



Department of
Science & Technology
Government of Gujarat



GSBTM & GUJCOST Sponsored Two Days National Conference on

Emerging Trends in Biological, Chemical, Computer and Interdisciplinary Sciences BCCIS-2026

SOUVENIR

Date: 19th & 20th February, 2026

ORGANIZED BY

**Institute of Science & Technology
for Advanced Studies & Research
(ISTAR)**

**The Charutar Vidya Mandal
(CVM) University**

**SARDAR PATEL CENTRE FOR SCIENCE &
TECHNOLOGY, MOTA BAZAAR, VALLABH
VIDYANAGAR, ANAND, GUJARAT-388120**

PHONE: 02692 234955

Email: office.istar@cvmu.edu.in



CHARUTAR VIDYA MANDAL (CVM) @ Glance

One of the greatest sons of India Late Sardar Vallabhbhai Patel inspired Shri Bhaikaka and Shri Bhikabhai Saheb for rural resurgence of post-independent India through education, and Charutar Vidya Mandal was born. Charutar Vidya Mandal was established in the year 1945 as a charitable trust with a prime objective of rural development through education to bring about the social awakening, social upliftment and enrichment. The uniqueness of Charutar Vidya Mandal lies in its ability to use quality education as a powerful means of social transformation. It was a stupendous task for the founders to establish a visionary organization; but the large-heartedness and high sense of philanthropy of this region made this possible. The unique leadership style attracts many philanthropists to contribute to the development of Charutar Vidya Mandal. Today Charutar Vidya Mandal is empowering budding graduates to live up to the ever-changing environment and equipping them to face the Third Millennium with confidence and competence. Building competitive advantages is the renewed focus of Charutar Vidya Mandal in the 21st century. At present, Charutar Vidya Mandal operates 48 Educational Institutions from schools to colleges and a Sophisticated Research Institute, with over 30,000 students on the rolls.



THE CHARUTAR VIDYA MANDAL (CVM) UNIVERSITY @ Glance

The first of its kind university in Gujarat is a living memorial of Sardar Patel, a stalwart in the truest sense of the word. Evolving from Charutar Vidya Mandal's pioneering institutions, the university today brings together 22 colleges across diverse disciplines. With modern infrastructure, global collaborations, and a strong focus on research and societal impact, CVM University is shaping leaders, innovators, and global citizens for the future. Recognized by GSIRF with top ratings, the university emphasizes interdisciplinary learning, community engagement, and student-centric growth. It continues to be a hub where tradition meets modernity, creating opportunities that inspire knowledge, creativity, and transformation.

Vision:

We aspire to be a melting pot for educational excellence, fostering, creativity, innovation and leadership.

Mission:

THE CVM UNIVERSITY, an equal opportunity institution, pursues excellence in Education and Research in a conducive environment which is culturally rich with a legacy of eminence in building character and strength of mind while standing for sustainability



Institute of Science & Technology for Advanced Studies & Research (ISTAR) @ Glance

Institute of Science & Technology for Advanced Studies & Research (ISTAR) is one of the premier Institute in Gujarat and top ranked for consecutive three years accredited by KCG and approved Professional Institute by All India Council for Technical Education (AICTE). ISTAR has become a centre of quality education offering 14 Post-Graduate Programs with pioneered unique interdisciplinary courses and Doctoral Programs in 11 disciplines. The Institute is dedicated to preparing students for future by aligning their skills and aspirations with the demands of the rapidly evolving world, implementing numerous strategic initiatives to achieve this goal. The CVM University mission of an equal opportunity to pursue excellence in Education and Research in a conducive environment, which is culturally rich with a legacy of eminence in building character and strength of mind while standing for sustainability by the efforts of qualified and committed faculty members of ISTAR.

M. Sc. Programs @ISTAR

**Industrial
Chemistry**

**Surface
Coating
Technology**

**Organic
Chemistry**

**Polymer
Chemistry**

Microbiology

Biotechnology

**Environmental
Science &
Technology**

**Industrial
Hygiene &
Safety**

Geoinformatics

**Master of
Computer
Application**

Cyber Security

**Information
Technology**

**Real Estate
Valuation**

**Plant &
Machinery
Valuation**

Ph. D. Programs @ ISTAR

**Industrial
Chemistry**

Chemistry

**Environmental
Science**

Biotechnology

Zoology

Microbiology

Botany

Geoinformatics

**Computer
Science**

**Instrumentation
& Control**

Electronics

Instrumentation Facilities @ ISTAR

1. ABRESION TESTER
2. AMBRAY MACHINE
3. ANDREAS HETTICH HAND CENTRIFUGE (JAPAN)
4. BINOCULAR FLUORESCENCE MICROSCOPE(ZEISS)
5. BIOS DEFENDER CALIBRATOR
6. BOD INCUBATOR
7. COD DIGESTION APPARATUS
8. COMPRESSION MOULDING
9. CONDUCTO METER
10. COOLED GRADIENT PALM CYCLER (PCR)
11. DART IMPECT TESTER
12. DIGITAL POLARIMETER
13. DIGITAL SONIFIER CELL
14. EIE MAKE MUFFLE FURNACE
15. ELECTROPHORESIS
16. ELISA READER
17. EQUATION VERTICAL AUTOCLAVE
18. FLAME PHOTOMETER
19. FLOW CUP VISOMETER
20. FLUIDIZED BED DRYER
21. GEL DOCUMENTATION UNIT
22. GERHARDT IP DIGESTION
23. HAND INJECTION MOULDING
24. HIGH SPEED MICROPROCESSOR (CENTRIFUGE)
25. HIGH VOLUME AIR SAMPLER
26. HPLC SYNTHESIZER
27. IMPACT (IZOD/CHAPY) TESTER
28. INJECTION MOULDING MACHINE
29. LAMINAR AIR FLOW (LAF)
30. MELT FLOW INDEX (MFI)
31. MICROCONTROLLED SPECTROPHOTOMETER
32. PCR WORKSTATION
33. PLUG FLOW REACTOR
34. POLARIMETER
35. POTENTIOMETER
36. ROTARY EVAPORATOR
37. ROTARY FLASK SHAKER
38. SDS PAGE ELECTROPHORESIS
39. SOUND LEVEL METER (SLM)
40. SOXLET HEATING MANTLE
41. STACK MONITORING KIT
42. SYSTRONIC MAKE UV SPECTROPHOTOMETER
43. TUBULAR IMPACT TESTER
44. TURBIDOMETER
45. ULTRASONICATOR
46. UNIVERSAL TESTING MACHINE
47. UV DIGITAL SPECTROPHOTOMETER
48. VACUUM EVAPORATOR
49. VERTICAL AUTOCLAVE
50. WET ABRASION SCRUB TESTER

About Conference

The National Conference aims to provide a common interdisciplinary platform for researchers, academicians, students and industry professionals to exchange knowledge, share ideas and discuss recent advances across emerging and impactful scientific domains. This platform will encourage meaningful scientific dialogue and knowledge dissemination among diverse stakeholders. A key objective of the conference is to promote strong collaboration between academia and industry, fostering innovation and enabling the development of sustainable, scalable, and industry-relevant solutions to real-world challenges. The conference seeks to enhance research skills and scientific understanding among students and early-career researchers by exposing them to cutting-edge research with interactive technical sessions led by eminent professionals. This is also to encourage interdisciplinary research approaches by integrating diverse fields such as Biotechnology, Microbiology, Chemistry, Polymer Science, Nanotechnology, Computational Sciences, Artificial Intelligence, Cyber Security, Geoinformatics, Valuation and Industrial Hygiene and Safety thereby promoting holistic and solution-oriented research. The conference intends to highlight recent advancements in green, sustainable, and environmentally responsible technologies and environmental protection strategies aligned with global sustainability goals. The conference further seeks to strengthen the regional innovation ecosystem of Gujarat by aligning academic research and industrial innovation with state and national priorities, including sustainable growth, digital transformation and by promoting innovation that address pressing societal challenges related to health, environment and technology.

Thematic Areas

The conference theme includes, but is not limited to the following areas and emerging fields.

Biological Sciences

Advances in Biological Sciences, Bioinformatics & Computational Biology, Biomedical Innovations & Disease Management, Environmental Science & Technology, Genomics & Proteomics, Microbial Technology, Pharmaceutical Sciences, Synthetic & Molecular Biology, Systems Biology

Chemical Sciences

Analytical Chemistry & Environmental Monitoring, Chemical Process Engineering & Industrial Applications, Green Chemistry & Sustainable Catalysis, Medicinal Chemistry & Drug Design, Nanomaterials & Nanotechnology, Organic Synthesis, Polymer Science

Computer Sciences

Emerging Trends: AI / ML / DL, DevOps, Application Development, Big Data Analytics, Blockchain Technology, Cloud Computing, Cyber Security, Data Science, Digital Forensics, Immersive Technologies (AR/VR), Internet of Things (IoT), Quantum Computing, Robotics & Automation Systems, Software Engineering

Interdisciplinary Sciences

Geographical Information Systems, Global Positioning Systems, Industrial Hygiene & Safety Management, Occupational Health, Ergonomics, Remote Sensing Systems and Applications, Emerging Trends in Valuation of Real Estate and Plant & Machinery including statutory permissions

Organizing Team

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Er. Shri Bhikhubhai B. Patel
(Chairman, CVM and President,
The Charutar Vidya Mandal (CVM) University)

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Dr. Shantibhai G. Patel (Hon. Secretary, CVM)
Shri Mehul D. Patel (Hon. Jt. Secretary, CVM)
Shri Vishal H. Patel (Hon. Jt. Secretary, CVM)
Prof. (Dr.) Indrajit Patel (Provost, CVMU)

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(Dy. Director, SICART)
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(I/c Principal, NVPAS)

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Dr. Rohit Vekariya

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Dr. Ashish Joshi
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Mr. Yash Panchal (Software Engineer, Infilon Tech.)

Mr. Abhi Misra (Associate Director, Global EHS Xellia)

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Dr. Dhruvi S. Patel
Mr. Snehal S. Ingale

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Dr. Niraj H. Patel (Coconvener)
Dr. Jeimin Joshi
Dr. Rohit Vekariya

Computer Sciences

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Dr. Ashish P. Joshi (Coconvener)
Ms. Mahima Ahir
Mrs. Bansari A. Manvar

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Mr. Baiju Verghese (Convener)
Er. Rupesh Shah (Coconvener)
Dr. Krunal Suthar

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Dr. Jigar Patel (Convener)
Dr. Niraj Patel (Coconvener)
Dr. Khodidas Bhandari
Mr. Ashish Patel
Mr. Pinakin G. Patel

Registration

Dr. Krunal Suthar (Convener)
Dr. Hiren Soni (Coconvener)
Ms. Mahima Ahir
Mr. Ritesh Joshi
Mr. Kaushal Bavaliya

Certificate

Er. Rupesh T. Shah (Convener)
Mr. Parth Parikh (Coconvener)

Prize Distribution

Dr. Mayank Patel (Convener)
Dr. Vidhi H. Patel (Coconvener)
Dr. Jeimin Joshi
Mrs. Bansari A. Manvar
Mr. Yash Panchal

Inauguration and Valedictory

Dr. Kinnari Bhatt (Convener)
Dr. Niky K. Jain (Coconvener)
Dr. Dhruvi S. Patel

Hospitality and Transportation

Dr. Mandar Karve (Convener)
Mr. Ravish Patel

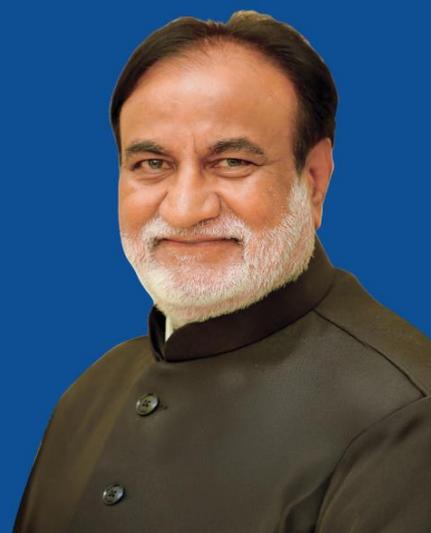
Souvenir

Dr. Himanshu Kapse (Convener)
Dr. Hiren Soni (Coconvener)
Mr. Parth Parikh

MESSAGE

Er. Shri Bhikhubhai B. Patel

Chairman, Charutar Vidya Mandal
President,
The Charutar Vidya Mandal (CVM) University



It gives me immense pleasure that ISTAR is organizing Two-Day National Conference on “*Emerging Trends in Biological, Chemical, Computer and Interdisciplinary Sciences (BCCIS-2026)*”. This conference is a significant step toward fostering collaboration among diverse scientific disciplines and creating a platform for meaningful dialogue, innovation, and knowledge exchange. In today’s rapidly evolving world, the boundaries between traditional fields of study are becoming increasingly blurred. This conference acts as a major step toward building interdisciplinary partnerships and offering a venue for insightful discussion, innovation, and sharing knowledge. The deliberations, presentations, and discussions during these two days will inspire new ideas, strengthen research networks, and pave the way for innovative solutions to the challenges of our time. I wish all participants an intellectually stimulating and enriching experience.

A handwritten signature in black ink, appearing to read 'Bhikhubhai B. Patel'.

Er. Shri Bhikhubhai B. Patel
Chairman, Charutar Vidya Mandal
President, The Charutar Vidya Mandal (CVM) University

MESSAGE

Prof. (Dr.) Indrajit Patel

Vice Chancellor (Provost),
The Charutar Vidya Mandal (CVM) University



It is with great pride and enthusiasm that I extend my warm greetings to all participants of the Two-Day National Conference on “Emerging Trends in Biological, Chemical, Computer and Interdisciplinary Sciences (BCCIS-2026)”. This conference embodies the spirit of academic excellence and innovation that our institution strives to promote. The challenges of the 21st century demand solutions that transcend disciplinary boundaries. Biology, Chemistry, and Computer Sciences are no longer isolated domains; they are interconnected fields when combined, hold the potential to address pressing global issues from healthcare and sustainability to artificial intelligence and advanced materials. By fostering dialogue across these disciplines, BCCIS-2026 provides a unique opportunity to cultivate fresh perspectives, collaborative research and transformative ideas. I acclaim the organizing committee for their dedication in bringing together distinguished scholars, researchers, and young minds from across the nation. I am confident that the discussions and deliberations during this conference will inspire participants to push the frontiers of knowledge and contribute meaningfully to society. On behalf of the academic leadership, I welcome you all to this intellectual gathering and wish you a fruitful and enriching experience at BCCIS-2026.

Prof. (Dr.) Indrajit Patel
Vice Chancellor (Provost),
The Charutar Vidya Mandal (CVM) University

MESSAGE

Prof. (Dr.) Sandeep Walia

Registrar & Dean Academics,
The Charutar Vidya Mandal (CVM) University



It gives me great pleasure to extend my warm greetings to all participants of the Two-Day National Conference on *“Emerging Trends in Biological, Chemical, Computer and Interdisciplinary Sciences (BCCIS-2026)”*. This conference is a testament to our institution’s dedication to fostering academic excellence, interdisciplinary research, and collaborative learning. The convergence of Bio – Chemo and Computer Sciences has opened new horizons for innovation and discovery. By bringing together experts, researchers, and students from diverse fields, BCCIS-2026 provides a valuable platform for exchanging ideas, sharing knowledge, and exploring solutions to contemporary challenges. Such initiatives not only enrich academic discourse but also strengthen the bridge between research and real-world applications. I sincerely appreciate the efforts of the organizing committee, faculty members, and volunteers who have worked diligently to make this conference possible. I am confident that the deliberations and interactions during these two days will inspire participants to pursue new directions in research and contribute meaningfully to the advancement of science and society. I wish the conference great success.

A handwritten signature in black ink, appearing to be 'S. Walia'.

Prof. (Dr.) Sandeep Walia
Registrar & Dean Academics,
The Charutar Vidya Mandal (CVM) University

MESSAGE

Dr. Mahendrasinh Raj
Principal, ISTAR
Dean, Faculty of Science
The Charutar Vidya Mandal (CVM) University



It is a matter of great honour and delight to welcome all distinguished guests, scholars, researchers, and students to the Two-Day National Conference on “Emerging Trends in Biological, Chemical, Computer and Interdisciplinary Sciences (BCCIS-2026)”. This academic gathering reflects our institution’s commitment to advancing knowledge, encouraging innovation, and nurturing interdisciplinary collaboration. Science today is not confined within the boundaries of individual disciplines. The most impactful discoveries emerge when ideas from Biology, Chemistry, Computer and Interdisciplinary Sciences converge, opening new pathways for research and application. This conference provides a vibrant platform for exchanging ideas, presenting cutting-edge research, and inspiring young minds to think beyond conventional frameworks. I sincerely appreciate the efforts of the organizing committee, faculty members, and student volunteers who have worked tirelessly to bring this vision to life. I am confident that the deliberations and interactions during these two days will not only enrich participants academically but also strengthen the spirit of collaboration and innovation across disciplines. On behalf of the institution, I extend my warmest wishes for the success of BCCIS-2026 and hope that this conference will leave a lasting impact on all who participate.

A handwritten signature in black ink, appearing to read 'R. M. Raj', with a horizontal line underneath.

Dr. Mahendrasinh Raj
Principal , ISTAR
Dean, Faculty of Science
The Charutar Vidya Mandal (CVM) University

Convener's Message

It is with great pleasure that we present the Souvenir of the Two-Day National Conference on “*Emerging Trends in Biological, Chemical, Computer and Interdisciplinary Sciences (BCCIS-2026)*”. This conference has been envisioned as a national platform where academicians, researchers, students, and industry professionals come together to share research outcomes, exchange innovative ideas, and engage in meaningful discussions on recent advancements across diverse scientific domains. The scope of BCCIS-2026 reflects the dynamic nature of modern science. Biological Sciences, Chemical Sciences, Computer Sciences, Interdisciplinary Sciences are increasingly interconnected, and their convergence is giving rise to transformative fields such as Artificial Intelligence, Data Science, Cyber Security, Biotechnology, and Green Chemistry. By embracing these intersections, the conference seeks to highlight the importance of collaborative approaches in addressing contemporary challenges and driving sustainable innovation. We believe that the contributions compiled in this Souvenir will serve as a valuable resource for scholars and practitioners alike. Each abstract represents creativity of its authors and collective spirit of inquiry that defines the scientific community. On behalf of the organizing team, we extend our heartfelt gratitude to all contributors, reviewers, and participants whose efforts have enriched this conference. We hope that this Souvenir will inspire further research, foster collaboration, and pave the way for new discoveries in the years to come.



Dr. Nisha Daxini / Dr. Rohit Vekariya

Conveners, BCCIS-2026

Acknowledgement



For facilitating the development of biotechnology in the State, Government of Gujarat has constituted Gujarat State Biotechnology Mission, under the aegis of Department of Science and Technology. The State intends to promote biotechnology sector by building appropriate image, encouraging entrepreneurship, strengthening organizational colorations and forecasting business partnerships and to promote support and facilitate the overall development of Biotechnology, in the state. To provide institute, legal financial and policy support and, facilitate networking among stakeholders at Regional, National and International level. It also facilitates the infrastructure development and R & D activities and creates scientific awareness, sensitization, socio ethical acceptance and adoption to the potentials and application of biotechnology. GSBTM provides financial support for research-driven initiatives at academic and research institutions, aiming to foster a strong biotechnology research and innovation ecosystem in the state. We sincerely extend our heartfelt gratitude to Gujarat State Biotechnology Mission; Govt. of Gujarat (GSBTM) for providing financial support for research initiatives at academic and research institutions and innovation ecosystem in the state.



GUJCOST play a catalytic role in promoting the use of Science and Technology in the development process of the State and to develop technologies appropriate to and in harmony with present conditions. The Council has been catalysing interaction between developers and users of technologies, by bringing on a common platform to train Scientists and Engineers on the one hand and policy makers as well as administrators on the other. The Council is an autonomous registered under the Societies Registration Act from 1st February, 2000 and working under department of Science & Technology. Hon'ble Minister of Education is the Chairman of the Council. We are highly indebted to Gujarat Council on Science and Technology (GUJCOST) and Department of Science & Technology (DST) for their generous support.

Conveners (ISTAR)

Schedule of Program

National Conference Programme Schedule Emerging Trends in Biological, Chemical, Computer And Interdisciplinary Sciences (BCCIS-2026) Day 1 – Thursday, 19th February 2026

Time	Session /Activity			
09:00 AM To 10:00 AM	Registration & Breakfast			
10:00 AM To 11:00AM	Inaugural Ceremony & Keynote Speech			
	Expert Session	Experts Detail	Title	Venue
11:30 AM To 01:00 PM	Chemical Science	Expert Talk 1 Dr. Randhir Parmar Chief Senior Manager (Technology), Asian Paints Limited, India	Sustainability: The Global Trend Transforming Chemical Industries	V.P Science Auditorium
	Biological Science+ Interdisciplinary Science (MIHS)	Expert Talk 1 Dr. Murlidhar Zope Associate Vice President, Sun Pharmaceuticals Industry Limited, Vadodara, India	Next Generation characterisation tools shaping nanomedicine regulation	NVPAS Auditorium
	Interdisciplinary Science (Valuation)	Expert Talk 1 Mr. Keyur Shah Gov. Reg. Valuer & Managing Partner, Shah Parikh & Associates, Vadodara, India	Recent Trends and Challenges in Valuation Practice	Presentation Room (322), 2 nd Floor, ISTAR Main Building
	Computer Science+ Interdisciplinary Science (GIS and Physics)	Expert Talk – 1 Mr. Ketan Rathod Senior Technical Trainer, Rishabh Software, Vadodara, India	Cloud 3.0: The Intelligent Nervous System of Modern Business	Seminar Room (421), 3 rd Floor, ISTAR Main Building
01:00 PM To 02:00 PM	Lunch Break (ISTAR Main Building)			

02:00 PM To 04:00 PM	Chemical Science	Poster Presentation	Contact persons	Activity Room (408), Block-02, Chemical Science Division, ISTAR
			Dr. Amit Thummar 82004 12596 Dr. Rohit Vekariya 98791 43295	
	Biological Science		Dr. Shilpa Gupte 97238 10919 Dr. Dhruti Patel 99259 10970	4 th and 5 th Floor, ISTAR Main Building
	Interdisciplinary Science		Er. Rupesh Shah 98241 61415 Mr. Baiju Verghese 9574342770	4 th Floor (Room No: 9), ISTAR Main Building
	Computer Science		Dr. Suchita Patel 95743 49141 Dr. Ashish Joshi 63599 75276 Dr. Niky Jain 90333 67762	Moot Court, 5 th Floor, ISTAR
04:00 PM	High-Tea			

Day -2 – Friday, 20th February 2026

Time	Session/Activity			
09:00 AM To 09:40 AM	Breakfast			
	Branch	Expert Name	Title	Venue
09:45 AM To 11:15 AM	Chemical Science	Expert Talk 2 Dr. Maheshkumar Gandhi Ex-Chief Scientist, CSMCRI, Bhavnagar, India	Joy of Invention	V.P Science Auditorium
	Biological Science	Expert Talk 2 Dr. Sanket Joshi Professor and Deputy Director, Amity Institute of Microbial technology, Amity University, Rajasthan	Microbial Technology in Action: From Oilfields to Ecosystems	NVPAS Auditorium

	Computer Science+ Interdisciplinary Science (GIS, Physics and Electronics)	Expert Talk 2 Dr. Ninad More Associate Professor and Head, Department Computer Science & Engineering, Xavier Institute of Engineering, Mumbai University, Mumbai, India	Remote Sensing of Satellite Imagery Using Machine Learning Algorithms	Seminar Room (421), 3 rd Floor, ISTAR Main Building
	Interdisciplinary Science (Industrial Hygiene and Safety)	Expert Talk – 2: Mr. Maulik Shah , Shah Industrial Hygiene Solutions, Ahmedabad, India	Industrial Hygiene Controls Across Diverse Industries: Practical Insights and Emerging Trends	Presentation Room (322), 2 nd Floor, ISTAR Main Building
		Expert Name	Title	Venue
11:30 AM To 01:00 PM	Chemical Science	Expert Talk 3 Dr. Atindra Shukla , Associate professor, Shah-Schulman Center for Surface Science and nanotechnology, Dharamsinh Desai University, Nadiad, Gujarat, India	Nanomaterials: Interdisciplinary science and Instrumentation	V.P Science Auditorium
	Biological Science	Expert Talk 3 Dr. Rajesh Patel , Professor, Department of Bioscience, VNSGU, Surat, India	AI-Augmented Translational Drug Discovery: Bridging in Silico Prediction and In Vitro Validation of Natural Products	NVPAS Auditorium
	Computer Science+ Interdisciplinary Science (GIS, Physics and Electronics)	Expert Talk 3 Prof. (Dr.) Sailesh Iyer Principal and Professor, NSIT-IFSCS, Ahmedabad, India	AI Research Trends	Seminar Room (421), 3 rd Floor, ISTAR Main Building
01:00 PM To 02:00 PM	Lunch Break (ISTAR Main Building)			

02:00 PM To 04:00 PM	Chemical Science	Oral Presentation	Contact Person Dr. Rohit Dave 89809 50643 Dr. Niraj Patel 94279 80656	V. P. Science Auditorium
	Biological Science		Dr. Shilpa Gupte 97238 10919 Dr. Hiral Patel 99780 33036	NVPAS Auditorium
	Interdisciplinary Science		Er. Rupesh Shah 98241 61415 Mr. Baiju Verghese 95743 42770	Presentation Room (322), 2 nd Floor, ISTAR Main Building
	Computer Science		Dr. Suchita Patel 95743 49141 Dr. Ashish Joshi 63599 75276 Dr. Niky Jain 90333 67762	Seminar Room (421), 3 rd Floor, ISTAR Main Building
04:00 PM	High-Tea			
04:30 PM	Valedictory Function		V. P. Science Auditorium	

Oral Presentations

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Abstracts
(Oral Presentations)
Biological Sciences

BIO-01

Evaluation of Groundwater Quality and Potential Health Risks Related to Heavy Metals in a Peri-Urban Area of Vadodara Region

Vinay Premshankar Tiwari, and Dr. Kamlesh K Tiwari,
Sophisticated Instrumentation Centre for Applied Research and Testing, Vallabh Vidyanagar,
Anand- 388120, Gujarat

Abstract

Water is an essential resource for every living being on Earth. Water has played an important role since the beginning of human civilization, from agriculture, construction, and food industries to the rapid industrial revolution. Water is stored in lakes, dams, and ponds for further domestic use. Gujarat, being Asia's largest chemicals industrial zone, has high chances of groundwater contamination; again, polluted rainwater recharge increases pollutant load in groundwater during the rainy season. The study aims to assess the water quality index through arithmetic analysis and health risk as per the WHO guidelines. Ground water quality has been determined by collecting 04 ground water samples at Vadodara Peri-feral region mainly village nearby industrial area and subjecting to them to comprehensive physico-chemical analysis, for calculating WQI, parameters such as Color, pH, Alkalinity, Ammonical nitrogen, Electrical conductivity, Chloride, Fluoride, Turbidity, TDS, Nitrate, Sulphate, Calcium, Sodium, Potassium, magnesium, Total Hardness and Metal likes Nickel, Copper, Lead, Arsenic, Chromium, cadmium, selenium, mercury and cobalt were considered. Every sample failed according to the acceptable limit of the IS 10500-2012 standard. Also sample contains heavy metals like copper and chromium, and others which posing high health risk as per the WHO guidelines. Water is being used for irrigation purposes by farmers for castor and cottonseed farming.

