords: Renewable energy, Sustainable development, Environmental pollution, Biofuels

PP13. Deinococcusradiodurans- Derived Microvesicles as Radioprotectors

Ramanada Besra* and Susamay Roy

Department of Microbiology, Vijaygarh Jyotish Ray College (Affiliated to University of Calcutta)

***Presenting Author:** besraramananda@gmail.com

Radiation represents one of the most transformative scientific forces harnessed by humankind. It has significantly accelerated technological and medical advancement, contributing to diagnostic imaging, radiotherapy, nuclear energy production, and space exploration. In many respects, radiation has propelled human civilization toward

scientific excellence. However, this advancement is accompanied by profound biological consequences. Exposure to ionizing radiation induces DNA strand breaks, genomic instability, oxidative stress, and cellular apoptosis, ultimately leading to tissue damage, carcinogenesis, and acute radiation syndrome at higher doses. Despite decades of investigation, an ideal and universally effective radioprotective strategy remains elusive. Currently, only a few pharmacological agents are approved for clinical use. Among them, Amifostine is the most prominent FDA-approved radioprotectant. Although it acts as a free radical scavenger and provides selective protection to normal tissues, its clinical application is limited due to side effects such as hypotension, nausea, and vomiting, along with its selective mode of action.

In recent years, researchers have reported that extracellular vesicles (EVs) derived from Deinococcusradiodurans, an extremophilic bacterium renowned for its extraordinary radioresistance, may serve as a potential radioprotectant. Proteomic analyses have identified the presence of multiple oxidative stress–reducing proteins within these EVs. Experimental studies demonstrated that administration of these EVs into mice resulted in no observable side effects and an approximate 85% survival rate following radiation exposure. Nevertheless, research in this area remains limited, and further comprehensive investigations are essential before definitive conclusions can be drawn.

Keywords: Extracellular vesicles, Deinococcusradiodurans, Administration, Researchers

PP14. Nature-Driven Synthesis of Fluorescent Silver Nanoparticles Using Gymnadeniaorchidis Root Extracts

Rima Debnath and Dr. Shilpi Show Mandal*

Department of Physics, BanwarilalBhalotia College, Asansol, West Bengal

***Presenting Author:** sssurosa@gmail.com

A rapid, one-pot, and green biosynthesis of stable fluorescent silver nanoparticles (Ag-NPs) was achieved using Gymnadeniaorchidis Lindl. Root extract at ambient temperature. Formation of Ag-NPs was confirmed by surface plasmon resonance at 439 nm. The nanoparticles exhibited strong fluorescence with two characteristic emission peaks at 610 and 780 nm. FTIR analysis indicated the presence of biofunctional groups from the root extract on the nanoparticle surface, acting as natural reducing and stabilizing agents. XRD results confirmed a face-centered cubic crystalline structure, while FESEM revealed predominantly spherical Ag-NPs with an average particle size of 28 ± 2 nm (n = 100). Zeta potential measurements demonstrated good colloidal stability under neutral pH conditions. The biosynthesized Ag-NPs showed enhanced antioxidant activity and notable photocatalytic degradation of methylene blue dye, attributed to protein-based biomolecules associated with the nanoparticles. Additionally, significant antibacterial activity was observed against Gram-positive Staphylococcus aureus. This study highlights a simple, eco-friendly strategy for producing fluorescent Ag-NPs with promising biological and environmental applications.

Keywords: Environmental, Gram-positive Staphylococcus aureus, Predominantly, Fluorescent silver nanoparticles

PP15. Cloning of Hs ATD (*Homo sapiens* Animalia-Specific tRNA Deacylase) and Hs EPRS (*Homo sapiens* Bifunctional Glutamyl-Prolyl tRNA Synthetase) in Yeast Expression Constructs

Gopal Dutta[1]*, Rathin Das[1], Soumabrata Pal[1] and Rajan Sankaranarayan[2]

[1] Department of Microbiology, Ramakrishna Mission Vivekananda Centenary College, Rahara, Kolkata, West Bengal, India

[2] Structural Biology Lab, CSIR–CCMB, Hyderabad, Telangana, India

***Presenting Author:** gdutta538@gmail.com

The specificity of the aminoacyl tRNA synthetases (aaRS), which load specific tRNAs with specific amino acids, makes much of the fidelity of protein synthesis depend on it. In the metazoan lineage, the two types of tRNA synthetases (glutamyl-tRNA and prolyl-tRNA) are fused into a single polypeptide which is bifunctional glutamyl prolyl tRNA synthetase (EPRS). Complementary to this, the tRNA deacylase (ATD) which is Animalia-specific is a proofreading enzyme that fixes mischarged tRNA, especially the incorrect binding of L -alanine to tRNA Thr. Some early evidence of an interaction in vivo has been implicational interaction of ATD with EPRS which stabilizes a functional complex.

To enable a system-wide analysis in both biochemical and structural studies in a eukaryotic system, this study cloned human ATD (Hs ATD) and human EPRS (Hs EPRS) into yeast expression vectors (pGAL). The technique employed an amplification of the genes through a gradient and ramp down PCR scheme with results of about 609 base pairs in case of Hs ATD and 4.7 kbp in case of Hs EPRS. Linearized pGAL vectors (~7.1 kbp) into which these amplicons were inserted were made using Gibson Assembly and Restriction Free (RF) cloning. It was then transformed into Escherichia coli DH5α since this was the initial successful plasmid construction and could then be followed up with colony PCR and sequencing and after that we will go through protein extraction by SDS-PAGE, western blot, chromatographic techniques for protein extraction, X-ray crystallography or cryo-electron microscopy for protein structure prediction. The resultant constructs of this expression system are a formidable platform of heterologous expression and subsequently allow the study of translational quality control processes and protein interactions in a system that supports correct eukaryotic folding and post-translational modification. Preliminary experiments suggest that ATD and EPRS interact and form a stable complex in vivo. To understand the reasoning behind this complex formation and EPRS structure prediction, go through with this process.

Keywords: Implicational interaction, Cloned human, Linearized, Chromatographic techniques

PP16. AI-Based Diagnostic Imaging and Disease Prediction

Shreya Maity, Selimunna Sardar*, Raj SK and Abdul Sahid

Medical Lab Technology, Department of Allied Health Sciences, Brainware University, Kolkata, India

***Presenting Author:** bwubmt23008@brainwareuniversity.ac.in

Computers are changing how we find and treat diseases. Looking at medical pictures is a big part of how doctors figure out problems early and effortlessly. These days, smart computers are uses smart math to find patterns. They can scan through images like X-rays or brain scans much faster than a person can. Basically, this helps catch

diseases early and stops small issues from becoming big problems. These tools are great at finding tiny patterns that the human eye might miss. Doctors are now using these methods to tackle things like cancer, heart disease, and memory loss. The software learns from thousands of old cases to figure out what might happen in a new patient. It is like having a highly qualified expert that never gets tired. On top of that, these systems can check info from digital health records and even wearable gadgets which gives a clearer picture of a person's overall health over a long period. But we have to be smart about how we use it. Honestly, it is not always perfect. If the data we give the computer is messy, the answer it gives back won't be helpful. Despite a number of challenges that still need to be addressed, the potential advantages are great. The application of these technologies allows doctors to spend more time on the patient that is actually in the room. As these technologies continue to evolve, they are likely to become an integral part of the standard examination. The ultimate goal is simple: to use technology to help people live longer and healthier lives.

Keywords: Examination, Technology, X-rays, Effortlessly, Healthier

PP17. Effect of Roasting and Oil Treatments on Antioxidant and Anti-Inflatory Activity of Pumpkin Seed–Based Energy Balls

Shreejita Saha[1], Beepsa Basu[2] and Atreyi Ghosh[3]

[1] Department of Microbiology, School of Health Sciences and Translational Research, Sister Nivedita University, India

[2] Department of Nutrition, School of Health Sciences and Translational Research, Sister Nivedita University, India

[3] Sister Nivedita University, India

There is increasing interest in the development of plant-based functional foods enriched with bioactive compounds that promote health benefits such as antioxidant and anti-inflammatory activities. Pumpkin seeds are known to be rich sources of phenolic, flavonoids, essential fatty acids, and other bioactive constituents. The present study aimed to evaluate the effect of different processing treatments on the antioxidant and anti-inflammatory potential of pumpkin seed–based energy balls. Raw pumpkin seeds were subjected to three different treatments: (1) dry roasting, (2) oil treatment with sunflower oil, and (3) oil treatment with mustard oil. Treated seeds were incorporated into a standardized formulation to prepare energy balls as a value-added functional food product. Extracts of each treated sample were prepared for further biochemical analysis. Antioxidant activity was assessed using established methods including DPPH radical scavenging assay, Ferric Reducing Antioxidant Power (FRAP), and determination of total phenolic and flavonoid contents following standard protocols described in the reference paper. Results indicated significant variation in antioxidant and anti-inflammatory activities among the three treatment groups. Processing conditions influenced the retention and availability of bioactive compounds. This study highlights the impact of thermal and oil-based processing on the functional quality of pumpkin seed–based food products. The findings support the development of nutritionally enriched energy balls as a convenient functional snack with potential health benefits.

Keywords: Plant-based functional foods, Antioxidant activity, Antioxidant and Anti-inflammatory

PP18. A Soil-Isolated Bacterium: Exploring Its Agricultural and Biomedical Applications

Deep Sengupta[1]*, Sahil Maity and Rajat Pal

Department of Microbiology and Department of Biotechnology, Sister Nivedita University, Kolkata, India

***Presenting Author:** deepsengupta369@gmail.com

Soil bacteria play a crucial role in maintaining terrestrial ecosystem balance and agricultural productivity. In this study, a soil bacterium that produces pigment was isolated and its multifunctional potential was biochemically characterized. The isolate showed a strong capacity to promote plant growth by synthesizing the phytohormone Indole-3-acetic acid (IAA). Additional characterization verified the production of siderophores on Chrome Azurol S (CAS) agar, ammonia generation, positive zinc solubilization activity, and phosphate solubilization on Pokrovsky's and NBRIP agar (clear halo formation). Together, these characteristics demonstrate its potential as a sustainable Plant Growth Promoting Rhizobacteria (PGPR), promoting nitrogen supply, nutrient availability, and phytopathogen biocontrol.

Apart from its capacity to stimulate plant growth, the isolated bacterium was investigated for its potential to produce bioelectricity in a pigment-assisted Microbial Fuel Cell (MFC). By acting as an electron shuttle, the bacterial pigment enhances electron transfer and generates stable bioelectricity. This energy is utilized to operate a wearable; self-powered patch designed for continuous immune monitoring.

The patch selectively detects different inflammatory cytokines by using graphene oxide microneedles to access interstitial fluid. Measurable voltage changes result from their interaction with graphene oxide, which modifies its electrical characteristics. Without the need for external power, these signals are recorded, processed, and wirelessly transmitted to allow for early, portable, and real-time immune status evaluation.