Keywords: Evaluation, Metal, physicochemical analysis, WQI, WHO

BIO-02

Mechanistic Evaluation of Chlorine Stress on Metabolic Reprogramming and Antibiotic Resistance Genes in Environmental *S. aureus*: A Transcriptomic Approach

Kunal K. Joshi and Hiren B. Soni
Department of Environmental Science and Technology (EST), Institute of Science and Technology for Advanced Studies and Research (ISTAR), The CVM University (CVMU), Vallabh Vidyanagar-388120, Dist. Anand (Gujarat) India.
Hiren B. Soni: hirenkumar.soni@cvmu.edu.in

Abstract

Wastewater treatment plants (WWTPs) serve as critical checkpoints for public health but may inadvertently function as "evolutionary reactors" for antimicrobial resistance (AMR). Routine chlorination, while effective for bulk disinfection, often leaves behind a residual population of bacteria. Emerging evidence suggests that surviving this oxidative stress forces activation of survival mechanisms such as biofilm formation and efflux pump overexpression which confer cross-protection against clinically relevant antibiotics. This study investigates the genomic basis of this "Chlorine Induced Cross Resistance." Bacterial isolates were recovered directly from the chlorination contact tank of municipal WWTPs, representing a population of "natural survivors."

From this pool, *S. aureus* was selected and subjected to sub-lethal chlorine stress (10 ppm). Antibiotic Susceptibility Testing (AST) was performed per CLSI M100-S25 guidelines. Currently, comparative transcriptome sequencing (rRNA Depleted RNA-Seq) is being conducted on chlorine survived versus control to decode the underlying molecular drivers. Preliminary phenotypic analysis revealed a significant "Class Shift" in chlorine adapted *S. aureus*, which transitioned from "Susceptible" to "Intermediate/Resistant" phenotypes, particularly against cell wall targeting antibiotics. The ongoing transcriptomic analysis targets the validation of three specific upregulated mechanisms: Efflux Pump Activation (*norA*), Cell Wall Thickening (*pbp* genes), and the Oxidative SOS Response (*recA/lexA*, *PerR*). By correlating phenotypic resistance with gene expression, this study aims to construct a comprehensive "Metabolic Map" detailing how disinfection protocols drive AMR evolution, providing critical insights into the environmental dissemination of superbugs.

Keywords: *Antimicrobial Resistance (AMR), Chlorine-Induced Cross-Resistance, Staphylococcus aureus, Transcriptomics, Wastewater Chlorination*

BIO-03

Transforming Industrial Food Waste into Briquettes: A Pathway to Sustainable Energy and Resource Recovery

Prachi D. Patel, Dhruvi S. Patel

Department of Environmental Science and Technology (EST), Institute of Science and Technology for Advanced Studies and Research (ISTAR), The CVM University (CVMU), Vallabh Vidyanagar-388120, Dist. Anand (Gujarat) India

Prachi D. Patel: prachi3212@gmail.com

Dhruvi S. Patel: dhruvi.patel@cvmu.edu.in

Abstract

The contemporary economy is confronted with the interconnected challenges of global food security and pollution. The United Nations Sustainable Development Goals' Target 12.3 aims to reduce food losses and halve per-capita global food waste by 2030, emphasizing the necessity of valuing refuse streams. This study examines the sustainable waste-to-energy pathway of converting dried industrial food waste into energy-dense briquettes. Prior to briquetting, plant-based feedstocks, such as dried sawdust, peanut shell, rice husk, sweet maize waste, and mixed agro-waste, were collected from urban centers in Gujarat, India, and subjected to sun-drying to reduce moisture. Briquette production was conducted using a hydraulic briquetting machine, and material characterization (proximate analysis: moisture, ash, volatile matter, fixed carbon, and gross calorific value) was included in a structured methodology. The study contrasted the physical and chemical properties of briquettes across six feedstock variants, as well as their energy potential. The results suggest that the energy density of dried sweet corn waste briquettes is the highest, as evidenced by their elevated gross calorific value and fixed carbon, as well as their low moisture and ash contents. Rice husk briquettes also exhibit robust calorific performance. The quality of briquettes was significantly influenced by the properties of the raw materials, as evidenced by the significant variations in moisture, ash, volatile matter, and fixed carbon that were observed by feedstock. The discussion underscores the importance of feedstock-specific suitability and processing considerations, with sweet maize waste emerging as a particularly promising feedstock for efficient briquette production. In conclusion, the effective conversion of desiccated industrial food wastes into clean, energy-dense briquettes is a viable solution that promotes waste minimization, reduced fossil fuel dependence, and circular economy. The work establishes the foundation for the optimization and scaling up of briquetting technologies for industrial waste streams.

Keywords: *Agro-Industrial Waste, Briquettes, Food Waste, Proximate Analysis, Resource Recovery, Waste Valorization*

Anti-biofilm activity of *Bacillus safensis* subsp. *osmophilus* SD2 against multidrug resistant hospital isolates of ESKAPE group

Saklain Mustak Saiyad¹, Bhakti Bajpai², Chirag Patel³, Siddhi D. Shah⁴, Nisha Daxini^{1,*}

¹Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120, Gujarat, India

²Bhaikaka University, Karamsad 388325, Gujarat, India

³Department of Microbiology, Pramukhswami Medical College, Bhaikaka University, Karamsad 388325, Gujarat, India

⁴Vidhyadeep Institute of Science, Vidhyadeep University, Anita, Surat 394110, Gujarat, India

Corresponding author: nisha.daxini@cvmu.edu.in

Abstract

Multidrug resistance (MDR) is the ability of microorganisms, including bacteria, viruses, or parasites, to withstand the effects of multiple antimicrobial drugs that are commonly used to treat the infections they cause. As a result, these drugs become less effective or even ineffective against the pathogens. Overuse and misuse of antimicrobial agents are major contributors to MDR, leading to the frequent emergence of antibiotic-resistant strains. Therefore, there is an urgent need for innovative strategies in drug discovery and development to combat antimicrobial resistance (AMR). Quorum sensing (QS) is a sophisticated bacterial communication system that regulates gene expression in response to population density. When signalling molecules bind to specific receptors, bacteria express genes involved in virulence factors such as biofilm formation, motility, and sporulation. This study aimed to identify bacterial isolates capable of inhibiting the QS system of *Chromobacterium violaceum* and clinically relevant pathogens. A total of 66 bacterial isolates were obtained from coastal soil and water samples collected from the Gujarat coastline (Surat, Dhuvaran, Diu and Bhavnagar). Qualitative and quantitative screening identified three isolates, SB1, SB6, and SD2, with anti-QS activity against *C. violaceum* MTCC 2656. Among them, *Bacillus safensis* subsp. *osmophilus* SD2 showed the strongest activity, inhibiting violacein pigment production by $60.85 \pm 5.64\%$. The antibiofilm activity of SD2 was further evaluated against ESKAPE pathogens. The highest inhibition was observed against *Pseudomonas aeruginosa* ($40.74 \pm 0.03\%$), followed by *Klebsiella pneumoniae* ($25.09 \pm 0.23\%$), *Staphylococcus aureus* ($18.55 \pm 0.22\%$), and *Escherichia coli* (Enterobacteriaceae) ($17.16 \pm 0.06\%$). The extract was less effective against *Enterococcus* spp. and *Acinetobacter baumannii* biofilms. Statistical analyses, including ANOVA, Tukey's Honestly Significant Difference (Tukey-HSD), and the Q test, revealed significant differences in biofilm inhibition between cinnamaldehyde (the standard compound) and the SD2 extract, indicating both statistically and biologically meaningful variation in antibiofilm efficacy between the two treatments.

Keywords: Multidrug resistance, Quorum sensing, Biofilms, Anti-quorum sensing (anti-QS), *C. violaceum*

Phytochemical studies of *Boerhavia verticillata* Poir. Leaves

Samta A. Mahyavanshi and Hiren B. Soni

Department of Environmental Science and Technology (EST), Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar-388120

Corresponding Author: hirenkumar.soni@cvmu.edu.in

Boerhavia verticillata poir. plant is an important medicinal herb in Ayurveda, commonly known as *Punarnava* in Sanskrit. It is herbaceous plant belonging to the Nyctaginaceae family and is widely used for its therapeutic properties. Scientific evaluation of its phytochemical constituents is essential to validate its medicinal importance. In the present study, phytochemical constituents were analyzed from the dried leaves of the *Boerhavia verticillata* poir. plant. Crude extracts were prepared using the Soxhlet extraction method with four different organic solvents, namely methanol, ethyl acetate, chloroform, and petroleum ether. Qualitative and quantitative phytochemical analyses were carried out using standard protocols. HPTLC and LC-MS were employed for phytochemical profiling. The highest phytochemical yield was obtained in the methanolic extract (12.50%), followed by chloroform (2.30%), ethyl acetate (0.80%), and petroleum ether (0.70%). Preliminary qualitative analysis of the methanolic extract revealed the presence of alkaloids, cardiac glycosides, flavonoids, phenols, tannins, and sterols. Quantitative analysis showed that the methanolic extract contained a high total phenolic content (37.51 mg/g) and total flavonoid content (14.58 mg/g). HPTLC analysis revealed the presence of ten distinct peaks, indicating chemical diversity. LC-MS analysis further confirmed the phytochemical complexity of the *Boerhavia verticillata* poir. plant leaf extract. The higher extraction efficiency and phytochemical richness of the methanolic extract suggest that polar solvents are more effective for extracting bioactive compounds from *Boerhavia verticillata* poir plant leaves. The study demonstrates that the crude methanolic extract of *Boerhavia verticillata* poir plant leaves possesses the highest phytochemical potential. These findings support the medicinal significance of *Boerhavia verticillata* poir plant and provide a scientific basis for further pharmacological and bioactivity studies.

Keywords: *Boerhavia verticillata* Poir., Leaves, Methanolic Extract, Phytochemicals, LC-MS profiling.

BIO-06

Lentil Protein-Based Encapsulation Matrix for Probiotic in Functional Food Applications

Rahi Shah¹, Dr. Viraj Roghelia²

¹P.G. Department of Home Science, Sardar Patel University, Vallabh Vidyanagar, India

*Rahishah38@gmail.com

ABSTRACT

The development of functional foods is a viable alternative for the prevention of numerous diseases. However, the food industry faces significant challenges in producing functional foods based on probiotics due to their high sensitivity to various processing and gastrointestinal tract conditions. Encapsulation technology offers a promising solution to this issue. Therefore, the present study focuses on improving probiotic stability and survivability by microencapsulating *Lactocaseibacillus Casei* within Lentil Split Protein (LSP) and Alginate (ALG) matrix by extrusion technique. The encapsulation efficiency (EE%), the viability after simulated gastrointestinal digestion, thermal stability, and capsule probiotic content of the microcapsules were examined. The results demonstrate that alginate beads exhibited a lower encapsulation efficiency (EE%) (70%); however, the LSP-ALG matrix showed an EE% (85%). LSP-ALG matrix encapsulated probiotic cells exhibited maximum survival upon gastrointestinal transit, with 8.45 and 7.24 CFU g⁻¹ after gastric and complete stimulated gastrointestinal digestion, respectively. The thermal tolerance of probiotics was assessed at 50°C, 60°C, and 80°C for 5 and 10 min each, with LSP-ALG capsules retaining higher viability, followed by ALG capsules. Color analysis (L*, a*, and b*) was performed to evaluate visual characteristics of LSP-ALG beads, showing L*, a*, and b* values of 60.99, 3.23, and 13.41, respectively, while alginate beads exhibited corresponding values of 62.22, (-0.81), and 7.32. In conclusion, legume protein-ALG capsules, especially LSP-ALG, demonstrate a better matrix for the encapsulation of probiotics in food applications.

Keyword: Microencapsulation, Probiotic, *Lactocaseibacillus casei*, Lentil split protein

Survey of Medicinal Plants related to Male Infertility and Reproductive Health Disorders in East Nimar Region, Madhya Pradesh

Rut N. Megha* & Hiren B. Soni

Department of Environmental Science & Technology (EST), Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar – 388120, Gujarat, India
Email: rutbhoi943@email.com

ABSTRACT

This research investigates the ethnomedicinal knowledge of communities across five tribal-dominated blocks of the East Nimar region, focusing on plant species traditionally used to address reproductive and infertility-related problems. Through semi-structured interviews, guided field visits, repeated cross-checking with knowledgeable healers, and on-site plant identification, information was collected from 146 informants. The survey led to a detailed documentation of 159 medicinal plant species. Among these, 16 species were repeatedly cited for issues such as menstrual irregularities, low sperm count, sexual debility, and infertility, making them high-priority candidates for laboratory evaluation. The consistency of these reports gives a strong ethnobotanical signal worth investigating scientifically. To support accurate taxonomic identification, herbarium work has been carried out alongside field documentation. Voucher specimens for all recorded species were collected, pressed, dried, and mounted following standard herbarium protocols. Each specimen has been labelled, catalogued, and authenticated through regional floras and expert consultation, creating a reliable reference archive for all further analyses. For experimental preparation, the selected plant materials are being extracted using a Soxhlet apparatus with chloroform, ethyl acetate, and methanol. Careful temperature control is maintained throughout extraction to protect heat-sensitive metabolites. After extraction, each solvent fraction is concentrated using rotary evaporation, allowing efficient removal of solvents under reduced pressure. The resulting concentrates are then dried in a desiccator and stored securely for phytochemical work. These extracts will be taken forward for phytochemical profiling, antioxidant assays, and later for targeted in vitro evaluation on Leydig cell lines to explore their influence on testosterone production.

Keywords: Ethnomedicinal survey, East Nimar, Madhya Pradesh, Male Infertility, Reproductive health, Phytochemical analysis

Bioethanol Production from Lignocellulosic weed (*Parthenium hysterophorus*) via an Optimized Saccharification Process using UV-Mutant *Saccharomyces cerevisiae*

Snehal S. Ingale¹, Urvis Chhaya^{2*}

¹Department of Microbiology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120, Gujarat, India

²Department of Microbiology, Natubhai V. Patel College of Pure and Applied Sciences (NVPAS), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120, Gujarat, India
Corresponding author: urvis.chhaya@cvmu.edu.in

Abstract

Lignocellulosic biomass represents a promising, sustainable feedstock for bioethanol production, yet its complex structure presents significant conversion challenges. This study aimed to develop an efficient process for bioethanol production from agricultural residue, specifically *Parthenium hysterophorus*. Key objectives included standardizing pretreatment methods, optimizing enzymatic saccharification using artificial intelligence-driven statistical

models, and enhancing fermentation through a developed UV-mutant strain of *Saccharomyces cerevisiae*. Methods involved physicochemical pretreatment of biomass, followed by saccharification using cellulase, xylanase, and hemicellulase cocktails. Process parameters were optimized using Design Expert software tool for statistical design. A UV-induced mutant yeast strain was developed and employed in submerged fermentation, with further optimization in a bioreactor using immobilized cells. Results confirmed successful pretreatment and saccharification, yielding high reducing sugars. The mutant strain of *Saccharomyces cerevisiae* [SC-M16] demonstrated superior ethanol production (10-15% rise) compared to the parent strain, with fermentation conditions effectively optimized. Bioreactor studies showed enhanced ethanol productivity using the immobilized mutant strain. In conclusion, this integrated approach significantly improves bioethanol yield from lignocellulosic waste, contributing to sustainable biofuel strategies and waste valorization. The findings highlight the potential of combined process optimization and strain improvement for efficient renewable energy production.

Keywords: *Lignocellulosic biomass, Bioethanol, Saccharification, UV-mutant, Saccharomyces cerevisiae, Bioreactor, Statistical optimization, Sustainable energy.*

BIO-09

Artificial Intelligence in Non-Invasive Prenatal Diagnosis: Concepts, Methods, and Clinical Utility

Pratibha Parihar^{1*}, Upti Aayer²

¹Assistant Professor, Natubhai V Patel College of Pure and Applied Sciences, The Charutar Vidya Mandal University, Vallabh Vidyanagar, Gujarat, India

²PhD Research Scholar, Natubhai V Patel College of Pure and Applied Sciences, The Charutar Vidya Mandal University, Vallabh Vidyanagar, Gujarat, India

*pratibhaparihar@gmail.com

Abstract

Non-invasive prenatal diagnosis (NIPD) has recently emerged as a frontier approach for foetal genetic testing using cell-free foetal DNA (cffDNA) present in maternal plasma. Although next-generation sequencing can detect high-resolution chromosomal abnormalities, biological and technical factors, such as placental mosaicism, low foetal fraction, sequencing noise, and GC bias, make interpreting NIPT results challenging and complex. Therefore, recently, the analysis pipelines have incorporated an Artificial Intelligence (AI) approach to overcome these challenges by providing data-driven, adaptive, and robust analytical tools. Machine learning and deep learning algorithms have recently been included in AI-driven NIPD to learn the complex, non-linear patterns in high-dimensional datasets generated by the sequencer by using variables such as read depth, fragment size, foetal fraction and quality scores. Incorporating Machine Learning (ML) and Deep Learning (DL) algorithms improves classification accuracy for common aneuploidies such as trisomy 21, 18, and 13, and it also helps in improving the pipeline performance in cases of low foetal fraction and early gestational age samples. In addition to just common aneuploidy screening, AI-based detection has the ability to identify sex chromosomal abnormalities, sub-chromosomal copy number variations, and some common monogenic disorders. It has been seen that the incorporation of AI-driven NIPD has improved the detection sensitivity and specificity by reducing the false-positive rates and reducing the invasive follow-up cases. However, the model interpretability, population bias, data standardization, and regulatory approval remain important considerations for clinical translation of this approach. This article discusses the concept of AI-driven NID, its current clinical usage, and future directions towards more interpretable and scalable prenatal diagnosis tools.

Keywords: *Artificial Intelligence, Prenatal care, Next-Generation Sequencing, Non-invasive prenatal screening, Foetal genetics*

Analysis of Functionally Important nsSNPs In The Bovine CSN2 Gene :An In Silico Approach

Shailja Jitendrabhai Vyas¹ and Dr. Anjali Kulkarni *

¹ Ashok and Rita Patel Institute of Integrated Study and Research in Biotechnology and Allied Science (ARIBAS), The Charutar Vidya Mandal University, Vallabh Vidyanagar, Anand, Gujarat-388120.

*Natubhai V. Patel College of Pure and Applied Sciences, The Charutar Vidhya Mandal University, Vallabh Vidhyanager, Anand, Gujarat-388120.

*Corresponding Email:anjali.kulkarni@cvmu.edu.in

Abstract

In the present study, the *CSN2* gene, which encodes beta-casein and plays a pivotal role in milk composition, nutritional quality, and processing characteristics such as curd formation and digestibility. *In silico* approach was used to study genetic variations in *CSN2* gene, particularly non-synonymous single nucleotide polymorphisms (nsSNPs). Present study reveals that amino acid substitutions that may alter the primary structure of the beta-casein protein and consequently affect its stability, folding and biological function. These molecular changes have the potential to influence economically important dairy traits, including milk yield, protein content, and technological properties relevant to cheese and fermented dairy product manufacture. Comprehensive experimental evaluation of all possible nsSNPs using conventional laboratory methods is both time-consuming and resource-intensive, especially when large numbers of variants must be examined. Therefore, this study employed computational prediction methods as a rapid and cost-effective strategy to assess the functional consequences of genetic variations. Multiple bioinformatic tools, including SIFT, PolyPhen-2, PROVEAN, and SNAP2, were used to predict the deleterious effects of amino acid substitutions based on evolutionary conservation, physicochemical properties, and protein structural features. In addition, protein stability analysis using I-Mutant 2.0 and evolutionary conservation assessment via ConSurf were conducted to identify mutations likely to disrupt protein integrity and occur at functionally important residues. Structural modeling and comparative analysis of wild-type and mutant proteins were performed to evaluate mutation-induced conformational changes that may underlie functional impairment. Collectively, this *in silico* framework enables the identification of potentially deleterious variants and prioritizes candidate SNPs for further experimental validation, thereby enhancing understanding of the genetic determinants of milk traits and supporting marker-assisted selection and genetic improvement strategies in dairy cattle.

Cotton genome analysis by EST-SSR Markers for fibre quality traits

Kundan Kumar Mishra
Natubhai V Patel College of Pure & Applied Sciences
CVM University
Vallabh Vidyanagar- 388120
District-Anand, Gujarat
Email: Kundan.mishra@cvmu.edu.in

ABSTRACT

EST- SSR markers in tetraploid cotton linked to fibre quality traits used for mapping in diploid cotton species. Selected lines of allotetraploid species viz, *G. hirsutum* and multiple lines of its putative diploid ancestors viz, *G. arboreum* and *G. herbaceum* respectively were used for comparative analysis. These EST-SSR markers are derived from fibre/ovule cDNA libraries, providing effective methodology for gene and QTL based mapping in tetraploid cotton. 35

tetraploid-derived EST-SSR primers, were used in studies among them approximately 88% gave amplification in both diploid species, indicating that flanking sequences around repeats are conserved in the diploid and tetraploid species of cotton. Average number of bands amplified by each primer was 16. The average observed mean heterozygosity was 0.67. DNA sequence information of 12 randomly selected EST-SSR amplicons were used for phylogenetic analysis of *Gossypium* sps. which revealed that two diploid species of *Gossypium* (i.e.; *G. herbaceum* & *G. arboreum*), shares a close genetic similarity with each other. Tetraploid-derived microsatellites may be useful in comparative genetic mapping of both diploid *Gossypium* species, for evolutionary studies and marker assisted selection (MAS) for introgression of agriculturally important traits from exotic diploid and tetraploid germplasm sources. Blast n analysis of randomly selected EST-SSR sequence data showed significant similarity (70-93%) between diploid *G. arboreum* and *G. herbaceum* species and (12-37%) between diploid and tetraploids *G. hirsutum* species.