Keywords: Immune monitoring, Evaluation, Ammonia generation, Positive zinc solubilization activity

PP19. Biological Evaluation of *Justicia adhatoda* Essential Oil: Prospects for Nano-Formulation and Therapeutic Use

Avinaba Choudhury*, Arpan Roy, Nikita Asopa, Sadhika Singh and Rajat Pal

Department of Microbiology and Department of Biotechnology, Sister Nivedita University, Kolkata, India

***Presenting Author:** avinabach2004@gmail.com

Essential oils derived from medicinal plants have gained significant attention due to their diverse biological activities and potential role in combating multidrug-resistant microorganisms. The present study focuses on the extraction, chemical characterization, and biological evaluation of essential oils obtained from the medicinal plant Justicia adhatoda (Basak). Essential oils were extracted from plant leaves using the hydro-distillation method, followed by solvent removal using a rotary evaporator. The biological potential of the essential oils was assessed through antioxidant, oxidative stress, and antimicrobial studies, with oxidative stress assays conducted on bacterial cells. Antimicrobial efficacy was evaluated against clinically relevant strains of Escherichia coli using minimum inhibitory concentration (MIC) assays and through comparative analysis with standard antibiotic such as Tetracycline. The results were used to assess the relative antibacterial effectiveness of the essential oil. Further studies are planned

to investigate combination therapy and determine the fractional inhibitory concentration index (FICI) to evaluate possible synergistic interactions. In addition, future work includes the development of nano-emulsions from the extracted essential oils, followed by structural characterization and evaluation of their antibacterial and wound-healing activities, with the expectation that nano-formulation may enhance bioavailability and therapeutic efficacy.

Keywords: Structural characterization, Bioavailability, Therapeutic efficacy, Nano-formulation

PP20. Biotechnological Advancements in Viral Monitoring

Pawlina Mandal*, Rehana Mondal and Sabana Yesmin

Medical Lab Technology, Department of Allied Health Sciences, Brainware University, Kolkata, India

***Presenting Author:** bwubmt23064@brainwareuniversity.ac.in

The challenge of rapid pathogen discovery for emergent respiratory pathogens, such as novel coronaviruses (nCoV) and respiratory syncytial virus (RSV), requires a diagnostic strategy that integrates the need for speed with genomic accuracy. This study evaluates the effectiveness of liquid-phase nucleic acid hybridization and next-generation sequencing (NGS) as complementary tools for comprehensive viral analysis. Liquid-phase hybridization was carried out using fluorescence and flow cytometry with a microchip platform to facilitate high-throughput analysis, focusing on sensitivity and rapid detection capabilities at strategic surveillance points such as entry and exit points. At the same time, sequencing-by-synthesis-based NGS was utilized for the detection of unknown pathogens and the identification of new mutations through comprehensive sequence analysis. Liquid-phase hybridization showed significant improvements in terms of rapid diagnostic capabilities and the ability to distinguish different coronavirus samples, although it showed high levels of cross-reactivity. On the other hand, NGS provided unprecedented sensitivity for the detection of exogenous nucleic acids and new mutations, although it had drawbacks such as high operating costs, long analysis times, and the potential for false positives due to background nucleic acid contamination. Comprehensive viral surveillance, therefore, demands a multi-tiered approach. Liquid-phase hybridization can serve as a useful tool for rapid and high-throughput screening in transit points, while NGS remains the gold standard for comprehensive analysis of new genetic variants. A combination of the two technologies can potentially improve the detection of respiratory threats while addressing the limitations of each technology.

Keywords: Comprehensive viral surveillance, Limitations, Sequencing-by-synthesis-based, Respiratory pathogens

PP21. Medical Diagnostics and Imaging

Divya Nandan

Department of Zoology, Asansol Girls' College

Presenting Author: nandandivya27@gmail.com

Medical diagnostics and imaging are essential components of modern healthcare, playing a critical role in early disease detection, accurate diagnosis, and effective treatment planning. Significant advances in molecular diagnostics have transformed disease identification by enabling precise analysis of genetic, proteomic, and biochemical markers. Techniques such as polymerase chain reaction, next-generation sequencing, and biomarker-based assays allow early detection of infectious diseases, inherited disorders, and cancers, often before clinical

symptoms appear. In parallel, medical imaging technologies including X-ray, computed tomography, magnetic resonance imaging, ultrasound, and positron emission tomography provide non-invasive visualization of internal organs and tissues, supporting diagnosis, monitoring disease progression, and guiding therapeutic interventions. The integration of artificial intelligence into diagnostic imaging has further enhanced accuracy and efficiency by enabling automated image analysis, pattern recognition, and predictive modeling. AI-based systems assist clinicians by detecting subtle abnormalities, reducing human error, and supporting early disease prediction in conditions such as cancer, neurological disorders, cardiovascular diseases, and metabolic syndromes. Furthermore, AI-driven diagnostics contribute to personalized medicine by predicting disease risk and treatment response based on individual patient data. The combined application of molecular diagnostics, advanced imaging modalities, and AI-based analytical tools represents a transformative shift in medical diagnostics. This integrated approach improves diagnostic precision, facilitates timely intervention, and holds great promise for enhancing patient care, clinical decision-making, and overall healthcare outcomes.