BIO-12

Artificial Intelligence based Enhancement of Chitinase Production in *Stenotrophomonas* sp. BSUC-16, Its Bioformulation, and Application in Sustainable Agriculture for Biocontrol of *Fusarium oxysporum*

Bushrabanu Shaikh¹ and Urvish Chhaya^{1*}

¹Natubhai V. Patel College of Pure and Applied Sciences, The Charutar Vidya Mandal (CVM) University, Motabazar, Vallabh Vidyanagar, Anand – 388120
E-mail: bushrashaikh1210@gmail.com

Abstract

Fusarium oxysporum is one of the most destructive soil-borne phytopathogens, affecting a wide range of crops, including legumes, where it causes Fusarium wilt, leading to severe yield losses. Chitinase plays a crucial role in the biological control of this pathogen by degrading chitin in the fungal cell wall, thereby inhibiting pathogen growth. In this study, a chitinase-producing bacterial strain identified as *Stenotrophomonas* sp. BSUC-16 was isolated from rhizospheric soil of Anand, Gujarat, and evaluated for its potential application in sustainable agricultural biocontrol of *Fusarium oxysporum* f. sp. *ciceris*, the causal agent of chickpea wilt. Chitinase production was enhanced using an integrated optimization approach combining statistical and artificial intelligence-based models. CCD demonstrated excellent model reliability ($R^2 = 0.9995$), yielding a maximum chitinase activity of 380.21 mU/ml, closely matching the RSM predicted value of 377.47 mU/ml. Model validation using Support Vector Machine ($R^2 = 0.9991$, 371.96 mU/ml), Genetic Algorithm (376.08 mU/ml), and Artificial Neural Network with Levenberg-Marquardt algorithm ($R^2 = 0.9796$, 375.54 mU/ml) confirmed strong predictive accuracy, with all predicted values closely aligned with experimental CCD results. Biomass obtained after cultivation in optimized medium was formulated into bioinoculants using talc-based carrier and calcium alginate bead encapsulation, and evaluated through pot assays on *F. oxysporum*-infected chickpea plants, which resulted in significant disease suppression, reduced plant mortality, and enhanced growth parameters, with bio-formulated products performing comparably to chemical fungicides. Phytochemical analyses revealed elevated activities of PAL, PPO, PO, β -1,3-glucanase, and SOD, while SEM confirmed effective pathogen inhibition. Overall, the study demonstrates the potential of advanced artificial intelligence assisted optimization in enhancing chitinase production from *Stenotrophomonas* sp. BSUC-16, supporting its development as an eco-friendly and sustainable biocontrol agent for the management of Fusarium wilt in chickpea.

BIO-13

Synthesis of Bacterial Exopolysaccharide-Coated Silver Nanoparticles and Their Potential Application as Biofilm-Based Food Packaging Material

Devyani Parmar, Maheshwari Patadiya and Shilpa Gupte*

Department of Microbiology, Institute of Science and Technology for Advanced Studies and Research, V.V. Nagar-388120, Anand, Shilpa.gupte@cvmu.edu.in

ABSTRACT

The research explores the biosynthesis of silver nanoparticles (SNPs) using exopolysaccharides (EPS) from the lactic acid bacteria (LAB) DPCH1 through a green and sustainable approach. EPS-assisted biosynthesis of silver nanoparticles was achieved by optimising EPS and AgNO₃ concentrations under alkaline conditions, resulting in a visible brown colour after 24 hours of incubation. The EPS-SNPs were further characterised by using UV-visible spectroscopy, Fourier-transform-infrared (FTIR) and X-ray diffraction (XRD). The UV-Visible analysis indicated the synthesis of EPS-SNPs by showing an absorption peak at 425 nm corresponding to the surface plasmon resonance. FTIR analysis confirmed the interaction of EPS functional groups of SNPs. XRD analysis validates the crystalline nature of the EPS-SNPs produced, as supported by an average crystalline size and a face-centred cubic (FCC) lattice structure. Moreover, the EPS-stabilised SNPs showed a significant level of concentration-dependent antibacterial and antifungal activity against bacterial and fungal pathogens, demonstrating their functionality. Further, Biofilms incorporating EPS-SNPs were prepared using solvent casting and the brushing method, in which the brushing method resulted in better handling characteristics and overall film quality. Among the plasticisers evaluated, sorbitol was found to be more effective than glycerol in improving the functional properties of the biofilm. The antimicrobial efficacy of the developed biofilm was assessed against pathogenic microorganisms and demonstrated strong antibacterial activity, as evidenced by prominent zones of inhibition. Additionally, when applied as a coating on fruits, the biofilm effectively reduced weight loss and suppressed microbial growth compared to uncoated samples and cellophane-coated controls, as confirmed by viable cell count analysis. These findings indicate that EPS-SNP-based biofilms are a promising, eco-friendly antimicrobial coating for food preservation.

Keywords: *lactic acid bacteria, Exopolysaccharide, Silver nanoparticles, Antibacterial activity*

BIO-14

An Ethno-Botanical survey on Medicinal Plants Used for Treating Reproductive Health Care Problems in Kaprada Taluka of Valsad District, Gujarat

Ayushi H. Patel & Hiren B. Soni

Department of Environmental Science & Technology (EST), Institute of Science & Technology for Advance Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar- 388120, Gujarat, India
Email: aayuship448@gmail.com

Abstract

This study documents the ethnomedicinal knowledge of tribal communities across 129 villages in Kaprada Taluka, Valsad District, Gujarat, focusing on plants used for women's reproductive health issues, including irregular menstruation, vaginal infections, infertility & postpartum complications. Semi-structured interviews, guided field walks with traditional healers iterative cross-verification, and on-site plant identification were employed to gather data from 213 informants in Warli and Kokna hamlets. A total of 136 medicinal plant species from 58 families were recorded for various ailments, with 41 species frequently cited for gynecological concerns, indicating their potential for further scientific validation. Quantitative ethnobotanical indices, including Informant Consensus Factor, Use Value (UV), Fidelity Level (FL), Relative Frequency of Citation (RFC), and Relative Importance Index (RI), were calculated; statistical analysis using these parameters prioritized 10 high-value species for laboratory evaluation. Voucher specimens for all taxa were collected, pressed, dried, labeled, cataloged, and authenticated against Gujarat Biodiversity Board herbarium records and regional floras, establishing a verified

reference collection. Key plant parts (roots, leaves, tubers) from selected species such as *Desmodium gangeticum*, *Cassia tora*, *Commelina benghalensis*, *Crateva nurvala*, etc underwent sequential extraction via Soxhlet apparatus using petroleum ether, chloroform, methanol, and water at controlled temperatures to preserve bioactive constituents. Extracts are concentrated and stored for phytochemical profiling, antioxidant assays, antimicrobial and antifungal screening, and in silico molecular docking to assess affinity against targets for vaginal infections. This research bridges indigenous wisdom with modern pharmacology, emphasizing forest conservation to safeguard Gujarat's biocultural heritage.

Keywords: *Ethnomedicinal Knowledge, Kaprada Taluka (Gujarat), Women's Reproductive Health, Quantitative Ethnobotany, Phytochemical Profiling, In Silico Molecular Docking*

BIO-15

Selective Adsorption of Proteins on Chemically Grown Metal Silicate Structures

Sneh Yadav, sneh.yadav@cvmu.edu.in

Abstract

Chemical gardens are self-organized inorganic structures characterized by complex, plant-like morphologies formed through precipitation reactions under far-from-equilibrium conditions. These systems have long fascinated scientists due to their relevance to hydrothermal vent chemistry and the origin of life; however, their translation into functional, engineered biomaterials remains a significant challenge. In this work, we bridge the gap between chemobrionics and biotechnology by investigating chemobrionically generated metal silicate membranes as novel, intrinsic affinity interfaces for protein purification applications. Utilizing a seed-mediated growth protocol, we synthesized hollow, tubular inorganic microstructures featuring surfaces naturally enriched with accessible transition metal ions. Comprehensive structural and compositional characterization using electron microscopy and spectroscopic techniques revealed a hierarchical architecture comprising unique porosity and specific elemental gradients; features that are typically difficult to achieve in synthetic resins without complex processing. Functional binding assays demonstrated that these self-assembled structures possess a remarkable capacity to selectively adsorb polyhistidine-tagged recombinant proteins directly from solution. This interaction effectively mimics the selectivity principle of conventional immobilized metal affinity chromatography (IMAC) but operates without the requisite organic chelating ligands or polymer backbones. Distinctively, protein retention was found to be governed by a synergy of chemical coordination and physical confinement encoded during the rapid growth process, resulting in binding profiles that differ from commercial standards. Additionally, the system demonstrated compatibility with external stimuli for controlled protein release, offering a versatile alternative to standard elution methods. These findings establish self-assembled chemical gardens as robust, low-cost, and structurally evolved candidates for next-generation bioseparation technologies, highlighting the untapped potential of non-equilibrium inorganic materials in life sciences.

BIO-16

AF4-Guided Optimization of Doxorubicin Liposomes: Tuning Cholesterol:Beta-Sitosterol Ratios for Injectable Stability

Bhavin Dave (Email: bhavindave22@gmail.com)

Corresponding author: Dr Rajesh Dodiya (Email: rajesh.dodiya24770@paruluniversity.ac.in.)

Faculty of Pharmacy, Parul University, Vadodara Gujarat, India.

Abstract

Asymmetric flow field flow fractional (AF4) is a newly emerging technology that has its wide array of application in size-based fractionation of analytes in the size ranging in nanometer to

micrometer. As per regulatory agencies of many advanced countries, it is a primary requirement to use orthogonal analytical techniques to characterize the native properties of nanoparticles in order to determine quality attributes and the suitability of nanostructures as drug delivery systems. These attributes include particle size distributions and shape. As AF4 can be readily coupled to multiple online detectors like Multi-Angle Light Scattering (MALS), Dynamic Light Scattering (DLS), Refractive Index (RI) Detector, Fluorescence Detector an in-depth spectrum of characterization information about size, mass, shape, dispersity, and many other important quality attributes can be easily collected. Liposomes were formulated using the ethanol injection method. AF4 analysis was conducted with a Postnova mini-channel (350 μm thickness; Nova RC 30 kDa regenerated cellulose membrane), employing 0.5 mM NaCl as eluent. A 5 μL sample was injected at 0.2 mL/min flow rate, with cross-flow at 0.6 mL/min and focus flow at 0.9 mL/min; data were acquired via UV detection at 254 nm. AF4 elution profiles supported the DLS and Cryo-TEM data. L-Doxo C produced a sharply resolved, symmetric elution peak at approximately 17.8 minutes with a narrow peak width at half height, indicating a monodisperse population with negligible aggregates, while L-Doxo A, B, and D generated slightly broader peaks with shoulders and trailing edges, suggesting higher polydispersity and the presence of larger or aggregated species. L-Doxo C produced a sharply resolved, symmetric elution peak with a narrow peak width at half height, indicating a monodisperse population with negligible aggregates, while L-Doxo A, B, and D generated slightly broader peaks with shoulders and trailing edges, suggesting higher polydispersity and the presence of larger or aggregated species.

BIO-17

Development and Bioefficacy of Orange Essential Oil-Chitosan Nanoemulsion Targeting *Saccharomyces cerevisiae*

Anamika Jha*, Amatulla Sadabar and Divyesh Patel

Department of Biological Sciences, P.D. Patel Institute of Applied Sciences, Charotar University of Science and Technology, Changa, Anand, Gujarat, India.

*E-mail: anamikajha.bt@charusat.ac.in

Abstract

Fruit juices are widely valued for their nutritional and health-promoting properties; however, microbial contamination has become a significant public health concern due to the rising incidence of foodborne illnesses. Among spoilage microorganisms, yeasts such as *Saccharomyces cerevisiae* and *Schizosaccharomyces pombe* are particularly problematic in fruit juices and soft drinks. Their proliferation leads to sensory deterioration, gas formation, and reduced product stability, thereby shortening shelf life. Therefore, effective control of yeast growth is critical to maintaining quality and safety in juice-based beverages. Although essential oils (EOs) have gained attention as natural antimicrobial agents, their practical application in aqueous systems like fruit juices remains limited because of their hydrophobic nature, which restricts solubility, dispersion, and overall antimicrobial efficacy. To address this limitation, an essential oil-chitosan nanoemulsion (EO-CNE) was developed using orange oil, chitosan, Tween 80, and acetic acid. The optimized formulation (oil:emulsifier ratio 1:5) demonstrated excellent stability for 50 days, maintaining a Z-average droplet size of 165 nm with high distribution intensity (93%) even after thermodynamic stress cycles. FTIR analysis confirmed successful molecular interactions through the appearance of a characteristic C=O peak at 1734.64 cm^{-1} . The nanoemulsion exhibited significant antimicrobial activity against *Saccharomyces cerevisiae*, a common fruit juice spoilage yeast. A concentration-dependent inhibitory effect was observed, with a minimum inhibitory concentration (MIC) of 0.5 ppm in plate assays. Complete growth inhibition was achieved at 100 ppm within 24 h, comparable to sodium benzoate. Enhanced cell surface hydrophobicity and severe morphological alterations, including membrane disruption and ghost cell formation, confirmed its mode of action. These findings have highlighted EO-CNE as a promising natural preservative for controlling yeast-mediated spoilage in fruit-based beverages. The scope of EO-CNE application can be further broadened to evaluate its efficacy

against *Zygosaccharomyces sp.*, other fruit-juice spoilage yeasts, as well as bacterial and mold contaminants.

Keywords: Nanoemulsion, orange oil, fruit juice, chitosan, yeast, ghost cell

BIO-18

Identification of Salivary Biomarkers in Tobacco Chewing Persons for Early Detection of Oral Squamous Cell Carcinoma (OSCC) from Central Gujarat

Priya Patel, Nisha Daxini

Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar-388120, Gujarat, INDIA

Email: nisha.daxini@cvmu.edu.in

Abstract

Oral squamous cell carcinoma (OSCC) is a leading malignancy in India, primarily driven by the high prevalence of tobacco chewing in regions like Central Gujarat, which often results in delayed diagnosis and poor clinical outcomes. To address the urgent need for non-invasive early detection strategies, this study utilises salivary transcriptomics, leveraging the capacity of saliva to reflect molecular alterations within the oral cavity through a repeatable and easy to collect methodology. Employing a case-control design with histopathologically confirmed OSCC patients and habit-matched healthy controls, unstimulated whole saliva was collected under standardized conditions optimized to prevent RNA degradation and ensure assay reproducibility. Total salivary RNA was isolated and analyzed using an optimized one-step reverse transcription quantitative PCR (RT-qPCR) pipeline to quantify candidate genes associated with inflammation, extracellular matrix remodeling, and tumor progression. The diagnostic performance of these biomarkers. This research establishes a robust molecular framework that supports the clinical utility of targeted salivary RNA biomarkers for high-risk population surveillance and early OSCC screening in tobacco-exposed cohorts.

Keywords: Salivary transcriptomics; Oral cancer screening; Smokeless tobacco exposure; Molecular diagnostics;; Non-invasive oncology; High-risk population surveillance

BIO-19

Emerging Trends in Millet Processing and Value Addition: Biological, Chemical and Technological Perspectives

Er. Monika R. Bhoi ¹ and Dr. Anant S. Kulkarni ²

¹Assistant Professor, Natubhai V.Patel College of Pure and Applied Science, The Charutar Vidya Mandal University, V V Nagar, Anand

²Associate Professor, A.D. Patel Institute of Technology, The Charutar Vidya Mandal University, V V Nagar, Anand

Correspondence: *monika.bhoi@cvmu.edu.in (*8140340254), fpt.kulkarni@adit.ac.in (94274 03538)

Abstract

Millets are increasingly recognized as climate-resilient and nutritionally superior cereals with significant potential to address food security, lifestyle disorders, and sustainable dietary needs. Despite their rich composition of dietary fiber, essential minerals, bioactive compounds, and gluten-free proteins, their utilization in mainstream diets remains limited. The present review aims to highlight emerging trends and recent technological advancements in millet processing and value addition from biological, chemical, and technological perspectives. It comprehensively

examines global and Indian production and consumption patterns, along with growing consumer awareness regarding the health-promoting properties of millets, including improved cardiac health, better glycemic control, enhanced gut function, antioxidant activity, and support for weight management. The review discusses conventional and modern processing techniques such as dehulling, milling, soaking, germination or malting, fermentation, roasting, flaking, popping, extrusion, and microwave treatment, with emphasis on their influence on physicochemical characteristics, nutrient bioavailability, reduction of antinutritional factors, and functional quality. Processing-induced biochemical transformations that improve digestibility, sensory acceptability, and shelf stability are also addressed. Furthermore, recent innovations in millet-based value-added products—including weaning foods, bakery products, fermented foods, functional foods, beverages, and traditional formulations—are explored for their nutritional, technological, and commercial potential. This review highlights opportunities for product diversification, entrepreneurship, and the development of health-oriented food systems.

Keywords: *Millets, Processing Techniques, Health Benefits, Value Addition, Functional Foods, Composite Flour*

Chemical Sciences

CHO-20

An Extensive Comparison of Analytical Data Using Various Stability Condition of Non-Steroidal Anti-Inflammatory Drug (NSAID) for Meloxicam Injection of Various Manufacturers of Branded (Innovator) Drug Product and Generic Drug Product

Kushal Pankajkumar Shah^a, Rohit. H. Dave*

Department of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand, Gujarat, India, 388120

E-mail: - Pramukhbhprit@gmail.com

Abstract

In recent years, there has been a noticeable and sustained increase in the utilization of generic pharmaceutical products across healthcare systems worldwide. This growth can be attributed to their cost-effectiveness, improved accessibility, and regulatory assurance of quality and therapeutic equivalence. As a result, both generic and branded non-oral drug formulations are now manufactured and marketed by a wide range of pharmaceutical companies. Among these formulations, Meloxicam injection is widely used as a non-steroidal anti-inflammatory drug for the management of pain and inflammation, making it an important candidate for quality and stability evaluation. The present study focused on the assessment of Meloxicam injection samples obtained from different manufacturers to evaluate their stability and quality attributes. The samples were stored under controlled long-term conditions of 25 °C/60 % RH and accelerated conditions of 40 °C/75 % RH in accordance with the requirements of ICH guideline Q1A(R2). Stability studies are an essential component of pharmaceutical development and quality assurance, as they provide critical information on how environmental factors such as temperature, humidity, and packaging systems influence drug product performance over time. Exposure to unfavourable storage conditions may result in physical changes, chemical degradation, formation of impurities, or interactions with container closure systems, which can ultimately compromise product safety and efficacy. Therefore, systematic stability evaluation ensures that pharmaceutical products maintain their intended quality, potency, and therapeutic effectiveness throughout their assigned shelf life. The analytical results generated during the study demonstrated that all Meloxicam injection samples complied with predefined acceptance

criteria. Assay values for all samples remained above 95.0 %, while total associated impurities were consistently below 1.0 % throughout the study period. These findings confirm the stability of Meloxicam injection and indicate comparable quality and performance among products from different manufacturers.

CHO-21

Natural Catalyst Assisted Synthesis of Potential Antidiabetic Molecules: A Combined Docking and In Vitro Study

Dr. Priteshkumar Thakor*¹, Dr. Jatin D. Patel², Dr. Priteshkumar M. Thakor
¹Shri Alpesh N. Patel Post Graduate Institute of Science and Research, Anand
²M. B. Patel Science College, Anand
Email: priteshtakor.pt@gmail.com

Abstract

This study presents the natural acid-catalyzed synthesis of newly designed compounds and their evaluation for antidiabetic potential using computational and experimental methods. The synthetic approach employed mild reaction conditions, offering high efficiency, reduced toxicity, and adherence to green chemistry principles. Molecular docking studies were performed against the α -amylase enzyme to evaluate binding affinity and active-site interactions, revealing favorable docking scores. In vitro α -amylase inhibition assays demonstrated significant antidiabetic activity, comparable to standard inhibitors. The results indicate that the synthesized compounds are promising candidates for antidiabetic drug development. Furthermore, a positive correlation between molecular docking outcomes and biological assay results supported structure–activity relationship (SAR) analysis, providing insights into the role of structural features in enhancing biological activity.

Keywords: *Natural acid catalysis; α -Amylase inhibition; Molecular docking.*

CHO-22

Understanding Aggregation Behaviour of Tetronics®–Ionic Liquid Interactions via Cloud Point, DLS, SANS, and Computational Approach

Jaykumar J. Gami^a, and Rohit L. Vekariya^{a*}
^aDepartment of Organic Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar - 388120, Gujarat, India
E-mail: jaygami913@gmail.com

Abstract

The micellization behavior of Tetronics® T904 and T1304 in aqueous solution was systematically investigated using cloud point (CP) measurements, dynamic light scattering (DLS), small-angle neutron scattering (SANS), and computational approaches. The ionic liquids (ILs) studied included pyridinium, picolinium, and imidazolium derivatives with varying alkyl chain lengths and counterions. The synthesized ILs were analyzed structurally using spectroscopic methods. The experiments revealed that the incorporation of ILs led to an increase in cloud points and a notable decrease in the hydrodynamic diameter (D_h) of the micelles. According to SANS studies, the addition of ILs to pure Tetronics® resulted in a reduction of the micellar core radius. The combined data showed that IL-induced demicellization occurred, and the IL head group, chain length, and counterion identity significantly influenced the extent of disruption. Further molecular-level insights were provided by Density Functional Theory (DFT) calculations, which indicated that the electronic energy gap widened in the presence of ILs, thereby explaining the observed destabilization of micellar assemblies. This study highlights the critical impact of IL structural characteristics on the self-

assembly of Tetronics®, which has implications for the customization of responsive soft matter systems.

Keywords: Tetronics®, Ionic Liquids, Cloud Point, DLS, SANS, Computational simulation

CHO-23

DIPEA-PTS Assisted Synthesis of Pharmacologically Important Diversely Substituted Pyrazolo-Quinolines: An Eco-Friendly Approach

Patel Harsh C.¹, Ram Kesur R.^{1*}

¹Department of Chemistry, Sardar Patel University, Vallabh Vidyanagar, Gujarat, India.

Email: k_ram@spuvvn.edu

ABSTRACT

Heterocyclic compounds are foundational to organic chemistry, playing pivotal roles in medicinal chemistry, materials science, and agriculture.¹ Their presence in macromolecules such as enzymes, vitamins, and biologically active compounds underscores their significance. These compounds form the backbone of numerous therapeutic agents in the pharmaceutical industry. Among these, pyrazolo-quinoline derivatives are particularly noteworthy for their potent anticancer and antioxidant activities. These compounds interact with biological targets to inhibit DNA synthesis, promote oxidative stress, and induce apoptosis in cancer cells, making them promising candidates for novel cancer therapies.² In parallel, green chemistry principles, which emphasize the reduction of hazardous substances and the development of sustainable processes, are increasingly crucial.³ Within this context, Multicomponent reactions (MCRs) and ionic liquids (ILs) are critical strategies for advancing sustainable chemical processes. MCRs reduce the number of synthetic steps and overall reaction time, contributing to more environmentally friendly practices. Similarly, ILs, with their low volatility and recyclability, offer a promising alternative to traditional organic solvents and significantly reduce volatile organic compound (VOC) emissions.⁴ Aligned with our ongoing efforts to develop biologically significant pyrazolone-based frameworks under environmentally benign conditions,⁵ we report the efficient synthesis of novel pyrazolo-quinoline derivatives using diisopropyl ethyl ammonium p-toluene sulfonate (DIPEA-PTS) as both a solvent and a catalyst. Furthermore, *in vivo* antiproliferative studies of the synthesized compound against six cancer cell lines revealed promising activity, with particularly notable effects against the lung cancer cell line (A549).