Keywords: Clinical decision-making, Pattern recognition, Predictive modeling, Molecular diagnostics

PP22. Isolation and Identification of *Staphylococcus* Species from Human Skin, Scalp, and Foot Samples

Sayanika Mitra[1]*, Shreyoshi Bhattacharjee[2], Prettika Lahiri[2], Ranjit Bhowmick[3] and Atreyi Ghosh[4]

[1] Department of Biotechnology, School of Health Sciences and Translational Research, Sister Nivedita University, India

[2] Department of Microbiology, School of Health Sciences and Translational Research, Sister Nivedita University, India

[3] Department of Nutrition, School of Health Sciences and Translational Research, Sister Nivedita University, India

[4] Sister Nivedita University, India

***Presenting Author:** sayanikam11@gmail.com

Staphylococcus a common inhabitant of human skin and mucous membrane is a genus of Gram-positive, facultative anaerobic bacteria. They are among the leading causes of bacterial infections worldwide, including skin infections, pneumonia, bacteremia, and endocarditis which makes their scientific studies significant. With of aim of successful isolation of Staphylococcus strains foot, skin and scalp were collected using standard microbiological methods. The samples were aseptically collected using a cotton swab and streaked on mannitol salt agar, a selective and differential medium that favours the growth of salt-tolerant Staphylococci and allows differentiation based on mannitol fermentation. Distinct colonies were examined for characteristic morphology and pigmentation, followed by Gram staining, which revealed Gram-positive cocci arranged in clusters. Further confirmation was carried out using biochemical tests such as catalase, IMViC and triple sugar iron test. This approach enabled successful isolation and identification of Staphylococcus species commonly associated scalp microflora.

Keywords: Staphylococcus, Skin microflora, Mannitol salt agar, Gram staining, Biochemical tests

PP23. Formulation of Riboflavin-Encapsulated Chitosan Nanoparticles: Characterization, Encapsulation Efficiency, and Stability Studies

Sohni Chowdhary[1], Debasmita Das[1] and Somsubhra Thakur Choudhury[2]

[1] Department of Biotechnology, School of Health Sciences and Translational Research, Sister Nivedita University, India

[2] Department of Biotechnology, Sister Nivedita University, India

Nanotechnology has transformed pharmaceutical sciences by enabling nanocarriers (1–100 nm) that improve drug bioavailability, stability, targeted delivery, and controlled release while reducing toxicity and enzymatic degradation. Chitosan nanoparticles (ChNPs), derived from deacetylation of chitin from crustacean shells, stand out as biodegradable, biocompatible, mucoadhesive carriers with superior stability compared to liposomes. Their cationic nature and functional amino/hydroxyl groups facilitate efficient encapsulation of poorly soluble or light-sensitive drugs like riboflavin (Vitamin B2), essential for energy metabolism and cell growth, but limited by low solubility, photodegradation, and gastrointestinal instability. Encapsulation in ChNPs enhances riboflavin's photostability, protects against enzymatic breakdown, enables sustained release, and may impart antimicrobial effects via ROS generation under UV light—offering potential in biomedicine, nutraceuticals, and food fortification.

This laboratory study utilized the ionic gelation method to prepare riboflavin-loaded ChNPs. Chitosan (MW 3,800–20,000 Da, DD ≥75%) was dissolved in 2% acetic acid (pH 5.0), mixed with riboflavin in PBS, and crosslinked with sodium tripolyphosphate (TPP) under stirring, followed by centrifugation and resuspension in PBS. Results showed an encapsulation efficiency of ≈49.8%. Dynamic light scattering (DLS) revealed particle sizes ≈322.5 nm. In vitro release at 37°C exhibited slow initial kinetics, accelerating thereafter. Thermal stability was highest at 4°C (minimal degradation over 72 h), moderate at 37°C, and lowest at 50°C (rapid release/degradation).

This proof-of-concept highlights ChNPs as promising, eco-friendly carriers for riboflavin, demonstrating improved stability and controlled release with scope for size optimization and enhanced scalability in therapeutic and food applications.

Keywords: Nanotechnology, Dynamic light scattering, Chitosan nanoparticles, Eco-friendly carriers

PP24. Biosynthesis of Silver Nanoparticles Using Soil Microorganisms: Characterization and Antimicrobial Potential

Archita Saha[1], Pritha Pain[1], Suman Sekhar[1] and Somsubhra Thakur Choudhury[2]

[1] Department of Biotechnology, School of Health Sciences and Translational Research, Sister Nivedita University, India

[2] Department of Biotechnology, Sister Nivedita University, India

In the modern era, nanotechnology has revolutionized biological sciences by enabling the development of metal nanoparticles with unique physicochemical properties for applications in catalysis, drug delivery, cancer treatment, gene therapy, and antimicrobial agents. Silver nanoparticles (AgNPs), in particular, stand out due to their potent antibacterial effects against multidrug-resistant pathogens. Traditional chemical synthesis methods often involve toxic reagents, compromising biomedical safety and environmental sustainability. This underscores the need for

eco-friendly biogenic approaches using microorganisms, which leverage enzymatic processes like nitrate reductase to reduce silver ions into stable nanoparticles in a cost-effective, non-toxic manner.

This laboratory-scale study explores the biosynthesis of AgNPs using bacteria isolated from coal mine soils in Jamshedpur and Dhanbad. Fifteen strains were isolated via serial dilution; potent reducers were selected for extracellular synthesis from AgNO3 at 50 mM and 75 mM concentrations. AgNPs were characterized by UV-Vis spectroscopy (absorption peaks confirming formation), FTIR (identifying functional groups), and SEM (sizes ≈80–100 nm). Antimicrobial efficacy was assessed via well diffusion against Bacillus, Staphylococcus, E. coli, Klebsiella, and Pseudomonas, revealing clear inhibition zones, often surpassing AgNO3 controls. Bacterial strains were identified as cocci (Gram-positive and Gram-negative) via staining and biochemical tests (catalase-positive, oxidase-negative).