Keywords: Antiproliferative, Diisopropyl ethyl ammonium p-toluene sulfonate, Green chemistry, Multicomponent reactions, Pyrazolo-quinolines

CHO-24

Synthesis and screening for anticancer, antimicrobial and antioxidant activities of new benzimidazole linked 1,2,3-triazole derivatives

Akash Pankaj Ramolia^a

Department of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand, Gujarat, India, 388120

E-mail: - ramoliaakash@gmail.com

Abstract

A series of novel 1,2,3-triazole-based heterocyclic compounds were synthesized using click chemistry to explore their potential as antiproliferative agents against human breast cancer cells. The compounds underwent extensive *in vitro* evaluation for anticancer, antimicrobial, and antioxidant activities. Molecular docking studies revealed strong interactions with the aromatase enzyme, aligning with observed biological activity. Synthesis was achieved via the

Copper(I)-catalyzed azide-alkyne cycloaddition method, with structural characterization confirmed by mass spectrometry, NMR analyses. Pharmacokinetic profiling supported drug-likeness and selected compounds demonstrated notable anticancer and antibacterial efficacy, suggesting their promise as candidates for future therapeutic development.

CHO-25

Improving Compatibility and Performance of Biodegradable Polymer Blends through Reactive Grafting

Kaushal J. Bavaliya, Mahendrasinh Raj*

Department of Polymer Chemistry- Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University Vallabh Vidyanagar – 388120, Gujarat, India.

Corresponding Author email ID: Mahendrasinh.raj@cvmu.edu.in

Abstract

Poly(lactic acid) and poly(butylene adipate terephthalate) are widely explored biodegradable polymers for sustainable material development. However, their poor interfacial compatibility and phase separation significantly limit their practical performance. In this study, poly(lactic acid) grafted with glycidyl methacrylate was successfully synthesized and employed as a novel reactive compatibilizer to improve the interfacial interactions in poly(lactic acid) and poly(butylene adipate terephthalate) blends. Blends with different polymer compositions were prepared by melt blending using varying amounts of the synthesized compatibilizer to systematically evaluate its effectiveness. Successful grafting of glycidyl methacrylate onto poly(lactic acid) was confirmed through Fourier transform infrared spectroscopy by the appearance of a characteristic epoxide absorption band, along with gel permeation chromatography showing a clear increase in molecular weight. Mechanical testing revealed substantial improvements in tensile strength, flexural strength, impact resistance, and surface hardness for the compatibilized blends compared to uncompatibilized systems. Thermal analysis further demonstrated enhanced thermal stability, evidenced by a noticeable shift in the degradation onset toward higher temperatures. Scanning electron microscopy images showed a finer, more uniform dispersion of the poly(butylene adipate terephthalate) phase within the poly(lactic acid) matrix, indicating stronger interfacial adhesion and reduced phase separation. In addition, the compatibilized blends exhibited improved resistance toward chemical environments and accelerated biodegradation behavior under soil burial conditions. Overall, the incorporation of poly(lactic acid) grafted with glycidyl methacrylate proved to be an effective strategy for simultaneously enhancing mechanical, thermal, morphological, chemical, and biodegradation properties. This work highlights the strong potential of this novel compatibilizer for developing high performance, environmentally sustainable polymer blends suitable for advanced biodegradable applications.

Keywords: *Biodegradable polymers, Polymer compatibilization, Interfacial compatibility, Mechanical enhancement, Thermal stability*

CHO-26

Enhancing Compatibility in Poly(lactic acid) Based Blends

Nilesh S. Vala, Amit Thummar*, Mahendrasinh Raj

Department of Polymer Chemistry- Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University Vallabh Vidyanagar – 388120, Gujarat, India.

Corresponding Author email ID: amitkumar.thummar@cvmu.edu.in

Abstract

The limited miscibility between poly(lactic acid) and polycaprolactone restricts their broader utilization, despite their biodegradability and favorable mechanical characteristics. In the

present study, polylactic acid blends incorporating functionalized polycaprolactone derivatives, namely polycaprolactone grafted maleic anhydride and polycaprolactone grafted glycidyl methacrylate, were successfully prepared through melt blending to enhance interfacial adhesion and overall material performance. Thermal analysis revealed a noticeable improvement in thermal stability for the compatibilized blends, with the onset of thermal degradation shifting toward higher temperatures compared to neat polylactic acid. Mechanical characterization demonstrated a clear tradeoff between strength and toughness, where tensile strength gradually decreased with increasing functionalized polycaprolactone content, while impact resistance showed a significant improvement, indicating enhanced energy absorption capability. Differential scanning calorimetry results confirmed a reduction in glass transition temperature with increasing polycaprolactone grafted glycidyl methacrylate content, suggesting an effective plasticizing effect and improved chain mobility. Biodegradation behavior evaluated through soil burial studies showed a substantial increase in weight loss with increasing compatibilizer content, confirming enhanced biodegradability of the blends. Morphological observations using scanning electron microscopy revealed finer phase dispersion and stronger interfacial adhesion in blends containing polycaprolactone grafted glycidyl methacrylate compared to those containing polycaprolactone grafted maleic anhydride. Overall, the results demonstrate that reactive compatibilization using functionalized polycaprolactone derivatives effectively improves phase compatibility, thermal stability, toughness, and biodegradation behavior of polylactic acid and polycaprolactone blends. These compatibilized systems show strong potential for use in sustainable packaging and biomedical material applications.

Keywords: Polylactic acid, Polycaprolactone, Reactive compatibilization, Interfacial adhesion, Biodegradable polymer blends

CHO-27

Synthesis and Bio evaluation of Imidazole-Chalcone Compounds: Anticancer Efficacy on A549 Cells, Molecular Docking with Tubulin-Colchicine Complex, and Multispectral Antioxidant and Antimicrobial Activities

Meet B. Vekariya^a, Akash P. Ramolia^a, Niraj Patel^a, Mahendrasinh Raja^{a*}

^aInstitute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120, Gujarat, India

Abstract

A range of chalcone compounds were identified and synthesized to develop medicinally active agent. The evaluation of these chalcones, study shows that imidazole containing chalcones is active against various types of diseases, so we are intending to develop chalcones derivatives that are used as bioactive molecules against various types of diseases. Compounds were synthesized using n-alkylation and Claisen-Schmidt condensation. *In-Silico* studies were done by Molecular docking on 4O2B tubulin crystal structure, pharmacokinetic assessments were conducted using Swiss ADME tool, and toxicity properties of compounds on pre-ADMET software. *In-vitro* anti-cancer activity was done by MTT Assay on A549 (Human lung cancer cell line). Anti-oxidant, anti-microbial, and anti-fungal activities of the chalcone were done by DPPH assay, Gram-positive (*Bacillus subtilis*) bacterial and fungal (*Aspergillus Niger*) strain respectively. Results of the study suggest the possible utility of imidazole containing chalcones as new lead molecules to be a new class of anti-cancer agents.

CHO-28

Design, synthesis and development of new methodology of some novel heterocycles and their bioevaluation as potential therapeutics agents

Dr. Jigar Y. Soni*

Faculty of Basic and Applied Sciences, Madhav University, Abu Road Rajasthan.

Abstract

The series of spiro benzoxazole-one analogues were synthesized and cytotoxic studies are described. We have screened for their in vitro anticancer activity against nine different human cancer cell lines using the cell counting kit-8 (CCK-8) assay. The synthesized compounds were confirmed structurally by means of IR, ¹H-NMR, ¹³C NMR, Mass spectral analysis. Some of these new spiro benzoxazole-one shows potential anticancer activity. They displayed moderate to strong cytotoxic effects against the tested cancer cell lines. Compounds **AV1-B-04** and **AV1-B-06** showed the promising cytotoxic effects against PanC-1 cell line (EC₅₀ 9.5 μM) and (EC₅₀ 10.4 μM) as compare to FDA approved drug Imatinib. Docking studies of the synthesized compounds was done with the help of schrodinger Glide. Accordingly, synthetic analogue **AV1-B-04** and **AV1-B-06** were identified as the most promising potential anticancer agent in present study, and was selected as lead compound for further detailed investigations.

CHO-29

Sustainable Bio-Based Plastisol: Formulation and Application Performance in PVC Systems

Prince H. Patel ¹, Mandar Karve ^{1,*}

ORCID ID: - 0009-0009-9777-4507 ¹, 0000-0002-1107-9741 ^{1,*}

^{1,*} Department of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand, Gujarat, India, 388120

E-mail: - drmandarkarve@gmail.com

Abstract

The growing demand for sustainable and environmentally benign polymeric materials has stimulated interest in the development of bio-based plastisols as alternatives to conventional petroleum-derived systems. In the present study, bio-based plastisols were formulated using PVC resin in combination with epoxidized esters derived from renewable acid oils of soya and rice bran. The prepared plastisols were systematically evaluated for their performance in both molding and coating applications. For molding applications, plastisol formulations containing PVC, bio-based plasticizers and Ca/Zn stabilizers were prepared and thermally cured to achieve effective gelation and uniform film formation. For coating applications, plastisols were formulated with additional functional additives, including a crosslinking agent and silane binder and applied onto metal substrates followed by thermal curing to obtain well-adhered coatings. The processing behaviour, curing characteristics, and overall performance of the bio-based plastisols demonstrated their suitability for industrial molding and coating applications. The results highlight the potential of epoxidized acid oil-based esters as sustainable plasticizers in plastisol formulations, offering a promising pathway toward eco-friendly PVC processing systems.

Keywords: - *Bio-based plastisol; Epoxidized acid oil esters; PVC plastisol; Molding applications; Coating applications*

CHO-30

Synthesis of Pect-g-PAN by Ceric Ammonium Nitrate /Nitric Acid and Potassium Persulfate/Ascorbic Acid Initiator Systems: Mechanistic Pathway, Material Characterization and Application

Priyamvada Singh, Kinnari A. Bhatt*

Department of Organic Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120 Gujarat, India.

Email: priyamvdasingh5834@gmail.com, kinnari.bhatt@cvmu.edu.in

Abstract

Pectin-based superabsorbent materials were synthesized by grafting of acrylonitrile (AN) onto pectin using two different initiation systems: ceric ammonium nitrate (CAN)/nitric acid (HNO₃) and potassium persulfate (KPS)/ascorbic acid (AA). The resulting Pect-*g*-PAN copolymers were subsequently saponified to convert nitrile groups into hydrophilic carboxylate groups, which enhancing the water absorbency. The structural and morphological features of the grafted and saponified co-polymers were characterized using Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). FTIR confirms successful grafting and the conversion of cyano group to carboxylate group after saponification, while SEM revealed changes in surface texture associated with network formation. Water absorbency of the saponified products was determined and compared for both initiating systems. The CAN/HNO₃ initiated graft copolymer exhibited higher water absorbency than the KPS/AA initiator system. The pectin based graft co-polymers have potential application as an eco-friendly superabsorbent material remains a promising field of research.

CHO-31

Modified resin from recycled PET: structural analysis and performance in jute fiber reinforced composite

Pragnesh Rathva¹, Lata Raj^{1*}

¹Shri C.N.P.F. Arts & D.N. Science College, Dabhoi, Shri Govind Guru University, Godhra, Gujarat, India.

Corresponding author: Lata Raj

Email: lataraj1972@gmail.com

Abstract

This study demonstrates an environmentally friendly approach to the development of polymers by recycling the waste of polyethylene terephthalate (PET) through glycolysis and obtaining bis(2-hydroxyethyl) terephthalate (BHET). The recovered BHET was used to synthesize unsaturated polyester resin (UPR) by polycondensing with maleic anhydrides and succinic acids. As well as Multifunctional epoxy resin was synthesized from Phenol, formaldehyde, and epichlorohydrin. BHET, UPR and epoxy resins were characterized by using thermal and spectral analysis to investigate structure and stability. The hybrid resin was developed by mixing of UPR resin and multifunctional epoxy resin with various hardeners. These hybrid resins were used in the fabrication of jute fiber reinforced composites. The surface morphology, chemical resistance, thermal stability, and mechanical properties of the manufactured composites were analyzed. The results showed that the thermal and mechanical performance, adhesion, and chemical resistance of hybrid resin with aromatic hardeners increased considerably compared to those prepared with aliphatic hardeners. This work shows the effective reuse of PET waste for advanced polymers and highlights the potential of composite systems for high performance applications.

Keywords: *Recycling, BHET, UPR, Composite*

CHO-32

Chemical modification of waste cooking oil for the bio lubricant production through epoxidation process

Jeimin R. Joshi¹, Khodidas K. Bhanderi¹, Jigar V. Patel^{1,2}

Department of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand, Gujarat, India, 388120

E-mail: - Pramukbhprit@gmail.com

Abstract

The barrier that occurs between traditional and renewable lubricant base stocks needs to be closed by the lubricant industry. Maximal esters conversion was the goal in the synthesis of waste cooking oil methyl esters (WCOME), that were produced from waste cooking oil (WCO). In this study, waste cooking oil was to be used as the principal feedstock to make a biodegradable lubricant-grade ester with better tribological properties than commercial lubricant or cited biolubricants. The final esters physicochemical and tribological characterization came after the three steps of the synthetic process—transesterification, epoxidation, and ring-opening reaction using diverse long chain alcohols. Following the first transformation of WCO into WCOME, more chemical alterations were done. In this study, waste cooking oil underwent chemical epoxidation and ring opening reactions to improve its physicochemical characteristics and tribological characteristics to be utilised as a bio lubricant that can be utilised in various industrial application. The products were confirmed and characterised using NMR and FTIR. The efficacy of these produced bio lubricants was evaluated using a variety of analytical techniques, and it was discovered that it was on par with that of the lubricant that was commercially available or that was cited in the literature. The physico-chemical properties of synthesised esters were determined and compared using established methods. Overall, it was concluded from the physico-chemical and tribological characterization data that the generated esters might be used as a base stock for alternative lubricants in a number of industrial applications.

Keywords: *Bio lubricants, Alternatives, Green, Renewable, Epoxidation, Waste cooking oil*

CHO-33

Development of Synthesized Nanostructured Dendrimers as Novel Carriers for Improving the Solubility of Domperidone

Vidhi Patel^a, Pravinkumar M. Patel^b, Jigar V Patel^{c,*}

^a Department of Industrial Chemistry, Institute of Science and Technology for Advanced Studies and Research (ISTAR), The Charutar vidya mandal (CVM) University, Vallabh Vidyanagar 388120, Gujarat, India.,

^b Industrial Chemistry Department, V.P.& R.P.T.P. Science College (affiliated to Sardar Patel University), Vallabh Vidyanagar 388120, Gujarat, India.

^c Sophisticated Instrumentation Centre for Applied Research and Testing (SICART), Vallabh Vidyanagar, Gujarat, India

Email: vidhi.patel085@gmail.com

ABSTRACT

An antiemetic drug called domperidone (DMP) is used to treat dyspepsia, indigestion, epigastric pain, nausea and vomiting in both adults and children. DMP is class II medication, which indicates that it has a high permeability and a low solubility in water. One major obstacle to the successful development of effective dosage forms for domperidone is its poor solubility in water. Dendrimers have shown to be useful as solubilizers in recent decades. Because of these unique properties, dendrimers are a useful tool for drug solubilization. These characteristics include good drug encapsulation, high water solubility, excellent host-guest chemistry, versatile geometry, and customizable surface design. The current study showed that synthesized dendritic macromolecules outperformed commercially available PAMAM dendrimer in novel nanostructure Dendrimer's cytotoxicity and hemolysis tests were performed on lung cancer cell lines, A-549. Using a phase solubility method, reported nanostructured dendrimers are used to increase the solubility of domperidone. The impact of dendrimer concentration and generation on domperidone solubility was investigated. The outcomes of the experiment demonstrated that domperidone's solubility was roughly correlated with dendrimer generation and concentration. Infrared spectroscopy is used to confirm the drug containing dendrimer. The current work indicates that the TG3.0 dendrimer exhibits significant promise for improving domperidone solubility. For increasing domperidone solubility, dendrimer worked better than beta-

cyclodextrins. This research demonstrates that the hydroxyl-terminated nanostructured dendrimer system may serve as a promising delivery system for hydrophobic drugs.

Keywords: *Cytotoxicity, Dendrimer, Domperidone, Hemolysis, Nanostructure, Solubility*

CHO-34

Chemical recycling of plastic waste an alternative to derive value added product

Dr. Khodidas K. Bhandari^a, Dr. Jeimin R. Joshi Dr. Jigar V. Patel*

Department of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand, Gujarat, India, 388120

E-mail: - Pramukbhprit@gmail.com

Abstract

Today most of the products are based on petrochemicals. Due to the depletion of petroleum resources and the rising cost of these chemicals, it has become a significant issue for all chemical industries. Plastics are an essential part of everyday life in the modern industrialized world. As most of the utilized synthetic materials are less/non-biodegradable, environmental issues are faced due to unavoidable problem in an era where polymers dominate over the environment. Due to their non-biodegradable qualities, materials like paper and polyethylene terephthalate (PET), which are widely used in most of the industries as packaging materials, make significant contributions to environmental waste. A potential solution to these kinds of challenges is the chemical recycling of plastic waste materials. The current study focuses on the chemical recycling of PET waste plastic material to recover the intermediate product (BHET monomer) and optimized the reaction process by utilizing two different AW derived catalysts. New BHET-based polymeric esters that can be utilized as coating materials can be developed using the BHET as raw material. The syntheses of BHET-based esters were confirmed using the FTIR, GPC, and proton NMR techniques. Also, Industrial-grade polymeric coating materials were compared with BHET-based polyester polyol-based coating.

Key Words: *Waste PET, Chemical Recycling, Glycolysis, BHET-based polyester polyol, Coating*

Computer Sciences

COO-35

Advanced Data Analytics Algorithms Based on Machine Learning and AI Techniques

Samirbhai Vinubhai Patel^{1*}, Dr. Ahish Joshi²

¹Department of Computer Science, CVM University, Gujarat, India

²ISTAR College, CVM University, Vallabh Vidyanagar, Gujarat, India

Corresponding Author: samirpatel865@gmail.com

Abstract

The rapid expansion of large-scale, heterogeneous, and high-dimensional data has introduced significant challenges for traditional data analytics techniques, particularly in terms of scalability, accuracy, and adaptability. Conventional statistical methods often struggle to capture complex patterns and nonlinear relationships inherent in modern datasets. To address these challenges, this paper presents advanced data analytics algorithms based on machine learning and artificial intelligence techniques. The proposed approach integrates supervised and unsupervised learning strategies with intelligent analytical mechanisms to improve data preprocessing, feature extraction, pattern recognition, and predictive modeling. Machine learning models such as decision trees, support vector machines, ensemble learning, and

clustering techniques are employed to enhance analytical accuracy and robustness. Experimental evaluations using benchmark and real-world datasets demonstrate that the proposed algorithms outperform conventional analytics methods in terms of accuracy, efficiency, and scalability. The findings highlight the effectiveness of ML- and AI-driven analytics in supporting intelligent decision-making across diverse application domains, including healthcare, finance, and decision support systems.

Keywords: *Data Analytics, Machine Learning, Artificial Intelligence, Advanced Algorithms, Predictive Modeling.*

COO-36

A Comprehensive Performance and Robustness Evaluation of Vision Transformer Models for Anomaly Detection in Autonomous Driving Scenarios

Patel Nimisha Natvarlal¹, Dr. Niky Jain²

¹Research Scholar, The CVM University & Adhoc Lecturer

Department of Computer Science, C.K. Pithawalla College of Commerce, Management and Computer Applications, Application ID: PHD202500011

ORCID: 0009-0005-8661-3303, Email: nishamorker1512@gmail.com

²Research Guide & Assistant Professor

Department of Computer Science, ISTAR College, The CVM University

Anand, India. ORCID: 0009-0008-8186-9758, Email: niky.jain@cvmu.edu.in

Corresponding Author: nishamorker1512@gmail.com

Abstract

Vision Transformers (ViTs), first introduced for large-scale image recognition tasks, have significantly advanced computer vision by leveraging self-attention mechanisms to capture global contextual information. Subsequent research has demonstrated their effectiveness in image classification and object detection. However, their applicability in safety-critical autonomous driving systems, particularly for anomaly detection, requires systematic evaluation. Detecting unexpected or out-of-distribution objects is essential for ensuring operational reliability in real-world driving environments. This study evaluates five prominent Vision Transformer variants—ViT-Base, ViT-Large, DeiT, Swin Transformer, and BEiT—on established autonomous driving datasets including nuScenes, KITTI, and BDD100K. Models were pre-trained on large-scale datasets and fine-tuned for anomaly detection objectives. Robustness was assessed under environmental corruptions such as fog, rain, snow, and motion blur, along with occlusion scenarios and adversarial perturbations. Performance was measured using F1-score, precision-recall metrics, and inference efficiency. Hierarchical transformer architectures demonstrated superior performance in multi-scale feature learning and computational efficiency. Swin Transformer achieved the highest overall detection accuracy and faster inference speed, while BEiT exhibited improved resilience under adverse weather conditions. Nevertheless, performance degradation was observed under adversarial conditions across all evaluated models. Findings align with recent advancements in hierarchical transformer design and masked image pre-training strategies, which contribute to improved environmental robustness. However, susceptibility to adversarial perturbations highlights the need for enhanced training strategies before real-world deployment. Vision Transformers show strong potential for anomaly detection in autonomous driving systems. Future research should emphasize adversarially robust training methodologies and hybrid architectures to enhance deployment reliability.

Zero-Shot Learning for Autonomous Systems: Analyzing Generalization in Computer Vision with Self-Supervised AI Models

Kapadia Hetal Kamleshkumar¹, Dr. Niky Jain²

¹Research Scholar, The CVM University & Adhoc Lecturer

Department of Computer Science

C.K. Pithawalla College of Commerce, Management and Computer Application

Application ID: PHD202500012

ORCID: 0009-0005-4572-5536

Email: mehtahetal1687@gmail.com

²Research Guide & Assistant Professor

Department of Computer Science

ISTAR College, The CVM University

Anand, India

ORCID: 0009-0008-8186-9758

Email: niky.jain@cvmu.edu.in

Corresponding Author: mehtahetal1687@gmail.com

Abstract

Zero-shot learning (ZSL) enables machine learning models to recognize objects never encountered during training, a critical capability for autonomous systems operating in unpredictable real-world environments [1, 2]. Traditional supervised learning approaches cannot cover all possible scenarios, creating safety risks when autonomous vehicles or robots encounter novel objects [9]. Self-supervised learning has emerged as a powerful technique for learning robust visual representations without manual annotations [3, 4, 5]. This research investigates whether combining self-supervised learning with zero-shot learning can enhance generalization capabilities for autonomous systems in safety-critical computer vision tasks. We developed a novel framework integrating self-supervised pre-training using SimCLR [3] with zero-shot classification via semantic embeddings. The visual encoder (ResNet-50) was pre-trained on 2.7M unlabeled images from ImageNet, BDD100K, and nuScenes datasets [15, 16, 20] using contrastive learning. We compared three semantic embedding approaches: GloVe word embeddings [10], manually annotated visual attributes [14], and knowledge graph embeddings from ConceptNet and WordNet [11, 12, 19]. The zero-shot classifier learns projection functions mapping visual features and semantic descriptions to a shared 512-dimensional embedding space. Evaluation was conducted on standard benchmarks (CUB-200-2011, ImageNet) and custom autonomous driving scenarios with 60 seen and 15 unseen safety-critical object categories. Self-supervised pre-training achieved 76.3% accuracy on ImageNet unseen classes, outperforming supervised pre-training by 18.7%. On autonomous driving scenarios, the system achieved 82.1% accuracy with particularly strong performance on safety-critical categories: emergency vehicles (91.2%), construction equipment (87.8%), and road hazards (84.3%). Knowledge graph embeddings yielded superior results (76.3%) compared to attribute vectors (73.1%) and word embeddings (69.4%). The model achieved real-time inference at 81 FPS on NVIDIA Jetson AGX Xavier with only 3.2% false positive rate. Results demonstrate that self-supervised learning significantly enhances zero-shot capabilities for autonomous systems by learning task-agnostic representations with broader semantic coverage [3, 4]. The 18.7% improvement over supervised approaches addresses a critical gap in autonomous vehicle safety, enabling recognition of novel hazards without exhaustive training data. Knowledge graphs provide richer semantic relationships than simple word embeddings, facilitating better zero-shot transfer [11, 19]. However, performance degrades on highly similar unseen classes and adversarial examples remain challenging [2]. This work establishes self-supervised zero-shot learning as a viable approach for enhancing autonomous system robustness in open-world environments, with implications for safer deployment of autonomous vehicles and robots.

Keywords: *Zero-Shot Learning, Self-Supervised Learning, Autonomous Systems, Computer Vision, Contrastive Learning, Semantic Embeddings, Generalization, Safety-Critical AI*

COO-38

Process Fingerprints: Rethinking Deepfake Detection Through Generation Pipeline Analysis

Ms. Rupali Shinde¹, Dr. Niky Jain²

¹Ph.D. Student, The CVM University & Assistant Professor, School of Engineering & Technology, Navrachana University, Vadodara, Gujarat, India

ORCID: 0009-0001-8172-8364, Email: rupalishinde.1980@gmail.com

²Assistant Professor, Department of Computer Science, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The CVM University, Vallabh Vidya Nagar, Anand, Gujarat, India

ORCID: 0009-0008-8186-9758, Email: niky.jain@cvmu.edu.in

Corresponding author: rupalishinde.1980@gmail.com

Abstract

The rapid advancement of generative artificial intelligence has enabled the creation of highly realistic deepfake media, reducing the effectiveness of traditional artifact-based detection methods [1], [5]. Existing approaches largely assume that synthetic content contains detectable visual or audio imperfections; however, as deepfake generation pipelines mature, this assumption becomes increasingly unreliable [2], [7]. Beyond concerns of media authenticity, deepfakes introduce emerging risks in safety-critical cyber-physical systems, where synthetic perceptual inputs can influence automated or human-in-the-loop decision-making and potentially contribute to unsafe outcomes [3], [4]. This work introduces the concept of process fingerprints, offering a generation-aware analytical perspective for understanding deepfakes. Instead of proposing a new detection model, the study examines how design choices within deepfake generation pipelines—such as conditioning mechanisms, sampling strategies, and synthesis workflows—leave consistent, process-dependent characteristics that persist independently of surface-level artifacts [2], [6]. By reframing deepfake analysis at the generation-process level, this paper provides a foundational step toward characterizing deepfakes as risk-inducing events, with implications for downstream safety and accident prevention research in cyber-physical systems [3], [4]. Deepfake technologies, driven by advances in generative models, have significantly increased the realism of synthetic media [1], [7]. Most current detection methods focus on identifying artifacts in final outputs, an approach that becomes less reliable as generation quality improves and newer generative paradigms emerge [5], [6]. This limitation motivates a shift toward understanding how deepfakes are produced rather than how they appear. In cyber-physical transportation systems, perceptual inputs directly influence physical actions and system control decisions [3], [4]. Synthetic manipulation of such inputs therefore represents not only an authenticity challenge but also a potential source of systemic risk capable of propagating through perception, decision, and control pipelines. This study positions deepfakes within a broader safety context, emphasizing the need for generation-aware analysis. The proposed approach introduces process fingerprints to describe characteristic traces arising from deepfake generation pipelines. These fingerprints originate from inherent design and operational constraints of generative models rather than visible artifacts [2]. A conceptual framework is presented to categorize such process-level characteristics and distinguish them from artifact-centric cues commonly used in existing detection methods [6], [8]. By shifting focus from artifact detection to generation-process awareness, this work reframes deepfake analysis as a foundation for safety-oriented risk characterization. The concept of process fingerprints supports future research on modeling, detecting, and mitigating deepfake-induced risks in cyber-physical systems, particularly for accident prevention in transportation domains [3], [4].

A Comprehensive Study on Linguistic Transformation System through AI-Tools

Mrs. Salady L. R. Mayuri¹, Dr. Suchita Patel²

¹Research Scholar, The CVM University & Assistant Professor, NVPAS College, V. V. Nagar, Anand, India

ORCID: 0000-0002-1775-2618, Email: mayuri.salady@cvmu.edu.in

²Research Guide & Assistant Professor, Department of Computer Science, ISTAR College, The CVM University, Anand, India

ORCID: 0000-0002-8034-5839, Email: suchita.patel@cvmu.edu.in

Corresponding Author: mayuri.salady@cvmu.edu.in

Abstract

Digital transformation is reshaping not only technology but also the structure, function, and evolution of the English language. This study explores how Artificial Intelligence (AI), Machine Learning (ML), and Natural Language Processing (NLP) are driving linguistic transformation through detection systems, computational analysis, and algorithmic decision-making. English is increasingly functioning as both a programming medium and a communicative interface in Human-Computer Interaction (HCI), where prompt engineering and Natural Language Programming redefine how humans instruct machines. ML techniques such as Sentiment Analysis, Long Short-Term Memory (LSTM) networks, and behavioral detection models influence communication standardization, convergence, and digital storytelling. However, the shift from trust-based interaction to algorithmic verification raises concerns related to ethics, bias, transparency, and digital literacy. This interdisciplinary research highlights how AI-driven systems are transforming English into a dynamic, adaptive, and data-driven medium within the global digital ecosystem.

Keywords: *Artificial Intelligence (AI); Machine Learning (ML); Natural Language Processing (NLP); Linguistic Transformation; Digital Transformation; Human-Computer Interaction (HCI); Detection Systems; Sentiment Analysis; Prompt Engineering; Algorithmic Bias; Digital Literacy; Computational Linguistics.*

Bridging the Linguistic Divide: Advancements, Ethics, and Future Directions in Low-Resource NLP and Indigenous Language Technologies

Bansari Balochiya¹, Dr. Niky Jain²

¹Research Scholar & Assistant Professor

Department of Computer Science

Institute of Science & Technology for Advanced Studies & Research (ISTAR)

The CVM University

Application ID: PHD202500208

ORCID: 0009-0002-3655-4091

Email: bansari.manvar@cvmu.edu.in

²Research Guide & Assistant Professor

Department of Computer Science

Institute of Science & Technology for Advanced Studies & Research (ISTAR)

The CVM University

ORCID: 0009-0008-8186-9758

Email: niky.jain@cvmu.edu.in

Corresponding Author: bansari.manvar@cvmu.edu.in

Abstract

Natural Language Processing (NLP) has been transformed by large language models such as BERT, GPT-3, and T5. However, these advancements largely privilege high-resource languages, leaving billions of speakers of low-resource and indigenous languages digitally marginalized. This imbalance threatens linguistic diversity, cultural preservation, and equitable access to technology. Recent research suggests that transfer learning, multilingual embeddings, and community-driven corpus initiatives offer pathways toward greater inclusion, yet ethical and structural challenges remain unresolved. This study conducts a qualitative literature synthesis of five key works: Myakala & Naayini (2023), Salammagari (2024), Kunchukuttan et al. (2020), Bird (2020), and Doley (2025). The analysis integrates technical developments in low-resource NLP with socio-cultural and ethical perspectives, identifying recurring themes across computational innovation, data infrastructure, and community participation. Findings show that multilingual pretraining, few-shot learning, and LoRA-based fine-tuning reduce computational barriers for languages like Telugu. Cross-lingual embeddings and unsupervised learning improve Natural Language Understanding with minimal labeled data. The AI4Bharat IndicNLP corpus demonstrates that community-led datasets can significantly accelerate regional NLP progress. Despite technical gains, linguistic equity remains incomplete. Bird's decolonial critique highlights risks of extractive data practices, emphasizing participatory, community-centered frameworks. Doley illustrates how tribal youth in Assam leverage digital platforms to revitalize endangered languages, showing that technological inclusion must align with cultural agency. Advancing low-resource NLP requires not only better models but ethically grounded, community-driven, and culturally respectful approaches that prioritize linguistic sovereignty alongside technological innovation.

Keywords: *Low-Resource Natural Language Processing; Indigenous Language Technology; Transfer Learning; Multilingual Language Models; Cross-Lingual Embeddings; Decolonial AI; Language Preservation; Natural language understanding*

COO-41

Smart Health Monitoring Framework for Diabetes Prediction Using Clinical Data

Ms. Ami D. Trivedi¹, Dr. Tejas Thakkar²

¹Assistant Professor

S. G. M. English Medium College of Commerce and Management

²Assistant Professor

N. V. Patel College of Pure and Applied Sciences

Corresponding author: Ms. Ami D. Trivedi

Abstract

Diabetes mellitus continues to place a significant burden on global healthcare systems. Early detection is very important in reducing complications associated with disease. Development of smart health monitoring solutions that help in predictive analysis is possible due to the prevalent use of electronic clinical records. This paper presents a Smart Health Monitoring Framework for Diabetes Prediction using Clinical Data is implemented using the PIMA Indians Diabetes Dataset. The framework examines necessary clinical indicators like glucose measurements, blood pressure, body mass index, insulin levels, age, and hereditary risk factors. Data preparation steps are performed to improve the quality of data before performing analysis. The processed data is used to discover patterns related to diabetes risk through supervised predictive modeling. Effectiveness of framework is evaluated using commonly accepted assessment measures of healthcare analytics. This study establishes that smart monitoring framework can help in early diabetes prediction by analysing clinical data. It can support effective clinical decisions. It highlights the important role of data-driven methods in the area of modern preventive healthcare.

Keywords: *Diabetes Prediction, Smart Healthcare, Clinical Data, Health Monitoring Framework, Preventive Healthcare*

COO-42

A Machine Learning–Driven Architecture for Mental Well-Being Prediction Using Smartphone Usage Behavior

Palakben Rameshchandra Patel¹, Dr. Tejas Thakkar²

¹Research Scholar, Computer Science, The CVM University

²Assistant Professor, Computer Science, Natubhai V. Patel College of Pure & Applied Sciences (NVPAS), CVM University

Corresponding author: Palakben Rameshchandra Patel

Abstract

In current scenario, life without Smartphones is unimaginable and will remain void in future. Usage of smartphone is largely accepted routine for reducing stress and passing the time. A usage of smartphones generates huge amount of behavioral data like users' daily routines, communication patterns, and digital habits. A study of smartphone usage and users' behavioural data offers an understanding and prediction capacity of mental well-being. The Machine learning algorithms and methods have potential to learn the hidden patterns. Based on the new emerging patterns, machine learning model can do predictions. This research paper is focused on proposing a machine learning–driven architecture for mental well-being prediction based on users' smartphone usage and their behavior. The proposed architecture defines key system components from data acquisition to machine learning's prediction modules. The framework is designed to be scalable, modular, and privacy-aware. This study focuses on the conceptual design and workflow of the proposed architecture.

Keywords: *Mental Well-Being, Smartphone Usage Behavior, Machine Learning, System Architecture*

COO-43

A Comprehensive Analysis of AI and IoT Integration for Smart Healthcare Development for Patient Monitoring

Dr. Monika Patel¹, Dr. Tejas Thakkar², Dr Shreya Shah³

^{1,2,3}Natubhai V. Patel College of Pure and Applied Sciences, The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Gujarat

Corresponding Author: –monikaben.patel@cvmu.edu.in

Abstract

In today's era healthcare has become major sector where more challenges may occur to observe and keep a track of the various clinical parameters of the patients in day to day life. In modern life, each and every person may suffer from stress & anxiety. As a result, the society needs hospitals to provide the right facilities, resources, and services, including timely access to doctors, nurses, and pharmaceuticals. These problems have come to the doors of cutting-edge technologies like the Internet of Things (IoT), artificial intelligence, machine learning, and data analytics. Among them, integration of IoT and Artificial Intelligence has the most caught the eye of medical professionals. With the help of these technologies nowadays medical act has become digital. Due to hybridization of these two technologies now doctor-patient interactions have gotten simpler and more effective. It has also raised patient participation and satisfaction. Additionally, remote patient monitoring shortens hospital stays and avoids readmissions by keeping an eye on patients' health. This paper discusses the importance of integrated Artificial Intelligence and IoT technologies in the development of smart healthcare facilities for patient monitoring. It emphasizes how IoT-based medical devices and facilities have helped in collecting

medical information from patients and how machine learning and deep learning-based Artificial Intelligence technologies have been used to analyze this information for effective healthcare management. This study also evaluates related technologies and systems for RHM services by understanding the most pertinent monitoring applications based on several models with different corresponding IoT-based sensors.

Keywords: *Smart Healthcare, Artificial Intelligence, Internet of Things, Remote Patient Monitoring, Deep Learning, Machine Learning*

COO-44

A Machine Learning and Deep Learning Perspective on Wastewater-Based Epidemiology in Gujarat (2023–2025)

Ms. Marina Christia¹, Dr. Suchita Patel²

¹Research Scholar, Department of Computer Science
Institute of Science & Technology for Advanced Studies & Research (ISTAR)
The CVM University, Vallabh Vidya Nagar, Anand, Gujarat
Email: Christimerry20@gmail.com

²Research Guide, Assistant Professor, Department of Computer Science
Institute of Science & Technology for Advanced Studies & Research (ISTAR)
The CVM University, Vallabh Vidya Nagar, Anand, Gujarat
Email: suchita.patel@cvmu.edu.in
Corresponding Author: Christimerry20@gmail.com

Abstract

Between 2023 and 2025, wastewater-based epidemiology (WBE) in Gujarat progressed from city-specific pilot projects to coordinated multi-city surveillance supporting public-health monitoring. Major urban centers, including Ahmedabad, Gandhinagar, Vadodara, Surat, Rajkot, and other municipal catchments, implemented routine sampling at wastewater treatment plants and sewer networks to monitor SARS-CoV-2 circulation and emerging variants. Standard laboratory workflows involved viral concentration using polyethylene glycol precipitation or ultrafiltration, followed by RNA extraction and detection using RT-qPCR, while selected samples underwent digital PCR (dPCR) quantification for enhanced sensitivity. Targeted next-generation sequencing enabled detection of circulating viral lineages directly from wastewater samples. Analyses across cities showed that increases in wastewater viral load typically preceded reported clinical case surges by approximately one to two weeks, demonstrating WBE's effectiveness as an early-warning system. However, operational challenges remain, including inconsistent sewer connectivity, variation in sampling frequency, incomplete population normalization, and limited integration of environmental and clinical datasets. Machine learning (ML) and deep learning (DL) techniques offer opportunities to enhance WBE-based surveillance. Time-series forecasting models such as Long Short-Term Memory (LSTM) and Temporal Convolution Networks (TCN) can predict outbreak trends, while Random Forest, XGBoost, and Graph Neural Networks support spatial hotspot detection across sewer catchments. Additionally, anomaly-detection approaches, including autoencoders, can identify unusual viral trends or emerging variants. Effective implementation requires standardized data collection, adoption of normalization biomarkers such as PMMoV, consistent sampling protocols, and rigorous model validation. Integrating ML/DL analytics with routine wastewater monitoring could substantially strengthen outbreak preparedness and public-health decision-making across Gujarat.

Keywords: *Wastewater-Based Epidemiology; Multi-City Surveillance; Gujarat; ML & DL; Early Outbreak Detection; Variant Surveillance; RT-qPCR; Digital PCR; Public Health Monitoring.*

A Methodological Perspective on Supervised Machine Learning Approaches to Pharmaceutical Formulation Strategies for Neurological Disorders

Hetalbahen Kiritkumar Dave¹, Dr. Tejas Harshadbhai Thakkar²

¹Research Scholar

The Charutar Vidya Mandal (CVM) University

²Research Guide

The Charutar Vidya Mandal (CVM) University

Abstract

A pharmaceutical formulation strategy for neurological disorders is fundamentally complex because of the physiological barriers of the central nervous system and the multifactorial nature of formulation variables. Conventional formulation development generously depends on experimental trial-and-error method, which is often time-consuming and resource-intensive. This study presents a machine learning-driven comparative framework for analysing pharmaceutical formulation strategies for neurological disorders using supervised learning techniques. The proposed framework focuses on the application of Linear Regression, Decision Tree, and Random Forest algorithms to model the relationships between formulation parameters and critical quality attributes. Linear Regression is considered as a baseline approach for understanding linear dependencies among formulation variables. Decision Tree models are applied for their ability to capture non-linear relationships and provide interpretability. Random Forest is applied as an ensemble learning method, which also address model stability and enhance predictive robustness through combining multiple decision trees. The study outlines a structured workflow about data acquisition, pre-processing, model training, validation, and comparative evaluation using standard regression metrics. Rather than reporting empirical results, this work emphasizes the methodological advantages, applicability, and limitations of each algorithm within the context of pharmaceutical formulation strategies for neurological disorders. The proposed comparative framework serves as a foundation for upcoming experimental studies which provides guidance for researchers looking for to integrate machine learning techniques into formulation development. This approach highlights the potential of supervised machine learning to support data-driven decision-making and accelerate innovation in brain-targeted drug delivery systems.

Keywords - *Supervised Machine Learning, Pharmaceutical Formulation Strategies, Neurological Disorders, Comparative Methodological Framework, Predictive Modeling*

AI-Based Fraud Detection in Online Transactions in India: Mechanisms, Challenges, and Future Directions

Hemanshi Tandel¹

¹Student, M.Sc. (Cyber Security), ISTAR College, The CVM University

Corresponding author: hemanshitandel1508@gmail.com

Abstract

This research paper aims to assess how to use AI-based systems to identify and prevent online fraud in India and provide solutions for the implementation challenges of these systems as well as possible future strategies to enhance their accuracy, scale and trustworthiness. The exponential growth of digital payments in India has increased the incidence of advanced financial crimes, primarily due to the rapid growth of UPI (Unified Payment Interface) and AePS (Aadhaar Enabled Payment Systems). AI and machine learning models (ML) are being used to assess patterns within financial data to assist in developing an understanding of how to use them for fraud detection in online transaction systems within India's banking sector. The results

indicated that AI is far more efficient at reducing false positives and reducing detection response time than traditional rules-based fraud detection systems. However, issues surrounding data privacy, algorithmic bias and infrastructure preparedness remain with the implementation of AI-based systems. The final section of this research report will present policy recommendations that align with the RBI's policies regarding the use of AI in the financial sector.

Keywords: *AI in Banking, Fraud Detection, UPI Security, Machine Learning, RBI Guidelines, Digital Payments India, AnomalyDetection.*

COO-47

Beyond Transaction Anomalies: Intelligent Friendly Fraud Detection in Digital Payment Systems

Chandni Patel¹, Dr. Monika Patel²

¹Research Scholar, The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar

²Assistant Professor, Computer Science Department, Natubhai V. Patel College of Pure and Applied Sciences, The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar,

Email – monika@nvpas.edu.in

Corresponding Author: 310.chandni.patel@gmail.com

Abstract

Friendly fraud poses a significant and underexplored challenge in digital payment systems, where transaction disputes originate from legitimate users rather than external fraud actors. Such disputes may arise intentionally or unintentionally, and often lack clear transactional irregularities, making them difficult to detect using conventional rule-based systems and transaction-centric machine learning models. A critical review of existing literature reveals that most current fraud detection approaches emphasize anomaly detection, transactional feature analysis, and network-based modelling, with limited consideration of behavioural consistency, dispute behaviour, and long-term user–merchant interaction patterns. This limitation reduces their effectiveness in identifying friendly fraud accurately. To address this gap, this paper presents a behaviour-centric intelligent detection framework that integrates behavioural consistency modelling, temporal dispute sequence analysis, and contextual user–merchant interaction profiling. The proposed architecture combines behavioural feature engineering, temporal learning mechanisms, and explainable decision logic to ensure interpretability, transparency, and regulatory alignment. Explainable AI (XAI) components are embedded to support human-centric reasoning and accountability in automated financial decision-making. Experimental evaluation demonstrates that the proposed framework improves classification reliability and significantly reduces false-positive detection compared to conventional transaction-focused models. The results indicate that long-term behavioural modelling enables clearer differentiation between genuine disputes and deceptive claims. These findings establish that explainable, behaviour-driven intelligence provides a robust, trustworthy, and practical foundation for effective friendly fraud detection in modern digital payment ecosystems.

Keywords: *Friendly Fraud, Behavioural Modelling, Explainable AI, Digital Payments, Fraud Detection.*

COO-48

Real-Time Threat Identification in Hybrid IoT-Cloud Systems using Adaptive Zero-Trust Access Management

Mr. Divyakumar Shah¹

¹Assistant Professor, Department of Computer Science, Natubhai V. Patel College of Pure & Applied Sciences (NVPAS), The CVM University

Corresponding Author: divyakumar.shah@cvmu.edu.in

Abstract

The rapid growth of IoT devices integrated with cloud infrastructures has introduced significant security challenges that traditional perimeter-based models cannot address. This study proposes a real-time threat identification framework using Adaptive Zero-Trust Access Management (ZTAM) for hybrid IoT-Cloud environments. The system continuously verifies device identity, context, and behaviour, ensuring no implicit trust across the network. The framework employs machine learning-based anomaly detection and context-aware access control to generate dynamic risk scores. Adaptive policies and continuous lightweight authentication enable real-time threat mitigation. Implemented on a heterogeneous IoT-Cloud testbed, the system achieved over 92% detection accuracy with approximately 50 ms latency overhead. It maintained performance for up to 10,000 concurrent devices and reduced successful intrusion attempts by 70% compared to static Zero Trust models. The results demonstrate that Adaptive Zero Trust enhances security, scalability, and resilience in hybrid IoT-Cloud systems. Future work will focus on federated learning integration and further optimization for resource-constrained IoT devices.

Keywords: *Internet of Things (IoT), Cloud Security, Zero Trust Architecture (ZTA), Adaptive Zero-Trust Access Management (ZTAM), Real-Time Threat Detection, Anomaly Detection, Machine Learning, Context-Aware Access Control, Cybersecurity, Hybrid IoT-Cloud Systems.*

COO-49

A Review: Transitioning Legacy Banking Infrastructure to Quantum-Resistant Cryptography: Challenges and Solutions

Mr. Parth Parikh¹, Dr. Shreya Shah²

¹Research Scholar & Assistant Professor

Department of Computer Science, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The CVM University, Vallabh Vidya Nagar, Anand, Gujarat

Email: parth.parikh@cvmu.edu.in

²Assistant Professor

Department of Computer Science, The CVM University, Vallabh Vidya Nagar, Anand, Gujarat.

Email: shreya.shah@cvmu.edu.in

Corresponding Author: parth.parikh@cvmu.edu.in

Abstract

The advent of cryptographically relevant quantum computers (CRQC) poses a systemic risk to the global financial sector. Current banking infrastructures rely heavily on public-key encryption (RSA, ECC), which are vulnerable to Shor's algorithm. This report investigates the challenges of migrating "Legacy Banking Infrastructure"—characterized by rigid architectures and embedded dependencies—to Quantum-Resistant Cryptography (QRC). Through a multi-stage methodology involving cryptographic inventory and hybrid implementation, the study identifies that technical latency and vendor interoperability are the primary hurdles. The findings suggest that a "Crypto-Agile" framework is essential for maintaining financial stability during this generational shift.

Keywords: *quantum-resistant cryptography, legacy systems, post-quantum algorithms, banking security, migration challenges, hybrid encryption, compliance.*

COO-50

Comparative Research of Machine Learning Methods for Automated Weed Detection in the Kheda Area

Mrs. Pooja Meet Dave¹, Dr. Monika Patel²

¹Research Scholar, The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar

²Assistant Professor, Computer Science Department, Natubhai V. Patel College of Pure and Applied Sciences, The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar
Corresponding Author: monika@nvpas.edu.in

Abstract

The presence of weeds can have an impact on crop quality and yield, and this is especially true in local farm areas like those found in the Kheda area. Most weed removal techniques are performed manually or involve indiscriminately applying herbicides, which increases production costs and has negative effects on the environment. Therefore, the purpose of this paper was to conduct a comparative study of several machine learning methods for the automatic recognition of weeds in the Kheda area and ultimately improve smart decision-making in precision agriculture. Data were obtained with cameras at different times of day and in different soil conditions, and were used by the authors to develop a data set specific to the Kheda area. In addition to image preprocessing and model training, the methodology also included feature extraction, model selection and performance evaluation. The methodologies tested were several types of machine learning algorithms (supervised) and deep learning algorithms, specifically Support Vector Machines (SVM), Random Forest, K-Nearest Neighbors (KNN), and Convolutional Neural Networks (CNN). Accuracy, precision, recall, and the F1 score were the common metrics used to compare the performance of each algorithm. This comparative approach allowed a full comparison of the ability of each of these methods to identify crops vs. weeds in field conditions. Results of the experiments showed that the best weed detection and most robust to the complexity of the agricultural environment were achieved by deep learning architectures in particular CNN architectures. On the other hand, traditional machine learning architectures required less computing power and shorter training times, and therefore may be the better option for applications where there is limited access to resources. The research results also highlight the need to select the best algorithms depending on their performance and the practical limitations of the application. Finally, the work presented here contributes to the creation of efficient, scalable and environmentally friendly systems for weed control applicable to the Kheda region's agriculture.