This proof-of-concept highlights the viability of microbial-mediated AgNP synthesis for sustainable, therapeutic innovations, with scope for genomic optimization to enhance stability and efficacy.

Keywords: Cocci, Spectroscopy, Pseudomonas, Bacterial strains, Genomic optimization

PP25. Sustainable Dual Biofuel Production: Second-Generation Bioethanol from Rice Straw and Subsequent Biodiesel Synthesis

Akanksha Chowdhury[1], Abhranil Samanta[1] and Somsubhra Thakur Choudhury[2]

[1] Department of Biotechnology, School of Health Sciences and Translational Research, Sister Nivedita University, India

[2] Associate Professor, Department of Biotechnology, Sister Nivedita University, India

Rising fossil fuel demand and environmental concerns have intensified the search for renewable alternatives. This laboratory-scale study demonstrates an integrated, eco-friendly process to valorize rice straw—a widely available agricultural residue—into second-generation bioethanol, followed by its conversion into biodiesel, aligning with India's Ethanol Blended Petrol (EBP) programme and circular bioeconomy goals.

Cellulase-producing fungi were isolated from decaying soil using carboxymethyl cellulose (CMC) agar and confirmed by Congo red staining, showing clear hydrolysis zones. Microscopic analysis revealed characteristic long rod-shaped mycelia. Pretreatment of sun-dried, chopped, and ground rice straw was performed with the fungal isolate in mineral salt medium (120 rpm, 37°C, 10 days), releasing reducing sugars. The hydrolysate was fermented with baker's yeast (Saccharomyces cerevisiae) at pH 5.0, 30°C, 120 rpm for 7 days. Ethanol was recovered via dichloromethane solvent partitioning, yielding ≈5.6 ml per litre of broth. The bioethanol served as the acyl acceptor in KOH-catalyzed transesterification of coconut oil (60–65°C, 2 h), producing biodiesel and glycerol. The upper biodiesel phase was collected and confirmed by ignition (burn time 2.5–3 min, longer than pure ethanol).

This proof-of-concept workflow successfully transforms rice straw into dual biofuels, offering a promising, low-cost strategy for waste valorization, fossil fuel substitution, and sustainable energy production.

Keywords: Rising fossil fuel, Environmental concerns, Carboxymethyl cellulose, Saccharomyces cerevisiae

PP26. Green Chemistry and Sustainable Biosciences: Role of Green Chemistry in Healthcare, Agriculture and Environment

Avantika Shaw

Department of Zoology, Asansol Girls' College, Asansol, West Bengal

Presenting Author: avantikashaw@email.com

Green chemistry and sustainable biosciences play a crucial role in addressing global challenges related to human health, food security, and environmental protection. Green chemistry emphasizes the design of chemical products and processes that minimize the use and generation of hazardous substances, while sustainable biosciences focus on utilizing biological systems and renewable resources for long-term sustainability.

In healthcare, green chemistry contributes to the development of safer pharmaceuticals by reducing toxic solvents, energy consumption, and chemical waste during drug synthesis. Environmentally benign manufacturing processes improve patient safety and reduce pollution from pharmaceutical industries. In agriculture, green chemistry supports the production of eco-friendly fertilizers, pesticides, and herbicides that are biodegradable and less harmful to soil, water, and non-target organisms. Sustainable biosciences further enhance agricultural practices through biofertilizers, biopesticides, and improved crop varieties, promoting sustainable food production.

From an environmental perspective, green chemistry aims to prevent pollution at the source by promoting renewable raw materials, efficient resource utilization, and waste minimization. Sustainable biosciences contribute through bioremediation techniques, where microorganisms are used to detoxify polluted soil and water naturally. Together, these approaches help conserve natural resources, reduce environmental degradation, and support sustainable development.

Overall, the integration of green chemistry with sustainable biosciences provides an effective pathway toward a cleaner, safer, and more sustainable future for healthcare systems, agriculture, and the environment.

Keywords: Sustainable biosciences, Biodegradable, Manufacturing processes, Green chemistry emphasizes

PP27. The Luminous Coconut Husk: Sustainable and Intelligent Food Packaging

Debanga Halder[1]*, Pritam Das[1], Dipankar Das[2] and Sriparna De[2]

[1] Medical Lab Technology, Department of Allied Health Sciences, Brainware University, Kolkata, India

[2] Department of Allied Health Sciences, Brainware University, Kolkata, India

***Presenting Author:** bwubmt23033@brainwareuniversity.ac.in

Sustainable intelligent packaging protects environmental resources by preventing food products from spoiling. Coconut husk lignin derived pH-responsive carbon dots (CDs) was incorporated into κ-carrageenan matrix. The main aim is to combine intelligent sensing with active preservation by utilization of pH fluorescent response for instant quality evaluation while offering the package added functionality through UV-blocking, antioxidant, antimicrobial properties and extending shelf life by optimizing the oxygen and carbon dioxide transmission. First,

the κ-Carrageenan films and cyclodextrin (CD) composites were prepared by dissolving 1 g of κ-carrageenan in 50 mL water under stirring at 55°C for 30 minutes, followed by addition of 0.3 g glycerol for homogeneity.CD dispersions (0, 1, 2, or 3 wt% relative to carrageenan) were sonicated in 3 mL deionized water and incorporated into the carrageenan-glycerol solution, which was stirred until uniform. The mixtures were cast in Petri dishes and oven-dried at 50°C for 10 hours to form films without shrinkage. The optimized film containing 2 wt% CDs, retained 84% visible transparency while blocking ~70% of UV light, showed a 79% reduction in Oxygen Transmittance Rate (OTR) and an 81% reduction in CO2 permeability, exhibiting a distinct fluorescent colour change due to pH sensitivity and exhibiting high antibacterial activity against Escherichia coli and Staphylococcus aureus. For significance, this study explored pH responsive CDs with potential for intelligent packaging application from agro-biomass. The composite film demonstrated superior UV-blocking, oxygen barrier, and antibacterial efficacy. Furthermore, its pH-responsive fluorescence enabled visual real-time monitoring of food freshness, proving its viability for intelligent beverage preservation and packaging.

Keywords: pH-responsive fluorescence, Homogeneity, Carrageenan, Transparency, UV-blocking, Oxygen barrier

PP28. Crop-Specific Modulation of Urease Activity and Soil Microbial Dynamics in Spinach (*Spinacia oleracea*) and Maize (*Zea mays*) Rhizospheres of the East Calcutta Wetlands: Role in Nitrogen Transformation

Indrani Banerjee Chakraborty[1]*, Mohit Acharjee[1] and Swati Chakraborty[2]

[1] Guru Nanak Institute of Pharmaceutical Science and Technology, 157/F, Nilgunj Road, Panihati, Kolkata, West Bengal, India

[2] Asansol Girls' College, Asansol, West Bengal, India

***Presenting Author:** indrani.banerjeechakraborty@gnipst.ac.in

Excessive application of conventional urea fertilizer as a nitrogen source has emerged as a critical factor influencing soil physicochemical stability, rhizospheric microbial diversity, and nitrogen cycling in intensive agricultural systems. The present study evaluates the physicochemical and microbiological responses of conventional urea fertilizer on the rhizospheric soils of spinach (Spinacia oleracea), a high nitrogen-demand leafy vegetable, and maize (Zea mays), a major cereal crop, cultivated in the ecologically sensitive East Kolkata Wetlands, a Ramsar-designated wetland. The findings elucidate understanding the structure and functional potential of rhizospheric microflora, focusing on ureolytic bacterial proliferation, urease hyperactivity, physicochemical degradation in wetland-based agricultural systems with the ecological importance in sustaining productivity. Antibiotic profiling of the rhizospheric bacterial microbiota revealed strain-specific resistance and dose-dependent sensitivity, with pronounced susceptibility to amoxicillin but widespread resistance to cephalexin and cefixime, indicating fertilizer-driven adaptive stress selection and a probable β-lactamase-mediated resistance mechanism within the rhizosphere microbiome.UV tolerance variability among isolates, coupled with elevated urease activity and increased ammonia release, indicates fertilizer-induced stress adaptation, accelerated nitrogen mineralization, and heightened risk of volatilization-driven nitrogen imbalance. The data revealed that conventional urea application in spinach and maize rhizospheres drives fertilizer-driven microbial proliferation compromising long-term rhizospheric microbial

equilibrium, and promoting dominance of hyper-ureolytic and stress-adapted bacterial populations, and alters soil structural and chemical integrity, coupled with physicochemical alterations, enzymatic hyperactivity, salinity accumulation, localized compaction, and accelerated nitrogen turnover. Integrated nitrogen management strategies, including controlled-release formulations and organic amendments, are essential to maintain soil microbial functionality and long-term ecosystem sustainability.

Keywords: Physicochemical stability, Rhizospheric bacterial microbiota, Probable β-lactamase-mediated

PP29. Isolation and Characterization of Bacterial Pigment from Fluorescent Soil Isolates

Rohan Roy*, Arpan Das and Rajat Pal

Department of Microbiology and Department of Biotechnology, Sister Nivedita University, Kolkata, India

***Presenting Author:** rohanart12345dg@gmail.com

Soil bacteria play a vital role in the terrestrial ecosystem, contributing to the biodiversity within the soil. Among these bacteria, fluorescent species stand out due to their intriguing ability to emit visible light through bioluminescence. In addition to their bioluminescent properties, certain strains of fluorescent bacteria produce pigments with unique spectral characteristics. This study aimed to isolate and characterize the pigment derived from a fluorescent bacterium, focusing on its chemical composition, fluorescence properties, and potential applications. The isolation and characterization of the pigment from the fluorescent bacterium provide valuable insights into its chemical composition, fluorescence properties, and stability. The pigment's distinct spectral characteristics and stability make it a promising candidate for various applications, such as fluorescent labelling, biosensing, and bioimaging. Future studies could explore the pigment's biological functions, optimize its extraction process, and further investigate its potential applications in diverse fields.

Keywords: Bioluminescent properties, Chemical composition, Fluorescence properties, Stability

PP30: Role of plants in soil health and soil fertility

Subarna Ghoshal

Department of Zoology, Asansol Girls' College, Asansol, WB

Presenting Author: subarnaghoshal4@gmail.com

Soil health and soil fertility are essential for sustainable agriculture and ecosystem stability, and plants play a central role in maintaining both. Plants influence soil properties through their roots, litter, and interactions with soil microorganisms. Root systems help improve soil structure by binding soil particles together, reducing erosion, and enhancing water retention. Plant roots also release organic compounds known as root exudates, which stimulate microbial activity and contribute to nutrient cycling. Decomposing plant litter adds organic matter to the soil, improving soil texture, aeration, and moisture-holding capacity.