Keywords : *Artificial Intelligence, Machine Learning, Deep learning, Weed Identification*

COO-51

The Application and Future Role of Internet of Things in Agriculture: A Survey

A. T. Agja¹, Dr. A. P. Joshi²

¹Computer Programmer, IABMI, AAU, Anand – 388110

& Research Scholar, Computer Science, CVM University, Anand – 388120

²Assistant Professor, ISTAR, CVM University, Anand – 388120

Corresponding author: alpeshagja.mca@gmail.com

Abstract

Agriculture sector is the backbone of the Indian economy that contributes 18% to the Gross Domestic Product (GDP) and plays a vital role to the nation's socio-economic architecture. However, it is currently facing numerous challenges like water scarcity, labor shortages, rising operational costs, and the continuous reduction of arable land due to urbanization and infrastructure development. With the global population is projected to rise 9 billion by 2050, providing them good quality, nutritious and affordable food with conventional agricultural practices is nearly impossible due to significant limitations, including inefficient irrigation leading to water wastage, soil degradation from excessive use of pesticides and weedicides, seed loss, and inadequate harvesting and storage techniques. To address these challenges, the application of Internet of Things (IoT) and automation becomes a necessity. The Internet of Things (IoT) along with precision farming, real-time resource monitoring, and data-driven decision-making catalyzing a "Digital Green Revolution". The Internet of Things (IoT) provides

better solutions to enhance yield productivity and sustainability through smart irrigation, Crop monitoring, Soil management, Livestock Monitoring and Post-Harvet Monitoring and management. Smart Irrigation system including sensor system can reduce the wastage of water; while soil and crop health is continuously monitored for optimize fertilizer use. An IoT based Monitoring system can regulate the environment of the storage system preventing the wastage of the agricultural produce. Overall, IoT applications have strong potential to improve product quality, minimize post-harvest losses, and enhance the efficiency of the entire agricultural supply chain.

COO-52

An Analytical Study of Cost Optimization Algorithms in Cloud-Based Healthcare Systems

Mr. Mayur Madhubhai Patel¹, Dr. Tejas H. Thakkar²

¹Research Scholar & Assistant Professor

Natubhai V. Patel College of Pure and Applied Sciences

The Charutar Vidya Mandal (CVM) University

Email: mayur.patel@cvmu.edu.in

²Research Guide, Assistant Professor

Natubhai V. Patel College of Pure and Applied Sciences

The Charutar Vidya Mandal (CVM) University

Email: tejas.thakkar@cvmu.edu.in

Corresponding Author : mayur.patel@cvmu.edu.in

Abstract

cloud computing has become a vital technological foundation for modern healthcare systems by supporting large-scale data storage, on-demand computing resources, and advanced healthcare applications such as electronic health records, remote monitoring, and clinical decision support systems. Despite these benefits, healthcare organizations frequently encounter rising operational expenses due to fluctuating workloads, strict availability requirements, and complex pricing models of cloud service providers. As a result, effective cloud cost optimization has emerged as a key research and operational concern in cloud-based healthcare environments. This study presents a comprehensive analytical examination of cost optimization algorithms used in cloud-based healthcare systems. The analysis covers a wide range of algorithmic approaches, including rule-based heuristics, metaheuristic optimization techniques, and intelligent algorithms designed to improve resource allocation efficiency. These approaches are evaluated using multiple performance parameters such as overall cost savings, resource utilization efficiency, system responsiveness, scalability, and compliance with service-level agreements (SLAs). The study also incorporates healthcare-specific considerations, including data confidentiality, regulatory compliance, reliability, and workload unpredictability. A structured analytical framework is applied to compare the effectiveness of different optimization strategies under varying workload conditions typical of healthcare applications. The results indicate that simpler heuristic-based methods provide faster execution with lower computational overhead, making them suitable for stable environments. In contrast, advanced optimization algorithms demonstrate improved adaptability and enhanced cost efficiency when managing dynamic and large-scale healthcare workloads. However, these benefits often come at the expense of increased computational complexity. The outcomes of this research offer practical guidance for cloud service designers, healthcare IT administrators, and researchers aiming to implement cost-effective cloud solutions without compromising system performance or patient care quality. By synthesizing and analyzing existing optimization techniques, this study supports informed decision-making and encourages future research toward intelligent and healthcare-aware cloud cost optimization strategies.

Keywords: *Cloud computing, cost optimization, Quality of service, healthcare system, load balancing, Virtualization*

Dynamic Resource Orchestration: A Comparative Analysis of Cost-Optimization Models for Hybrid Big Data Architectures

Dr. Tejas H. Thakkar¹, Dr. Shreya Shah², Dr. Monika Patel³
¹²³Natubhai V. Patel College of Pure and Applied Sciences
The Charutar Vidya Mandal (CVM) University
Vallabh Vidyanagar – 388120, Anand, Gujarat, India
Corresponding Author: tejas.thakkar@cvmu.edu.in

Abstract

The rapid increase in big data volumes requires flexible resource management strategies for affordable hybrid architectures. These strategies combine the adaptability of public cloud services with the security of on-premises systems. This research provides a detailed comparison of cost-saving models, including auto-scaling methods, predictive analytics for resource allocation, reinforcement learning-based management, and auction-driven spot instances. These models are tailored for hybrid big data environments. We reviewed 32 peer-reviewed papers from top journals like IEEE Transactions on Cloud Computing and ACM Transactions on Data Science. We evaluated these models based on infrastructure costs, resource use, query response time, and fault tolerance. Simulations show that reinforcement learning models can save up to 42% on costs, achieve 98.5% compliance with service level agreements, and improve throughput by 55% for large datasets across batch, streaming, and interactive tasks. Key components we examined include container management through Kubernetes and Apache Mesos, serverless computing options, multi-cloud management techniques, and AI-driven resource forecasting using federated learning and graph neural networks. Our evaluation framework considers hybrid setups—cloud, edge, and on-premises—as well as data location policies, anomaly detection, and compliance with regulations like GDPR and HIPAA. Our findings reveal important trade-offs in the models: predictive approaches work well in stable conditions but struggle during spikes compared to auction methods, which are enhanced by automatic failover and smart data placement. This study provides data architects with useful benchmarks, a decision-making guide, and migration advice, underscoring the importance of flexible management for balancing cost, performance, and scalability in hybrid big data systems.

Keywords: *Dynamic Resource Orchestration, Cost-Optimization Models, Hybrid Big Data Architectures, Auto-Scaling, Predictive Provisioning, Reinforcement Learning, Kubernetes Orchestration, Serverless Computing, Multi-Cloud Bursting, Resource Forecasting, SLA Compliance, Data Locality.*

A Review: An AI-Driven Framework for Predictive Vehicle Maintenance (2020–2025)

Ms. Mahima Ahir¹, Dr. Suchita Patel²
¹Research Scholar & Assistant Professor
Department of Computer Science, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The CVM University, Vallabh Vidya Nagar, Anand, Gujarat
ORCID: 0009-0003-2653-2152, Email: mahima.ahir@cvmu.edu.in
²Research Guide & Assistant Professor
Department of Computer Science, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The CVM University, Vallabh Vidya Nagar, Anand, Gujarat
ORCID: 0000-0002-8034-5839, Email: suchita.patel@cvmu.edu.in
Corresponding Author: mahima.ahir@cvmu.edu.in

Abstract

The increasing adoption of Artificial Intelligence (AI) in the automotive domain has significantly transformed vehicle maintenance from reactive servicing to proactive, data-driven strategies. While traditional maintenance relies on fixed intervals, it often overlooks the complex operational variables that lead to unexpected failures. Given the rapid influx of research in this field, a structured review is essential to synthesize the developments, trends, and technological shifts occurring between 2020 and 2025. This paper presents a focused review of AI-driven predictive vehicle maintenance research published over the last five years. The methodology involves a systematic analysis of selected studies that apply machine learning (ML) and deep learning (DL) techniques. The literature is evaluated based on three primary criteria: the AI algorithms employed, the types of data sources utilized (such as OBD-II sensors and usage patterns), and the effectiveness of the frameworks in predicting the Remaining Useful Life (RUL) of vehicle components. Key findings from the reviewed literature highlight a significant transition from traditional machine learning models (e.g., Random Forest, SVM) toward sophisticated deep learning approaches (e.g., LSTMs, CNNs). The analysis shows that recent frameworks are increasingly moving toward "contextual intelligence," where internal sensor data is integrated with operational parameters to enhance prediction accuracy by approximately 10-15%. Despite technological advancements, the review identifies critical challenges, including heavy data dependency, the "black box" nature of deep learning models, and limited adaptability to varying geographic or environmental conditions. The paper summarizes an AI-driven conceptual framework derived from existing research to outline a standardized workflow for future maintenance systems. This review provides a consolidated understanding of the progress made in AI-driven vehicle maintenance from 2020 to 2025. It identifies a clear roadmap for future research, emphasizing the need for robust, scalable, and location-aware solutions to meet the demands of modern intelligent transportation systems.

Keywords: *Predictive Maintenance, Artificial Intelligence, Machine Learning, Deep Learning, Vehicle Health Monitoring.*

COO-55

Advanced Information Systems Analytics using AI

Mr. Abhishek Dave¹, Dr. Ashish Joshi²

1. Assistant Professor of Computer Science at Sardar Gunj Mercantile Cooperative Bank Ltd English Medium College of Commerce and Management (SEMCOM), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Gujarat, INDIA.

2. Assistant Professor and Head in the Department of Computer Science at Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Gujarat, INDIA.

Abstract

The rapid proliferation of digital data has transformed information systems into complex ecosystems requiring advanced analytical capabilities. This paper explores the integration of Artificial Intelligence (AI) into information systems analytics, emphasizing its role in enhancing decision-making, efficiency, and predictive accuracy. By leveraging machine learning, natural language processing, and deep learning, AI-driven analytics enable organizations to extract actionable insights from structured and unstructured data at scale. The study highlights key advancements such as automated data engineering, multi-modal data fusion, and adaptive algorithms that optimize system performance in dynamic environments. Furthermore, it examines the challenges of implementing AI in information systems, including data quality, ethical considerations, and interpretability of models. The findings suggest that AI-powered analytics not only revolutionize traditional information systems but also pave the way for intelligent, autonomous platforms capable of supporting strategic innovation across industries. This research contributes to the growing discourse on the future of information systems, offering a framework for harnessing AI to achieve sustainable competitive advantage.

Keywords: *Artificial Intelligence, Information System, Data Analytics, Machine Learning*

COO-56

Explainable Machine Learning for Mutual Fund Selection: Evidence from Indian Equity Funds

Mr. Premal Soni¹, Dr. Ashish Pratapbhai Joshi²

¹Assistant Professor, SEMCOM, The CVM University

²Assistant Professor, ISTAR, The CVM University

Corresponding Author: premal.soni@cvmu.edu.in

Abstract

Mutual fund selection remains a challenging task for retail investors and financial advisors due to the reliance on historical performance metrics and rating-based heuristics that often fail to generalize across market conditions. Recent advancements in machine learning (ML) have demonstrated superior predictive capabilities in financial decision-making; however, their adoption in mutual fund selection is limited by the lack of interpretability and transparency associated with black-box models. This study proposes an explainable machine learning framework for mutual fund selection using Indian equity mutual fund data. Traditional performance measures are first compared with supervised ML models, including Logistic Regression, Random Forest, and XGBoost, to evaluate predictive effectiveness. Explainable Artificial Intelligence (XAI) techniques, specifically SHAP (SHapley Additive exPlanations), are then employed to interpret model decisions at both global and individual fund levels. Empirical results indicate that ML-based models outperform traditional selection criteria, while explainability analysis reveals that cost efficiency, return consistency, and fund management stability play a more significant role than short-term returns in fund selection. The proposed framework enhances transparency, supports trust in AI-driven decisions, and provides practical insights for investors and financial advisors in emerging markets.

Keywords: *Mutual Fund Selection, Explainable AI, Machine Learning, SHAP, Indian Mutual Funds*

COO-57

Trust & Explainability UI Patterns for AI Chatbots in University Services: A Rapid Usability Study

Dhruv Piyushkumar Patel¹, Dr. Suchita Patel²

¹Research Scholar & Assistant Professor

Department of Computer Science, S. G. M. English Medium College of Commerce and Management (SEMCOM), The CVM University, Vallabh Vidya Nagar, Anand, Gujarat

ORCID: 0009-0009-0569-7154, Email: dhruv.patel@cvmu.edu.in

²Research Guide & Assistant Professor

Department of Computer Science, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The CVM University, Vallabh Vidya Nagar, Anand, Gujarat

ORCID: 0000-0002-8034-5839, Email: suchita.patel@cvmu.edu.in

Corresponding Author: dhruv.patel@cvmu.edu.in

Abstract

AI chatbots are increasingly used in universities for student support, but users often hesitate to rely on chatbot answers due to low trust, unclear reasoning, and uncertainty about accuracy. This paper investigates how trust-oriented UI/UX patterns—specifically explainability cues, confidence indicators, and source/justification links—influence perceived trust and usability in a university-service chatbot interface. We designed three Figma-based prototypes representing: (A) a basic chatbot UI, (B) a chatbot with a “Why this answer?” explanation feature, and (C) a

chatbot with confidence cues and source links, including uncertainty warnings. A rapid user study was conducted with university students using scenario-based tasks (e.g., academic schedule, fee information, and policy queries). We measured usability using the System Usability Scale (SUS), perceived trust via Likert-scale items, and collected qualitative feedback on decision confidence and interface clarity. Results show that trust-supporting UI patterns significantly improve user confidence in chatbot responses compared to the baseline interface, with source/justification cues and uncertainty messaging most frequently cited as reducing doubt. Based on quantitative and qualitative findings, we propose practical UI design guidelines for building trustworthy AI chatbot experiences in academic environments. The study provides actionable insights for designers and developers to improve adoption of AI support tools through human-centered interface design.

Keywords: *UI/UX, trustworthy AI, explainable AI, chatbot interface, usability, user trust, SUS, higher education, human-centered design.*

Interdisciplinary Sciences

INO-58

Flood Hazard Mapping and Monitoring of Flood Plains around Auda Areas

Maitry Bhatt, Research Scholar, Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University

Email: maitubhatt2506@gmail.com

Corresponding Author: Dr. Krunal Suthar, Assistant Professor, Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University

Email: krunal.suthar@cvmu.edu.in

Abstract

Floods are becoming more common and cause a lot of damage, especially in areas near rivers. This is happening more because of changes like uneven rain, cutting down forests and cities growing too fast. Mapping floods is really important to protect people and the environment. Therefore, the need to complement natural hazard studies with vulnerability and risk assets complement aim of this study is to generate a composite map for decision makers and identify flood vulnerable zone by using effective factors causing floods. The study reviewed the role of GIS in decision-making and then outlined the evaluation approach for many criteria in decision process. Land use / land cover (LULC) changes are influenced by human involvement and certain phenomena that are caused by natural processes such as agricultural demand and trade, population growth and consumption patterns, urbanization and economic development, science and technology, and many other factors (Research on Land use change & Agriculture, International Institute for Applied Systems Analysis, 2007). As a result, it is needed to have the LULC information which is necessary for all kinds of natural resource management and planning must for the development of an area. Information on regular intervals about the LULC change detection of earth's surface is extremely important for understanding the nature of relationship and interactions occurring between human and natural processes for making better decisions for the management purpose (Lu et al., 2004).

Keywords: *Flood, LULC, Hazard, AUDA, Remote sensing*

Geospatial-Driven Dynamic Updates of EV Charging Station with Power Capacity on Mobile

¹Dr. Krunal Suthar, ²Meet Raval

¹Department of Geoinformatics, CVM University, V.V. Nagar, Aanand, Gujarat

²University of Southern California, USA

*Corresponding Author : krunal.suthar@cvmu.edu.in

ABSTRACT

The rapid growth of electric vehicles (EVs) is driving the transition toward sustainable transportation due to their zero tailpipe emissions and reduced environmental impact. However, widespread EV adoption is still hindered by range anxiety and the limited availability of real-time information about charging station occupancy, particularly in developing regions where fast-charging infrastructure is sparse. Drivers often reach charging stations without knowing availability status, resulting in long waiting times and inefficient trip planning. This paper presents a geospatially enabled real-time monitoring framework for EV charging stations integrated with mobile accessibility. The proposed system employs a Raspberry Pi-based embedded unit coupled with a Global Navigation Satellite System (GNSS) receiver and GSM communication module to continuously collect and transmit operational parameters of charging ports. The system records charger occupancy, charging duration, and estimated completion time, and uploads the information to a centralized cloud server. Open-source geospatial services process and visualize the spatial data to provide location-aware updates. A mobile application retrieves the server data and displays nearby charging stations, slot availability, and predicted waiting time, allowing EV users to select optimal charging points before arrival. The framework also supports navigation assistance and dynamic updates to improve travel planning during long-distance journeys and in unfamiliar locations. Experimental deployment demonstrates improved charging station utilization and significant reduction in user waiting uncertainty. By combining embedded sensing, wireless communication, and geospatial analytics, the proposed solution enhances operational efficiency and user confidence in EV infrastructure. The system offers a scalable and cost-effective approach for smart charging networks and contributes toward accelerating the adoption of electric mobility in sustainable urban transportation ecosystems.

Keyword: *Electric Vehicle, Charging Station, Geospatial, GNSS, GSM, Raspberry*

Comparative Assessment of Spectral Matching Mineral Mapping Algorithms Using Airborne Hyperspectral Data over India

Manoj Singh^{1*}, Hasmukh K. Varchand¹, Jalpesh A. Dave¹, Parthkumar N. Parmar¹, Dhruv D. Desai¹, Himanshu J. Trivedi¹

¹The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, 388120, Gujarat, India

Corresponding author: mbs3112@gmail.com

Abstract

Hyperspectral imaging spectroscopy has revolutionized earth surface analysis, offering superior spectral and spatial resolution for mineral exploration. This study evaluates the effectiveness of three advanced spectral matching hyperspectral remote sensing techniques—Spectral Angle Mapper (SAM), Constrained Energy Minimization (CEM), and Adaptive Coherence Estimator (ACE)—for mineral detection using AVIRIS-NG airborne data. The study was conducted over multiple mining sites in India, including Ambaji, Jahazpur, Bhilwara, and Umra, to detect key minerals such as dolomite, chlorite, talc, jarosite, calcite, and quartzite. Comparative performance analysis based on detection accuracy and classification efficiency revealed that

CEM outperforms the other methods for precise mineral mapping. Enhanced statistical validation, including accuracy metrics and confusion matrices, corroborates these findings. The results demonstrate that hyperspectral remote sensing, especially using AVIRIS-NG, provides a robust approach for mineral detection. The methodological framework employed in this study enhances mineral classification accuracy, making it a potential tool for large-scale geological exploration. Additionally, we discuss the limitations of each method in the context of mixed-pixel effects and background noise suppression. This study underscores the importance of hyperspectral imaging in mineral mapping and highlights future research directions for improving classification algorithms.

Keywords: *Hyperspectral Remote Sensing, AVIRIS-NG, Mineral Detection, Spectral Angle Mapper, Adaptive Coherence Estimator.*

INO-61

Retrieval and Estimation of Fire Radiative Power for Crop Residue Burning Regions in Northern India Using India's Geostationary Satellite INSAT-3DS

Parthkumar N. Parmar^{1*}, Jalpesh A. Dave¹, Hasmukh K. Varchand¹, Dhruv D. Desai¹, Himanshu J. Trivedi¹

¹The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, 388120, Gujarat, India
Corresponding author: parth.parmar@nvpas.edu.in

Abstract

Crop residue burning (CRB) in the Indo-Gangetic Plain poses serious environmental and air-quality challenges. The Polar-orbiting satellites often fail to capture the rapid diurnal evolution of these anthropogenic fires due to their limited temporal sampling. This study presents, for the first time, a methodology to retrieve Fire Radiative Power (FRP) from India's newly launched geostationary satellite, INSAT-3DS, enabling continuous monitoring of biomass combustion. The FRP was retrieved using mid-wave infrared (MWIR) observations in conjunction with 370,744 MODTRAN-based radiative transfer simulations tailored to Indian atmospheric and surface conditions. The methodology was applied to CRB events over northern India on 19th November 2024. The analysis successfully captured the complete diurnal cycle of fire activity, revealing a critical burning window with peak intensity between 15:30 and 16:30 IST, during which FRP values reached ~1000 MW per pixel. The validation against MSG-SEVIRI FRP products showed strong temporal and spatial consistency. These results demonstrate the capability of INSAT-3DS to bridge the temporal gaps inherent in polar-orbiting observations, providing reliable near-real-time information for improved emission estimation and air-quality management.

Keywords: *Air Quality, Biomass Combustion, Crop Residue Burning, Fire Radiative Power, INSAT-3DS.*

INO-62

Effect of Substrate Temperature on Optical Properties of Pulsed Laser Deposited CdIn₂Se₄ Thin Films

Jagruti Jangale[#], S.D. Dhruv, D.K. Dhruv^{*}

Natubhai V. Patel College of Pure and Applied Sciences, The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar-388120, Anand, Gujarat, India

[#]Presenting author: jagrutijangale17@gmail.com

^{*}Corresponding author: dhananjay.dhruv@cvmu.edu.in

Abstract

The optical characterization of the pulsed laser deposition technique deposited ≈ 100 nm thick CdIn₂Se₄ thin films on amorphous quartz glass at mixed substrate temperatures (T_s) ($300 \text{ K} \leq T_s$

≤ 675 K) was carried out by recording room temperature (RT) (≈ 300 K) transmittance ($T(\lambda)$) spectra using a UV-Vis-NIR spectrophotometer. The optical band gap energy (E_g) of the CdIn₂Se₄ thin films grown below 550 K substrate temperature (T_s) is modestly lower than the published value due to their amorphous nature. For substrate temperature modulated CdIn₂Se₄ thin films, imaginary dielectric constant (IDC) (ϵ_i), real dielectric constant (RDC) (ϵ_r), and loss tangent ($\tan \delta$) dependent on refractive index (n) and extinction coefficient (k) have all been determined and compared with the reported data. The negative values of the real dielectric constant (ϵ_r) indicate that the semiconductor materials reveal metallic behaviour. The values of the Urbach energy (E_U), Urbach absorption coefficient (α_0), optical conductivity (σ_o), and electrical conductivity (σ_e) for substrate temperature (T_s) tempered CdIn₂Se₄ thin film has been extracted at characteristic wavelengths (λ_c). Peak values of VELF and SELF of CdIn₂Se₄ thin films limited by substrate temperature (T_s) were retrieved at characteristic wavelengths (λ_c). The purity of CdIn₂Se₄ thin films formed at different substrate temperatures (T_s) was verified by recording FTIR spectra, which showed no functional groups. The conclusions drawn from our extensive research include that the substrate-temperature-dependent optical parameters obtained in this study will aid in developing upcoming thin-film electronic devices, in which CdIn₂Se₄ is one of the semiconducting materials.

Keywords: CdIn₂Se₄, Pulsed laser deposition, UV-VIS-NIR spectroscopy, FTIR spectroscopy

INO-63

Variability Analysis of Tropospheric NO₂ Over Different Sites of India Using GIS Techniques

Dhruv Dipakbhai Desai^{1*}, Jalpesh A. Dave¹, Hasmukh K. Varchand¹, Parthkumar N. Parmar¹, Himanshu J. Trivedi¹, Naveen Agrawal¹
Natubhai V. Patel College of Pure and Applied Sciences, V. V. Nagar, Anand
Corresponding author: dhruvdesai640@gmail.com

Abstract

Geographic Information System is very important for keeping an eye on pollutants in the air like tropospheric NO₂ which come from both natural and anthropogenic sources. This study examines emissions at diurnal, monthly and yearly intervals across various regions of India utilizing satellite observations. It includes thermal power plants, metropolitan areas and stable reference zones. Human activities especially burning fossil fuels and biomass are major sources of air pollution that harm both human health and climate. Daily analysis shows when emissions are at their highest and monthly and yearly assessments show long-term trends and seasonal changes. This information helps to create effective rules to reduce emissions. GIS provides sensitive, extensive and continuous data on air quality allowing policymakers to assess emission control strategies and their efficiency. GIS is a non-contact method that uses electromagnetic radiation. It can be used for many different environmental purposes such as monitoring cities, estimating crops, mapping forests, assessing water resources, and studying climate change. As cities grow and industries expand, it has become necessary to keep an eye on pollutants and greenhouse gas emissions in the troposphere. Advanced space-based technologies give us important information about where emissions come from, how they affect the environment and how to manage air quality and climate research.

Keywords: GIS Techniques, Tropospheric NO₂, Different Emission Sources, Variability Analysis

Continuous Monitoring of Dam Subsidence Using Sentinel-1 DInSAR: A Case Study of the Teesta III Dam

Chancy Shah, Research Scholar, Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University

Email: shahchancy28@gmail.com

Dr. Krunal Suthar, Assistant Professor, Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University

Email: krunal.suthar@cvmu.edu.in

Abstract

Dams are critical infrastructure assets that play a vital role in water security, hydropower generation, and flood control. Given their strategic importance and severe downstream consequences associated with potential failure, continuous and reliable monitoring of dam structures is essential. Subtle ground deformation or progressive subsidence, if not detected at an early stage, can evolve into serious structural distress. While conventional ground-based monitoring systems provide high precision, they are often constrained by limited spatial coverage, accessibility challenges, and high operational costs. In this context, satellite-based remote sensing offers an effective solution for continuous, wide-area monitoring of dam infrastructure. This study demonstrates application of Differential Interferometric Synthetic Aperture Radar (DInSAR) using multi-temporal Sentinel-1 SAR data to monitor dam subsidence. Freely available C-band SAR imagery acquired at different epochs was processed using the SNAP software. The methodology was applied to Teesta III Dam located in North Sikkim, which collapsed during a Glacial Lake Outburst Flood (GLOF) event on 3–4 October 2023, using datasets from 2016, 2018, 2020, and 2023. The results reveal spatially coherent subsidence patterns, with maximum displacement reaching approximately 640 mm and clear evidence of differential settlement along specific dam chainages. Temporal analysis indicates that subsidence activity likely initiated prior to 2018, highlighting the importance of long-term satellite data archives for early warning and retrospective deformation assessment. Overall, the study highlights DInSAR as a rapid, cost-efficient, and scalable tool supporting proactive dam safety management and infrastructure resilience planning.

Keywords: *Dam safety, Subsidence monitoring, DInSAR, Sentinel-1 SAR, Remote sensing*

Abstracts
(Poster Presentations)
Biological Sciences

BIP-01

Antibiotic Resistance & its alternative

Aman Diwan, Harsh Dave, Himanshu Maheshwari
N V Patel College of Pure and Applied Sciences, The CVM University

Abstract-

Antibiotic resistance is a rapidly growing global health challenge that threatens the effective treatment of infectious diseases and increases patient morbidity, mortality, and healthcare costs. It occurs when bacteria adapt to survive the action of antibiotics through genetic mutations or by acquiring resistance genes from other microorganisms via horizontal gene transfer. These adaptations enable bacteria to employ mechanisms such as enzymatic drug inactivation, alteration of antibiotic targets, reduced membrane permeability, and active efflux pumps, making standard therapies ineffective. The misuse and overuse of antibiotics in human medicine, veterinary practice, and agriculture have significantly accelerated the emergence and spread of resistant strains. As a result, common infections that were once easily treatable now require prolonged therapy, expensive medications, or have limited treatment options. This poster highlights the major biological mechanisms driving antibiotic resistance and discusses innovative strategies being developed to combat this crisis. These include the discovery of novel antimicrobial compounds, combination therapies, bacteriophage-based treatments, antimicrobial peptides, and microbiome-targeted approaches. Advances in rapid diagnostic technologies are also improving pathogen identification and enabling more precise, targeted antibiotic use. In addition, antimicrobial stewardship programs, infection prevention measures, and public education campaigns play a crucial role in slowing resistance development. Understanding the molecular basis of antibiotic resistance alongside emerging therapeutic and preventive strategies is essential for preserving the effectiveness of existing antibiotics. A coordinated global effort integrating scientific innovation, responsible antibiotic use, and strong public health policies is vital to control resistance and ensure sustainable management of bacterial infections in the future.

BIP-02

Cancer Biomarkers

Ishika Jabuwala, Dhara Makwana, Drashti D. Patel and Prajapati Aesha
N V Patel College of Pure and Applied Sciences, The CVM University

Abstract

Cancer biomarkers are biological molecules that indicate normal or abnormal processes associated with cancer. These markers can be proteins, genes, enzymes, hormones, or specific molecular alterations found in blood, tissues, or other body fluids. They serve as important tools in cancer detection, diagnosis, prognosis, and treatment monitoring. Biomarkers enable early identification of cancer, sometimes even before clinical symptoms appear, which significantly improves patient survival rates. They also assist in predicting disease progression and evaluating the effectiveness of therapy. Based on their clinical use, cancer biomarkers are classified as diagnostic, prognostic, predictive, and monitoring biomarkers. Diagnostic biomarkers help identify the presence of cancer, prognostic biomarkers provide information about disease outcome, predictive biomarkers guide treatment decisions, and monitoring

biomarkers assess therapeutic response. In addition, cancer biomarkers play a key role in personalized medicine by supporting targeted therapies tailored to individual patients. However, limitations such as insufficient sensitivity, lack of specificity, and variability among patients may affect their accuracy. Ongoing research aims to discover novel biomarkers and improve detection technologies. Overall, cancer biomarkers are essential in modern oncology, contributing to improved clinical decision-making, better treatment strategies, and enhanced patient care

BIP-03

CAR-T : A Living Drug for Cancer

Pankti D. Gadhavi, Dhanvi K. Brahmhatt and Dharvi H. Patel
N V Patel College of Pure and Applied Sciences, The CVM University

Abstract :

Chimeric Antigen Receptor (CAR) T-cell therapy represents a breakthrough immunotherapy approach for treating B-cell malignancies such as acute lymphoblastic leukemia (ALL) and certain lymphomas. In patients with leukemia, mature T-cells remain present in the bloodstream despite the proliferation of malignant B-cells. These patient T-cells can be harvested and genetically engineered in the laboratory to express a synthetic receptor that redirects their activity toward cancer cells. The CAR construct consists of a designed extracellular antigen-binding domain (derived from an antibody fragment known as single-chain variable fragment or scFv), linked to a transmembrane region and intracellular signaling domains such as CD3 ζ and costimulatory elements (e.g., CD28 or 4-1BB). This engineered receptor enables T-cells to recognize and kill cancer cells independent of conventional antigen presentation. The most successful and widely used CAR target to date is CD19, a cell surface molecule expressed on most normal and malignant B-cells. CD19 CAR-T cells selectively bind to this antigen on leukemia and lymphoma cells, resulting in activation, expansion, and cytotoxic killing of the targeted cancer cells. Gene transfer methods typically utilize viral vectors (lentiviral or retroviral) to stably integrate the CAR gene into the T-cell genome, although newer approaches such as CRISPR/Cas9 gene editing are being studied for more precise insertion. Clinical evidence shows that CD19-directed CAR-T therapy induces deep, durable remissions in many patients with relapsed or refractory B-cell malignancies. Ongoing research focuses on improving safety, reducing toxicities, and expanding CAR-T therapy to additional cancer types.

Keywords: *Immunotherapy, B-Cell Leukemia ,CD19 Antigen Genetic , Modification Chimeric Antigen Receptor*

BIP-04

Formulation and Evaluation of Herbal Functional Foods and Novel Phytotherapeutic Delivery Platforms: An Interdisciplinary Approach

Himashu Chaudhary, Malhar Pithiya and Krishna Monpara
N V Patel College of Pure and Applied Sciences, The CVM University

Abstract

The growing global burden of lifestyle disorders, nutritional deficiencies, recurrent infections, and musculoskeletal pain highlights the urgent need for safe, plant-based, and patient-friendly health solutions. Traditional systems of medicine offer a vast repertoire of medicinal plants; however, their clinical effectiveness is often limited by inadequate formulation strategies and conventional dosage forms. The present work focuses on the integrated development of multiple innovative herbal formulations designed to address nutrition, immunity, throat infections, and pain management through scientifically rationalized delivery systems. This research encompasses the formulation of (i) a herbal functional milk blend enriched with adaptogenic

and immunomodulatory botanicals, (ii) a plant-based herbal multi-nutrient capsule for daily nutritional support, (iii) a novel throat-soothing herbal jelly designed for prolonged mucosal residence and symptomatic relief from throat infection, cough, and pain, and (iv) a fast-acting polyherbal topical painkiller spray for localized musculoskeletal discomfort. Carefully selected medicinal plants such as Ashwagandha, Moringa, Turmeric, Ginger, Tulsi, Amla, Guduchi, Licorice, and other supportive botanicals were combined based on complementary pharmacological actions including immunomodulatory, anti-inflammatory, antimicrobial, antioxidant, analgesic, and bioavailability-enhancing effects. Innovative formulation techniques—such as slow-dissolving jelly matrices, dual-phase spray systems, whole-herb nutritional synergy, and natural absorption enhancers—were employed to improve therapeutic effectiveness, patient compliance, and safety. All formulations were designed using food-grade or pharmacopeial-grade ingredients, avoiding synthetic additives and excessive sugars. The integrated approach demonstrates how traditional herbal knowledge can be transformed into modern, scalable, and patient-centric dosage forms aligned with current nutraceutical and AYUSH-based healthcare trends. Overall, this work presents a unified framework for the development of multifunctional herbal products that bridge nutrition, preventive healthcare, and symptomatic management, offering a sustainable and holistic alternative to conventional synthetic formulations. The outcomes provide a strong foundation for further pharmacological validation, stability studies, and potential translational development in functional food and herbal therapeutic sectors.

BIP-05

Gigantism: Where Growth Exceeds Control

Patel Archie Vishalkumar, Aayushi Shah, Om Patel and Goswami Zaranaben Amitpuri
Department of Medical Biotechnology, N V Patel College of Pure and Applied Sciences,
The CVM University

Abstract :-

Gigantism is a rare endocrine disorder characterized by excessive and uncontrolled physical growth caused by the overproduction of growth hormone (GH) during childhood or adolescence, before the closure of epiphyseal growth plates. This condition represents a state in which normal physiological regulation of growth fails, leading to extreme height and disproportionate enlargement of various body parts. The most common underlying cause of gigantism is a benign tumor of the pituitary gland, which disrupts hormonal balance and stimulates continuous secretion of growth hormone. Elevated levels of GH subsequently increase the production of insulin-like growth factor-1 (IGF-1), resulting in accelerated bone and tissue growth. Clinically, individuals affected by gigantism exhibit rapid height gain, enlarged hands and feet, thickened facial features, and delayed sexual maturation. In addition to physical changes, gigantism is often associated with serious health complications such as cardiovascular disorders, joint and muscle pain, metabolic disturbances, vision impairment, and neurological symptoms caused by tumor pressure. If left untreated, these complications can significantly reduce quality of life and life expectancy. Diagnosis of gigantism involves a combination of clinical evaluation, biochemical tests measuring growth hormone and IGF-1 levels, and imaging techniques such as magnetic resonance imaging (MRI) to identify pituitary abnormalities. Early detection plays a critical role in preventing irreversible skeletal deformities and long-term complications. Treatment strategies focus on controlling hormone overproduction and managing tumor growth through surgical intervention, radiation therapy, and pharmacological agents that suppress growth hormone secretion. This abstract emphasizes gigantism as a condition where growth exceeds biological control, highlighting the importance of medical awareness, early diagnosis, and timely treatment to restore hormonal balance and improve overall health outcomes.

GMO Crops: A Modern Approach for Sustainable and Food-Secure Agriculture

Pranati Mauleshbhai Acharya

Department of Biotechnology, N V Patel College of Pure and Applied Sciences, The CVM University

Abstract

Genetically Modified (GM) crops are plants whose genes are changed using modern biotechnology to improve useful traits such as pest resistance, higher yield, and better nutritional quality. With the increasing global population, climate change, and reduced agricultural land, GM crops play an important role in ensuring food security and sustainable agriculture. Recent studies show major progress in genetic engineering and genome-editing tools like CRISPR-Cas9, which allow precise changes in plant DNA without adding foreign genes. These technologies have been used to develop crops with better disease resistance, improved taste, and enhanced nutrient content. For example, gene-edited crops such as tomatoes and rice have shown improved quality traits in recent experimental studies. Commercial GM crops like Bt cotton and herbicide-tolerant maize have reduced the use of chemical pesticides and increased farmer income in many countries, including India. However, some challenges remain. Long-term cultivation of GM crops may lead to pest resistance, weed problems, and environmental concerns. Public acceptance and government regulations also differ across countries, affecting large-scale adoption. Recent research highlights the importance of proper crop management, biosafety assessment, and farmer education to maximize benefits and reduce risks. Overall, GMO crops are powerful tools for modern agriculture. With careful regulation, scientific monitoring, and responsible use, GM crops can help improve crop productivity, reduce environmental damage, and support sustainable agricultural development.

Keywords : *GMO crops; genetic engineering; CRISPR-Cas9; Bt cotton; food security; sustainable agriculture.*

Hypertrophic Cardiomyopathy

Hasti Joshi and Hetvi Nikunj Pathak

Department of Genetics, N V Patel College of Pure and Applied Sciences,
The CVM University

Abstract

Hypertrophic cardiomyopathy (HCM) is a relatively common inherited cardiac disorder characterized by unexplained left ventricular hypertrophy in the absence of conditions such as hypertension or aortic stenosis. It is usually inherited in an autosomal dominant pattern and is most commonly associated with mutations in genes encoding sarcomeric proteins, particularly β -myosin heavy chain and myosin-binding protein C. The disease shows marked genetic and clinical variability, with a prevalence of approximately 1 in 500 individuals. The pathological hallmarks of HCM include asymmetric septal hypertrophy, myocyte disarray, interstitial fibrosis, and microvascular dysfunction. These structural abnormalities lead to impaired diastolic relaxation, myocardial ischemia, arrhythmias, and an increased risk of sudden cardiac death (SCD). A significant number of patients develop dynamic left ventricular outflow tract obstruction due to systolic anterior motion of the mitral valve, contributing to symptoms and hemodynamic instability. Clinical presentation varies widely, ranging from asymptomatic individuals to those with exertional dyspnea, chest pain, syncope, atrial fibrillation, heart failure, or SCD. Risk assessment focuses on factors such as family history of SCD, severe hypertrophy, unexplained syncope, ventricular arrhythmias, and imaging evidence of myocardial fibrosis. Implantable cardioverter-defibrillators are the most effective strategy for preventing SCD in

high-risk patients. Diagnosis primarily relies on echocardiography and cardiac MRI, while genetic testing aids in family screening. Management includes pharmacological therapy, septal reduction procedures, and careful perioperative monitoring to minimize hemodynamic complications.

BIP-08

Morphogenetic Plasticity: Reconfiguring Frog Developmental Programs into Synthetic Bio-Machines

Purva Brahmwar, Prachi Valand, Ritu Patel and Dr. Poonam Mishra*

Department of Biotechnology, Krishna School of Science, Drs. Kiran & Pallavi Patel global University, Varnama, Vadodara 391423.

Email Id: Rutupatel0104@gmail.com, prachiiii3333@gmail.com,

purvabrahmwar@gmail.com, Poonammishra.kss@kpgu.ac.in

Abstract

Morphogenetic plasticity is the inherent capacity of cells to manifest novel forms beyond their genetic default. This study examined the reconfiguration of embryonic *Xenopus laevis* cells into "Xenobots"—autonomous bio-machines. Discovered in 2020 through collaboration between Tufts University and the University of Vermont, these robots were designed via a "sim-to-real" pipeline where evolutionary algorithms optimized shapes were realized in biological media. The technology has evolved rapidly: from manual assembly (2020) to cilia-driven self-assembly (2021) and the discovery of kinematic self-replication (Late 2021), Current 2026 trends includes the development of human-cell "Anthrobots" for tissue repair. Applications range from microplastic remediation to internal medical surgery. Key advantages include complete biodegradability and self-healing, though disadvantages exist in limited lifespans and complex control requirements. Ethical considerations remain paramount, as these "living programs" challenge the boundary between organism and machine. This work underscores a paradigm shift: viewing the genome not as a rigid script, but as a versatile hardware platform reprogrammable through physical and topobiological stimuli.

Keywords: *Morphogenetic Plasticity, Xenobots, Bio-Engineering, Synthetic Biology, Xenopus laevis.*

BIP-09

Radiotrophic Melanized Fungi in the Chernobyl Nuclear Reactor

Khushi Patel

Department of Biotechnology, N V Patel College of Pure and Applied Sciences, The CVM University

Abstract:-

The Chernobyl nuclear disaster of 1986 resulted in the release of large amounts of ionizing radiation, creating an extreme and hostile environment for most living organisms. Surprisingly, several microorganisms were later discovered thriving in highly radioactive zones of the damaged nuclear reactor. Among these, melanized (black) fungi, also known as radiotrophic fungi, gained significant scientific attention due to their unusual adaptation to radiation-rich environments. This review summarizes current knowledge on black fungi associated with the Chernobyl disaster and the proposed mechanisms underlying their radiation tolerance. Species such as *Cladosporium sphaerospermum*, *Cryptococcus neoformans*, and *Wangiella dermatitidis* were isolated from reactor walls and contaminated areas exhibiting elevated radiation levels. These fungi are characterized by the presence of melanin, a dark pigment embedded in their cell walls. Melanin is known for its ability to absorb ionizing radiation and protect cellular components from radiation-induced damage. Experimental studies have reported enhanced growth of melanized fungi under ionizing radiation compared to non-melanized strains,

suggesting a possible role of melanin in radiation-associated metabolic processes. It has been hypothesized that radiation exposure alters the electronic properties of melanin, enhancing electron transfer reactions that may support cellular functions under extreme conditions. Beyond their ecological significance, radiotrophic fungi have attracted interest for potential applications in bioremediation, radiation shielding, and space biotechnology, including studies conducted in microgravity environments. Overall, the presence of black fungi in the Chernobyl reactor highlights a remarkable example of microbial adaptation to extreme environments.

Keywords: *Radiotrophic fungi, Chernobyl disaster, Melanized fungi, Ionizing radiation, Melanin*

BIP-10

Role of Stem Cell Preservation and Regenerative Medicine in the Treatment of Heart Disease

Puwar Hitendrasinh Dungarsinh and Vala Rajvirsinh Ranjitsinh
Department of Genetics, N V Patel College of Pure and Applied Sciences, The CVM University

Abstract

Stem cells are undifferentiated cells characterized by their unique ability of self-renewal and differentiation into specialized cell types. Stem cell therapy and regenerative medicine have emerged as advanced medical approaches for the treatment of various degenerative and life-threatening diseases. Public awareness of stem cells is essential to understand their medical importance, ethical aspects, and future therapeutic potential. Stem cell preservation, particularly through umbilical cord blood banking, ensures the long-term availability of healthy and genetically compatible stem cells for future use. Cryopreservation at ultra-low temperatures helps maintain stem cell viability and functionality for several decades. Heart disease and heart attack are among the leading causes of mortality worldwide and occur mainly due to blockage of blood supply to the heart muscle, resulting in irreversible damage to cardiomyocytes. The adult human heart has very limited regenerative capacity, and damaged tissue is generally replaced by non-functional scar tissue, leading to reduced cardiac performance. Stem cell therapy offers a regenerative solution by repairing damaged heart tissue through differentiation into cardiomyocytes, promotion of angiogenesis, and reduction of inflammation. These processes are regulated by precise genetic and epigenetic mechanisms that guide stem cell differentiation and integration into cardiac tissue. Overall, awareness and preservation of stem cells play a crucial role in preventive and personalized medicine. Stem cell-based regenerative therapy holds significant future potential in improving heart function and reducing mortality associated with heart diseases.

BIP-11

Satellite-Based Evaluation of Groundwater Storage Anomalies in Agricultural Regions of India Using GRACE

Verma Anjali
Department of Environmental Science, N V Patel College of Pure and Applied Sciences, The CVM University

Abstract

Groundwater is a vital component of India's water security and plays a crucial role in sustaining agricultural productivity across the country. Rapid population growth, expansion of irrigated agriculture, and increasing climate variability has exerted significant pressure on groundwater resources, leading to widespread depletion in several agriculture-dominated regions. Conventional groundwater monitoring through observation wells provides valuable local-scale information but remains limited in capturing large-scale and long-term spatial patterns. In this context, satellite-based monitoring offers an effective alternative for regional assessment. This

study presents an assessment of groundwater storage changes in major agriculture-dominated Indian states using data from the Gravity Recovery and Climate Experiment (GRACE) satellite mission. Monthly terrestrial water storage anomalies derived from GRACE were processed to estimate groundwater storage anomalies by removing the contributions of soil moisture and surface water using Global Land Data Assimilation System (GLDAS) datasets. Spatial and temporal analyses were conducted to evaluate seasonal variations during pre-monsoon, monsoon, and post-monsoon periods. Results indicate a consistent decline in groundwater storage during the pre-monsoon season, particularly in north-western agricultural states such as Punjab, Haryana, Rajasthan, and western Uttar Pradesh. Although monsoon rainfall contributes to partial groundwater recharge, recovery remains insufficient to offset annual losses. Comparison with Central Ground Water Board (CGWB) well data shows good agreement, confirming the reliability of GRACE for large-scale groundwater monitoring. The findings highlight the urgency of sustainable groundwater management practices and demonstrate the importance of satellite-based observations for supporting climate-resilient agricultural and water resource planning in India.

BIP-12

SPATIAL GENOMICS: Mapping Gene Expression in 3D Space

Juhika Ayushkumar koisa and Riddhi Solanki
Department of Genetics, N V Patel College of Pure and Applied Sciences,
The CVM University

Abstract

Spatial genomics is a cutting-edge field that integrates high-resolution gene expression profiling with spatial information from intact tissues. Traditional bulk or single-cell sequencing techniques provide valuable molecular insights, but they lack the spatial context necessary to understand how cells are organized and interact within their native microenvironment. Spatial genomics overcomes this limitation by capturing gene expression patterns while preserving the physical location of cells, enabling the creation of detailed maps of transcripts in two- and three-dimensional tissue architecture. Techniques such as spatial barcoding, in situ hybridization and advanced sequencing platforms allow researchers to measure the abundance of thousands of genes across tissue sections without losing positional information. These spatially resolved datasets have transformed our understanding of complex biological systems, revealing how cellular neighborhoods contribute to development, disease progression, and therapeutic response. Applications of spatial genomics span oncology, neuroscience, developmental biology, and immunology. For instance, spatial maps of tumor tissues uncover cellular interactions that influence cancer progression, while brain tissue analyses reveal neuronal circuits in health and disease. As spatial genomics technologies continue to evolve, they promise to deepen our understanding of biological systems and empower translational research in precision medicine.

BIP-13

Anti-microbial and phytochemical evaluation of *Ipomoea sepiaria* with in-silico docking for female infertility

Dhruvanshi Mangar and Nisha Daxini*
Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar- 388120 Gujarat INDIA
Email: nisha.daxini@cvmu.edu.in

Abstract

Female infertility is also a significant reproductive health issue, which is commonly linked to the presence of microbial infection of the female reproductive tract. The growing resistance to the

traditional antimicrobial agents has increased the drive to seek alternative remedies under medicinal plants. *Ipomoea sepiaria* is a widely used traditional medicinal plant that is said to have many therapeutic effects although its antimicrobial and infertility effects are unexplored. The current research focuses on the determination of the phytochemical constituents and antimicrobial effect of *Ipomoea sepiaria* and in-silico molecular docking research to assess its efficacy in the treatment of female infertility. Plant extracts were made in various organic solvents and preliminary analogy phytochemical screening done to determine the biologically active secondary metabolites.

Keywords: Female infertility; *Ipomoea sepiaria*; Antimicrobial activity; MIC; Phytochemical screening; In-silico study

BIP-14

Antiproliferative Activity of *Hibiscus rosa-sinensis* and *Delonix regia* Extracts Using *Schizosaccharomyces pombe cdc2* Mutant as an Eukaryotic Cancer Model

Shivam Gour¹, Kumud Macwana¹, Braganza VJ² and Nisha Daxini^{1,*}

¹Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar-388120 Gujarat INDIA

²Loyola Centre for Research and Development, St. Xavier's College campus, Navrangpura, Ahmedabad.