Plants contribute to soil fertility by facilitating the cycling of essential nutrients such as nitrogen, phosphorus, and potassium. Leguminous plants, for example, form symbiotic associations with nitrogen-fixing bacteria, enriching soil nitrogen content. Mycorrhizal associations enhance nutrient uptake and improve plant resilience. Diverse plant communities promote greater biodiversity in the soil, leading to a more stable and productive ecosystem.

Sustainable agricultural practices that incorporate crop rotation, cover cropping, and organic amendments further enhance the positive impact of plants on soil health. Maintaining plant diversity and minimizing soil disturbance are key strategies for preserving soil structure and microbial balance. Overall, plants play an indispensable role in sustaining soil fertility, supporting agricultural productivity, and maintaining ecological balance.

Keywords: Nitrogen-fixing bacteria, Enriching soil nitrogen content, Soil fertility, Sustainable agricultural

PP31. Natural Food Preservation Using *Justicia adhatoda* Leaf Extract: Antibacterial and Preservative Activity Against Spoilage Microorganisms

Srija Sarkar*, Arpan Roy, Rishav Jee, Agnideep Sau and Rajat Pal

Department of Microbiology, Sister Nivedita University, Kolkata, West Bengal, India

***Presenting Author:** sarkarsrija561@gmail.com

Food spoilage in citrus fruits such as orange mainly occurs due to the growth of bacteria and other microorganisms. The widespread use of chemical preservatives in the food industry has raised concerns regarding their potential health and environmental impacts, leading to increased interest in natural, plant-based alternatives. Justicia adhatoda (Basak) is a medicinal plant known for its antibacterial properties due to the presence of bioactive compounds such as alkaloids and flavonoids. Phytochemical analysis was performed to identify the major bioactive constituents present in the Basak leaf extract. In the present study, the extract was prepared using water as a solvent and evaluated for its antibacterial activity against bacteria isolated from spoiled orange samples using the agar well diffusion method. The results showed clear zones of inhibition against spoilage-associated microorganisms, indicating effective suppression of microbial growth. These findings suggest that Basak leaf extract possesses significant antibacterial potential and may serve as a natural preservative agent. Further studies are planned to evaluate its preservative activity on orange pulp and to assess its effectiveness in extending shelf life, and it is expected that these investigations will provide additional evidence supporting its application in natural food preservation.

Keywords: Phytochemical, Spoilage-associated microorganisms, Food spoilage, Chemical preservatives

PP32. Isolation and Characterization of Probable Plant Growth Promoting Mangrove Rhizobacterium

Supratim Saha*, Anubhav Nag, Shreyasi Bagchi and Rajat Pal

Department of Microbiology and Department of Biotechnology, Sister Nivedita University, New Town, Kolkata – , West Bengal, India

***Presenting Author:** supratimsaha25@gmail.com

Mangrove ecosystems form dynamic interfaces between land and sea, where plants and microorganisms have co-evolved to survive in saline, waterlogged soils. A key adaptation in mangroves is the pneumatophore, a specialized aerial root that emerges from the mud and facilitates gas exchange under hypoxic conditions. The resilience of this system depends strongly on the associated microbial network, as soil bacteria can influence root health and development. This study investigates microbial communities in the mangrove rhizosphere of Henry's Island, Bakkhali, West Bengal, with emphasis on their potential role in promoting pneumatophore development and their biotechnological relevance. Soil samples were processed using serial dilution and spread plate techniques to isolate cultivable bacteria. Morphological and biochemical characterization revealed a diverse assemblage of halophilic and stress-tolerant strains. Biochemical assays, including catalase, urease, carbohydrate fermentation, and IMViC tests, demonstrated considerable metabolic diversity among the isolates, along with variation in temperature tolerance. Antibiotic susceptibility profiling indicated that some strains were sensitive while others exhibited resistance to commonly used antibiotics, suggesting possible environmental and industrial applications. Salt tolerance assays showed that several isolates could thrive under high salinity, a critical trait for survival in fluctuating mangrove soils. It is hypothesized that these microbes contribute to pneumatophore development by enhancing soil aeration and nutrient availability and possibly through the production of phytohormones such as auxins and cytokinins. Overall, this study integrates classical microbiological methods with ecological perspectives to highlight plant–microbe interactions in mangroves and their potential applications in bioremediation, sustainable agriculture, and climate-resilient coastal ecosystem management.

Keywords: Henry's Island, Bakkhali, Morphological, Biochemical characterization, Hypothesized

PP33. Susceptibility Trends of *Pseudomonas aeruginosa* in Hospitals

Dheeraj Kumar[1], Gagan Kumar Roy[1], Victor Patra[1]* and Dipankar Das[2]

[1] Medical Lab Technology, Department of Allied Health Sciences, Brainware University, Kolkata, India

[2] Department of Allied Health Sciences, Brainware University, Kolkata, India

***Presenting Author:** bwudlt24012@brainwareuniversity.ac.in

Nosocomial infections, which typically manifest between 48 to 72- hours following admission or within three days after discharge, pose a substantial obstacle to effective patient care. As a priority pathogen identified by the WHO, Pseudomonas aeruginosa is frequently associated with severe conditions like ventilator-associated pneumonia and bloodstream infections due to its inherent multidrug resistance. This research analyzed the prevalence and antibiogram of this bacterium across 40 clinical samples which comprised of pus (42.5%), blood (32.5%), and urine (25%), obtained from a tertiary hospital. Pathogen verification relied on detecting distinctive bluish-green colonies with a fruity aroma on nutrient agar, alongside Gram-negative rod morphology and positive catalase reactions using 3% hydrogen peroxide.

Keywords: Nosocomial infections, Pathogen, Antibiogram, Pseudomonas aeruginosa, Bloodstream

PP34. Utilization of Mangrove Leaves for Efficient Biogas Production in Rural India

Ankan Bera* and Akash Satpathi

Department of Biotechnology, The Neotia University, Diamond Harbour Road, Sarisha, Jhinga, West Bengal , India

Presenting Author: ankan.bera24@tnu.in

Biogas has emerged as a promising renewable energy source for rural India, offering an environmentally sustainable and economically viable solution to energy scarcity. Produced through the anaerobic digestion of organic waste such as cow dung and agricultural residues, biogas primarily consists of methane and carbon dioxide. This study explores an innovative approach to enhance biogas production by incorporating nitrogen-rich mangrove leaves from the Sundarbans region into traditional cow dung-based substrates.

A comparative experimental analysis was conducted using two anaerobic digesters: one containing only cow dung and the other containing a mixture of cow dung and mangrove leaves. The substrates were prepared and maintained under controlled anaerobic conditions, and biogas production was monitored daily over a two-week period. The findings revealed a significant increase in gas output from the mixed substrate digester, which produced approximately 300 liters of biogas compared to 200 liters from the cow dung-only digester. The enhanced methane yield is attributed to the high nitrogen content of mangrove leaves, which stimulates microbial activity and accelerates the digestion process. This approach not only improves energy production efficiency but also promotes the utilization of locally available organic resources, supporting sustainable waste management practices.

The adoption of such improved biogas production methods can play a crucial role in reducing reliance on fossil fuels, alleviating energy poverty, and improving living standards in rural communities. Overall, the integration of mangrove leaves into biogas systems demonstrates significant potential for advancing sustainable energy solutions and supporting rural development in India.

Keywords: Renewable energy, Experimental analysis, Production methods, Anaerobic conditions, Rural communities

PP35. Biotechnology and Food Sciences

Ankit Manna*, Subhadip Maity and Rohit Kumar Varma

B.Sc. Biotechnology and B.Sc. Microbiology, The Neotia University, West Bengal, India

Presenting Author: ankit.manna24@tnu.in

Biotechnology is playing a crucial role in food science by providing practical solutions to improve food quality, nutrition, and sustainability. One of its main contributions is in plant biotechnology. Modern techniques like tissue culture, molecular breeding, and genetic modification help develop better crop varieties. These improved crops are designed to yield more, withstand environmental challenges such as drought and salinity, resist pests and diseases, and offer better nutritional value. These advancements are vital for ensuring food security as the global population grows and climate conditions change.

Biotechnological methods have also allowed for the enrichment of crops with essential vitamins and minerals, helping to combat malnutrition and deficiencies in micronutrients. Using precise genetic tools, scientists can enhance protein quality, boost vitamin content, and improve the overall safety and shelf life of food products. In addition to

crop improvement, biotechnology has greatly advanced the production of fermented foods and beverages. Carefully chosen microorganisms and controlled fermentation techniques enhance taste, texture, digestibility, and nutritional value.

Fermented foods, including dairy and plant-based products, are highly valued for their probiotic benefits and positive impacts on gut health and immunity. Together, plant biotechnology, improved crops, and fermentation methods show how closely biotechnology and food science are linked. Their combined use supports the creation of healthier, safer, and more sustainable food systems.Ongoing research and responsible use of biotechnology will be essential for addressing future nutritional and environmental challenges.

Keywords: Biotechnology, Micronutrients, Fermentation techniques, Boost vitamin content

PP36. Isolation and Screening of Potent Biofilm Forming Pectinase Producing Bacteria from Agro-Waste Soil Samples of the Neotia University, West Bengal

Sambhit Bhattacharya*, Krishnendu Sarader, Sushmita Bangal, Purav Mondal and Sarita Sarkar

Equal Contribution ² Department of Biotechnology, The Neotia University, Diamond Harbour Road, Sarisha, Jhinga, West Bengal, India

***Presenting Author:** sambit.bhattacharya24@tnu.in

Pectinase is an important enzyme which is able to break up pectin, a major component of plant cell walls. The aim of the study is to isolate and screen for potential biofilm forming pectinase producing bacteria from agro-waste soil samples from The Neotia University, West Bengal. Soil samples were serially diluted and spread plated on nutrient agar to obtain morphologically different colonies of bacteria. The primary screening procedure used pectinase screening agar media (PSAM), which allowed for visual identification of hydrolysis zones that resulted from extracellular pectinase production. Secondary screening was completed using broth containing pectin and research optimisation methodologies to identify the most productive strains of pectinase. Morphological/bio-chemical characterization was completed on the most productive strains followed by molecular characterization using 16S rRNA gene analysis. The quantified pectinase production was then successfully determined using the DNS (3,5 Dinitrosalicylic Acid) method (Measurement of Reducing Sugars Released). Six different bacterial strains were confirmed to have produced pectinase; of which two strains showed significantly greater enzyme production and larger hydrolytic activity zones. This study provides an initial inventory of potential new sources of pectinase producers. The research also looked at biofilm formation, antibiotic susceptibility, and the effects of incubation time, temperature, and pH on enzyme production. The results of this study support the idea that agro-waste soil contains substantial numbers of bacteria capable of producing pectinase efficiently.

Keywords: DNS (3,5 Dinitrosalicylic Acid), Pectinase, Pectinase producing bacteria, Hydrolysis zones