*Email: nisha.daxini@cvmu.edu.in

Abstract

Medicinal plants such as *Hibiscus rosa-sinensis* (Malvaceae) and *Delonix regia* are rich sources of flavonoids, phenolics, and other phytochemicals with reported antioxidant, cytotoxic, and hepatoprotective properties. These plants have shown potential against cancer promotion in animal models, warranting screening for antiproliferative activity. The fission yeast *Schizosaccharomyces pombe cdc2* mutant serves as an established eukaryotic model for cell-cycle studies due to its conservation of Cdc2/CDK1 pathways with mammalian cells. Leaf extracts of *H. rosa-sinensis* and *D. regia* were prepared using three extraction methods (hot at ~60°C, cold at 25°C, bath sonication) and three solvents (water, methanol, water: methanol (1:1)). Antiproliferative activity was assessed in *S. pombe cdc2* mutant using the MTT cell viability assay, with untreated cells, DMSO (negative control), and a positive control vinblastine as standard. Viability was calculated as percent reduction relative to controls. *Delonix regia* water-methanol extracts (cold and sonication methods) showed the strongest antiproliferative effect, reducing *S. pombe cdc2* mutant viability to 34.86%. For *H. rosa-sinensis*, hot methanol extracts yielded the lowest viability at 63.99%, with controls at 100% (untreated), 91.59% (DMSO), and 61.99% (positive). Water, methanol, and water-methanol solvents enriched bioactive phytochemicals across both plants. The *cdc2* mutant hypersensitivity confirms extract interference with conserved cell-cycle pathways relevant to cancer proliferation. Water-methanol and hot methanol extractions optimize phytochemical recovery, positioning these plants as anticancer leads. *S. pombe cdc2* validates as a high-throughput screening model superior to budding yeast for mammalian like cell division. *H. rosa-sinensis* and *D. regia* extracts demonstrate significant antiproliferative activity in *S. pombe cdc2* mutant, supporting their potential as sources of novel anticancer agents. Fractionation of active extracts and mammalian cell validation are recommended.

Keywords: Antiproliferative activity; *Hibiscus rosa-sinensis*; *Delonix regia*; phytochemical analysis; *Schizosaccharomyces pombe*; *cdc2* cell-cycle mutant; MTT assay; anticancer screening.

Comparative In Vitro Antioxidant Evaluation of *Simarouba glauca* Leaves and *Butea monosperma* Bark Extracts Using Different Extraction Methods

Jigyasa Rathod¹ and Rinkal Mulani*

¹ *Department of Biochemistry, Shri Alpesh N. Patel Post Graduate Institute of Science and Research, Anand.388811

Email: drrinkalmulani93@gmail.com

Abstract

Medicinal plants are well known for their potential as natural sources of antioxidants. The current study was designed to assess the in vitro antioxidant activity of *Simarouba glauca* leaves and *Butea monosperma* bark extracts prepared using different solvents and techniques. The plant extracts were successively extracted using solvents of varying polarities, such as hexane, ethyl acetate, methanol, and water, using Soxhlet and maceration methods. The highest percentage extractive value was found in the methanolic extract of *Simarouba glauca* leaves using maceration (19.2%), followed by the methanolic extract of *Butea monosperma* using the same method (8.6%). Phytochemical analysis showed that the highest total phenolic content was found in the methanolic extract of *Butea monosperma* using Soxhlet extraction (2.428 µg/g), and the highest flavonoid content was found in the methanolic maceration extract of *Butea monosperma* (115.26 µg/g). Antioxidant activity analysis showed that the ethyl acetate extract of *Butea monosperma* using Soxhlet extraction exhibited the highest DPPH radical scavenging activity (82.75%). The nitric oxide scavenging activity analysis showed that the hexane extract of *Simarouba glauca* using maceration exhibited the highest inhibition (58.65%). The FRAP analysis showed that the methanolic and aqueous extracts exhibited the highest ferric reducing antioxidant power (207.45 µM/ml). Based on the above results, further studies are recommended to explore the anticancer activity of these extracts, especially against triple-negative breast cancer cell lines.

Keywords: *Simarouba glauca*, *Butea monosperma*, Antioxidant activity, phytochemical, Triple-negative breast cancer

Coprological Prevalence Of Gastrointestinal Parasites In Selected Domestic Animals At Anand, Gujarat

Sneha Bajaniya, Sumitra Kanara, Krishna Trambadiya* and Ujjaval Trivedi

PG Department of Biosciences, Sardar Patel University, Anand, Gujarat - India

Corresponding author: *krishnatrambadiya22@gmail.com

Abstract

Gastrointestinal (GI) parasitic infections are affecting livestock health, productivity and economic sustainability particularly in tropical and subtropical regions such as Gujarat, where climatic conditions favourable for parasite survival and transmission. These parasites impair nutrient absorption, reduce growth, milk yield and negatively influence reproductive performance. Gastrointestinal parasites possess zoonotic potential that create risks to both animal and public health. Coprological examination remains a reliable and cost-effective approach for monitoring parasitic infections under field conditions. The present study represents the coprological prevalence and diversity of gastrointestinal parasites in selected domestic animals of Anand district, Gujarat. A total of 97 freshly dropped fecal samples were randomly collected from cow (*Bos indicus*), buffalo (*Bubalus bubalis*), sheep (*Ovis aries*) and goat (*Capra hircus*) from different localities of Anand. The samples were examined using standard parasitological techniques, including direct smear, flotation and sedimentation methods for the detection of helminth eggs and protozoan oocysts. 97 fecal samples examined among them 72

(74.22%) were positive. The overall prevalence of *Ascaris* sp. (40.20%), *strongyle* sp. (23.71%), *Strongyloides* sp. (9.7%), *Trichuris* spp. (24.74%), *Paramphistomum* sp. (1.03%), *Buxtonella* sp. (6.18%) and coccidian oocysts (20.61%). The mixed infections were frequently observed that indicates continuous exposure of animals to contaminated grazing areas, poor sanitation and suboptimal parasite control practices. The study reveals a considerable burden of gastrointestinal parasitism among domestic animals in Anand district. These findings represent for regular parasitological surveillance, strategic deworming schedules, improved grazing management and farmer awareness programs to minimize economic losses and enhance livestock health and productivity.

Keywords: *Gastrointestinal (GI) parasites, Coprological study, Domestic animals, Ascaris sp., Anand*

BIP-17

Cow Dung Ash: A Natural Approach to Developing Alkaline Mineral Drinking Water

Priyanka T.Prajapati ¹, Raj Patel ², Hemvati Verma ³ and Amitsinh Mangrola *

^{1 2 3*}Department of Biochemistry, Shri Alpesh N. Patel Post Graduate Institute of Science and Research, Anand -388 001,
Email:avmang@gmail.com

Abstract

The increasing demand for safe, affordable, and mineral-rich drinking water has led to growing interest in sustainable alternatives to conventional purification methods. This study focuses on the development of alkaline mineral water using cow dung ash as a natural, eco-friendly, and low-cost treatment material. Cow dung ash is rich in alkaline minerals and has the potential to enhance water quality while improving its mineral composition. The effectiveness of cow dung ash was evaluated by examining its impact on key physicochemical parameters of water, pH was rise up to 8.7 at the 12g/L ash dose, turbidity was increase with increasing the ash concentration and hardness was found in normal range, chloride and sulfate slightly increase with increasing the ash concentration but found within normal range. Microbial load (bacterial and fungal) was determined by the total plate count method. Different dosages of cow dung ash were tested to determine the optimum concentration for water treatment. The results indicated that an overall optimum dosage of 12 g/L with a contact time of 24 hours provided significant improvement in water quality through effective adsorption. Treatment with cow dung ash increased the alkalinity and mineral content of water resulting in the formation of alkaline mineral water enriched with essential minerals beneficial for human health. Unlike many advanced purification systems that may remove natural minerals, cow dung ash contributes to mineral enrichment while remaining economical and environmentally friendly. Overall, the findings demonstrate that cow dung ash has promising potential as a sustainable material for producing alkaline mineral water. Further research is recommended to evaluate its long-term safety and applicability for large-scale drinking water treatment.

Keywords: *Cow dung ash, Alkalinity, mineral, Drinking water, contact time*

BIP-18

Nano-Revolution in Melanoma Therapy

Suryangi Meghani and Riya Patel

Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand-388120, Gujarat, India

Abstract

Melanoma is one of the most aggressive forms of skin cancer, with few possibilities for therapeutic approaches, due to its multi-drug resistance and, consequently, low survival rate for patients. Conventional therapies for treatment melanoma include radiotherapy, chemotherapy, targeted therapy, and immunotherapy, which have various side effects. For this reason, in recent years, pharmaceutical and biomedical research has focused on new site-specific alternative therapeutic strategies. In this regard, nanotechnology offers numerous benefits which could improve the life expectancy of melanoma patients with very low adverse effects. This review aims to examine the latest advances in nanotechnology as an innovative strategy for treating melanoma. In particular, the use of different types of nanoparticles, such as vesicles, polymers, metal-based, carbon nanotubes, dendrimers, solid lipid, microneedles, and their combination with immunotherapies and vaccines will be discussed.

Keywords: *Melanoma; nanotechnology; nanomaterials; polymers; immunotherapy; target therapy*

BIP-19

E-Coli: The hidden Metastasis Trigger

Shreya Patel and Sakshi Patel

Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand-388120, Gujarat, India

Abstract

The involvement of intestinal microbiota in the process of neutrophil-mediated colorectal cancer liver metastasis (CRCLM) is not yet fully understood. Here, we show that *Escherichia coli* is prevalent in CRC tissues with LM using 2bRAD-M-Seq and is linked to the release of neutrophil extracellular traps (NETs). Utilizing multi-omics and molecular techniques, we establish that *E. coli* recruits RIPK2, which promotes the binding of HNRNPK to the Atf3/Relb promoters in neutrophils, thereby enhancing their transcription. This process results in the upregulation of Ncf4, which triggers p-MLKL-mediated NET formation. NETs, in turn, increase the expression of TRPC1 and NFATC3 in CRC cells, promoting the calcium-dependent assembly of the STAT3/S100A8/9 heterotrimer. This trimer stabilizes STAT3enhancer-promoter loops (EPLs), thereby reinforcing the Tns1 transcription and facilitating CRCLM. Our findings elucidate the mechanism by which *E. coli*-induced NETs promote CRCLM through epigenetic modifications, offering an insight into the role of EPLs in immune regulation and tumour progression.

Keywords: *Escherichia coli, Colorectal cancer liver metastasis (CRCLM), Neutrophil extracellular traps (NETosis), RIPK2 signalling pathway, HNRNPK-mediated transcription, p-MLKL activation, STAT3/S100A8/9 heterotrimer, Enhancer-promoter loop stabilization (EPLs)*

BIP-20

Global Evolution of Multidrug-Resistant *Staphylococcus aureus* ST188

Shruti.B.Patel and Shilpa Gupte*

Department of Microbiology, Institute of Science and Technology for Advanced Studies and Research, V.V. Nagar, 388120, Anand, shilpa.gupte@cvmu.edu.in

ABSTRACT

Staphylococcus aureus sequence type 188 (ST188) is a globally distributed bacterial lineage associated with colonization and bloodstream infections in both humans and animals. However, its evolutionary patterns and genetic adaptations are not fully understood. This study aimed to investigate the genomic diversity, transmission, and adaptation of ST188 using large-scale genome analysis. A total of 808 ST188 isolates collected from 24 countries between 2004 and

2023 were analyzed using whole-genome sequencing. Phylogenetic analysis identified seven distinct clades. Among them, clades I and VII showed independent clonal expansion, particularly in China. Frequent transmission events across regions, countries, and host species were observed, indicating that ST188 functions as a host-generalist lineage. A methicillin-resistant *S.aureus* (MRSA) subclade was identified within clade VI, which likely evolved from a methicillin-susceptible ancestor through the acquisition of the SCCmec IVa element. This event was accompanied by the acquisition of additional antibiotic resistance determinants, including a resistance transposon and mutations associated with fluoroquinolone resistance. Genetic changes related to adhesion and virulence were also observed. Laboratory assays supported these findings by showing reduced adhesion and colonization ability in clade VI isolates. Further analysis revealed clade-specific patterns of mobile genetic elements, while overall genetic diversity was mainly driven by core genome variations. These findings highlight the evolutionary success of ST188 and emphasize the importance of ongoing genomic surveillance of this emerging lineage.

Keywords: *Staphylococcus aureus, sequence type 188, antimicrobial resistance, virulence*

BIP-21

Tattoo ink induces inflammation in the draining lymph node and alters the immune response to vaccination

Asma Saiyed

Department of Microbiology, Institute of Science and Technology for Advanced Studies and Research, The CVM University V.V. Nagar - 388120, Anand.

ABSTRACT

Tattooing is becoming very common worldwide, but there are still concerns about the safety and toxicity of tattoo inks. Until now, very few studies have examined how tattooing affects the immune system. In this study, we investigated how tattoo inks move through the body and how they influence immune responses using a marine animal model. After tattooing, the ink was quickly transported through the lymphatic system and accumulated in the lymph nodes (LN). We observed that immune cells called macrophages were mainly responsible for capturing and storing the tattoo ink inside the lymph nodes. This ink capture triggered an inflammatory response both at the tattoo site and throughout the body. Importantly, this inflammation did not disappear quickly; clear signs of inflammation were still present in the draining lymph nodes even two months after tattooing. We also found that the uptake of tattoo ink by macrophages was linked to increased cell death (apoptosis). This effect was observed in both human and mouse immune cell models, suggesting that tattoo ink can negatively affect immune cell survival. Furthermore, the presence of tattoo ink in lymph nodes altered the body's response to vaccines. When animals were vaccinated with an mRNA-based SARS-CoV-2 vaccine, the antibody response was reduced. This weaker response was associated with lower production of the viral spike protein in macrophages within the lymph nodes. In contrast, when an ultraviolet (UV)-inactivated influenza vaccine was used, the immune response was stronger than normal. Overall, this study shows that tattoo inks can persist in the lymphatic system, cause long-term inflammation, and modify immune responses, including responses to vaccination. Given the growing popularity of tattooing, these findings are important for toxicology research, public health authorities, policymakers, and the general public to better understand the potential immune risks associated with tattooing.

Keywords: *Lymphatic System, Lymph nodes, inflammation, Apoptosis, Vaccine response*

Incidence Of *Trichuris* Spp. In Selected Domestic Animals Of Anand District, Gujarat

Sumitra Kanara, Sneha Bajaniya, Krishna Trambadiya* and Ujjaval Trivedi
PG Department of Biosciences, Sardar Patel University, Anand, Gujarat - India
Corresponding author : *krishnatrambadiya22@gmail.com

Abstract

Gastrointestinal helminth infections remain a significant challenge to livestock health and productivity. *Trichuris* spp. (whipworms) are soil-transmitted nematodes that parasitize the large intestine of domestic animals and contribute to chronic intestinal disturbances, reduced nutrient utilization and lowered productive performance. The present study reported the incidence of *Trichuris* spp. infection in selected domestic animals of Anand district, Gujarat. A coprological survey was conducted on freshly fecal samples collected from cow (*Bos indicus*), sheep (*Ovis aries*) and goat (*Capra hircus*) from different locations of Anand district. The samples were processed using the direct smear technique in that small quantity of fecal material was emulsified in normal saline and examined under a light microscope for the presence of helminth eggs. 73 fecal samples examined among them 24(32.87%) were positive. Identification of *Trichuris* spp. was based on the characteristic lemon or barrel-shaped eggs with prominent bipolar plugs. Adult *Trichuris* species exhibit similar whip-shaped morphology and life cycles, variations in egg size and shape aided in tentative differentiation during microscopic examination. The detection of *Trichuris* spp. eggs in the examined animal species indicates active environmental contamination and continuous exposure of grazing animals to infective stages present in pasture soil. Trichuriasis may result in intestinal irritation, mild diarrhea, poor weight gain and reduced productivity. Regular fecal monitoring, improved sanitation and pasture management along with strategic antihelmintic drugs are essential for effective control of *Trichuris* infections and for improving overall livestock health and productivity.

Keywords: *Trichuris* spp., Sheep, domestic animals, direct smear method, gastrointestinal helminths, Anand

Innovation Trends in Nanotechnology-Based Gene Delivery for Breast Cancer

Priyanshi.D.Jotangiya
Department of Microbiology, Institute of Science and Technology for Advanced Studies and Research, The CVM University, V.V. Nagar, 388120, Anand

ABSTRACT

Breast cancer is the most common cancer among women worldwide and remains a major public health challenge. Conventional treatments such as chemotherapy and radiation therapy often cause adverse side effects and may become less effective due to drug resistance. Nucleic acid-based gene therapies offer a promising alternative by enabling targeted regulation of cancer-related genes. However, their success depends on the availability of safe and efficient delivery systems. Nanotechnology-based carriers have emerged as effective platforms for improving stability, targeting, and therapeutic efficiency. The rapid increase in patent filings related to nanotechnology-enabled nucleic acid delivery systems highlights significant technological progress in this field. Understanding the patent landscape is essential to identify innovation trends and future research opportunities. This study presents a global patent landscape analysis of nanotechnology-based delivery systems for nucleic acid therapies in breast cancer. Patent data were collected from the Derwent World Patents Index (DWPI) using relevant keywords and International Patent Classification (IPC) codes. A total of 1,084 patent families were identified and categorized by legal status. Active patents published between 2020 and 2025 were selected, resulting in 323 patents for detailed analysis. The results show that the United States, China, and

Europe lead innovation in this area. Lipid-based nanoparticles and polymeric carriers were the most commonly reported platforms, with strong emphasis on targeted delivery strategies and RNA interference technologies. Overall, this study highlights the growing impact of nanotechnology in advancing nucleic acid-based breast cancer therapies.

Keywords: *Nanotechnology, Breast cancer, Nucleic-acid therapies, Delivery systems*

BIP-24

Isolation and Screening of Cellulase Producing Microorganism from Waste of Ruminant Animal (Cow Dung) and its Media Optimization and Saccharification of Alkali-Pretreated Sawdust

Drashti Pande, Kirtan B. Patel and Snehal Ingale*

Department of Microbiology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), Vallabh Vidyanagar-388120, Anand, Gujarat Email- snehal.ingale@cvmu.edu.in

Abstract

Cellulases are enzymes hydrolysing cellulosic biomass and are produced by the microorganisms that are grown over cellulosic matter. Cellulase-producing bacteria were isolated from Cow dung. These isolates were screened and identified using HiBacillus™ Identification Kit, the isolate was identified to be *Bacillus subtilis*. The production of enzymes for maximum cellulase production CMCase and FPU activity was calculated to be 1.69 µg/ml and 1.76 µg/ml respectively. Optimization of cellulase production was carried out using Response surface methodology (RSM). The Plackett-Burman design method was used to evaluate the significant components of the production medium followed by Central composite design, which are significantly affecting enzyme production. The predicted carboxymethylcellulose (CMCase) activity and sawdust as a substrate under optimized parameters were 2.63 U/ml and 2.69 U/ml. The result showed that the responses of CMCase and sawdust were significantly affected by the quadratic model of pH, inoculum size, and fermentation time and the statistical analysis of variance (ANOVA) indicates a good correlation of experimental parameters selected. The saccharification process of the pre-treated sawdust with enzyme was optimized at different substrate concentrations. The rate of saccharification for the partially purified enzyme of *Bacillus subtilis* on alkali-treated sawdust was found to be 30.7%. The present study indicates NaOH- treated sawdust as a potential raw material for both productions of cellulase and saccharification on a large scale.

Keywords: *Cellulase, Bacillus subtilis, Response Surface Methodology, Enzymatic Saccharification Lignocellulosic biomass*

BIP-25

Isolation, Screening and Characterization of Probiotic *Bacillus* species

Paril Pagi and Shilpa Gupte*

Department of Microbiology, Institute of Science and Technology for Advanced Studies and Research, The CVM University V.V. Nagar, 388120, Anand, Gujarat, shilpa.gupte@cvmu.edu.in

ABSTRACT

Probiotics are live microorganisms that provide health benefits when consumed in sufficient amounts. They are commonly used in fermented foods and dietary supplements. Among different probiotic organisms, *Bacillus* species are gaining attention because they can form spores. These spores help them survive harsh environmental conditions such as high temperature, acidic pH, and bile salts present in the human gastrointestinal tract. The present study aimed to isolate, screen, and characterise probiotic *Bacillus* spp. from fermented food sources and to evaluate their probiotic properties and safety. In this study, sixteen spp. isolates

were obtained from various fermented food samples using selective isolation techniques. Primary screening was performed to assess their ability to tolerate acidic pH and bile salt conditions, which simulate the stomach and intestinal environment. Out of these sixteen isolates, seven showed good survival under low pH and bile salt conditions, suggesting their potential to survive in the human gut. These seven isolates were further subjected to secondary screening, including tests for auto-aggregation, cell surface hydrophobicity, and adhesion-related properties. These characteristics are important for probiotic strains, as they support attachment and interaction with intestinal epithelial cells. Among the tested isolates, two showed superior probiotic characteristics and were considered promising candidates. However, safety assessment is a critical requirement in probiotic selection. Hemolytic activity was evaluated to determine the safety of the selected isolates, and both isolates showed gamma hemolytic activity. Hence, this study depicts that both probiotic strains have efficient probiotic characteristics and also fulfil safety criteria, so they can be further explored for a more detailed study and applications.

Keywords: Probiotics, *Bacillus spp.*, Hemolytic Activity, Safety Assessment, Spore Forming

BIP-26

Molecular Detection of Oral Cancer Using SNPs in Salivary Genes

Vrushti Sutaria¹, Bansari Patel ¹, Dhanvee Thakkar ² and Nisha Daxini^{1,*}

¹Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar-388120 Gujarat INDIA

²Government Medical College Nizamabad, Kaloji Narayana Rao, University of Health Sciences, Warangal, Telangana

*Email: nisha.daxini@cvmu.edu.in

Abstract

Oral cancer remains a significant health concern, especially for high-risk groups exposed to alcohol and tobacco. Improving survival rates requires early detection, but traditional diagnostic techniques like biopsy are invasive and frequently carried out at a later stage. This study investigated the possibility of using saliva as a non-invasive sample to find Single Nucleotide Polymorphisms (SNPs) linked to oral cancer. Saliva is a trustworthy source of genetic material, as evidenced by the sufficient quality of its DNA for PCR amplification and SNP analysis. Saliva reflects molecular changes that take place during carcinogenesis because it comes into direct contact with oral lesions. The discovery of particular SNPs in genes linked to inflammation and tumour suppression raises the possibility that genetic differences could influence a person's risk of developing oral cancer.

Keywords: Oral Cancer, Salivary DNA, SNP, Molecular Biomarkers, PCR, Genetic Susceptibility

BIP-27

Natural Phycocyanin-Inspired Chitosan Hydrogel for Thrombolytic and Antiglycation Biomedical Applications

Palak Solanki, Twisha Patel, Dr. Dipeksha Macwan and Dr. Hiteshkumar Patel
Shri Alpesh N. Patel Post Graduate Institute of Science and Research,
Anand-388001, Gujrat-India.
E-mail: dipeksha77@gmail.com, hvphitesh@gmail.com

Abstract

Phycocyanin derived from the edible microalga *Spirulina platensis* is a pigment–protein complex known for its potent anti-inflammatory, immunomodulatory, antimicrobial, and antioxidant properties. C-phycocyanin has emerged as a promising bioactive molecule for wound healing applications, making it a potential candidate for hydrogel-based biomaterial systems. The present study focuses on the extraction, purification, characterization, and formulation of a phycocyanin–chitosan hydrogel, followed by comprehensive biological evaluation. Phycocyanin was extracted from *Spirulina* biomass using a sonication method, followed by precipitation and purification processes. Purity and structural characterization were confirmed through spectroscopic and FTIR analysis. Antioxidant activity was assessed using the DPPH radical scavenging assay, while thrombolytic potential was evaluated through an in vitro clot lysis assay. Antiglycation activity was determined using collagen protein as a model system. A yeast model was employed to examine cellular uptake and bioavailability. Polymer compatibility and stability were analysed by studying binding interactions between purified phycocyanin and chitosan. The phycocyanin–chitosan system formed a homogeneous, mechanically stable hydrogel that remained stable for over 30 days across varying pH and temperature conditions. The formulation exhibited significant antioxidant activity (>80% DPPH inhibition), approximately 40% thrombolytic activity compared to streptokinase, notable antibacterial activity (3–5 cm inhibition zone), and effective prevention of collagen glycation. Yeast uptake studies confirmed efficient cellular internalization. The phycocyanin–chitosan hydrogel demonstrated excellent stability, strong antioxidant activity, notable thrombolytic efficiency, antibacterial action, and effective antiglycation potential. Its favourable bio-interaction and cellular uptake highlight its promise as a biocompatible platform for diverse biomedical applications.

Keywords: *Phycocyanin, Chitosan, Hydrogel, Antioxidant activity, Antiglycation*

BIP-28

P27 Silencing as an Anti-Atherosclerotic Intervention

Nirali Parmar, Yasha Thakkar and Vidhi Patanwadiya

Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand-388120, Gujarat, India

Abstract

Arterial lesions in cardiovascular disease typically involve smooth muscle cell proliferation and migration, along with the buildup of connective tissue matrix. The factors that drive vascular smooth muscle cell (VSMC) growth have been extensively documented. However, the impact of overexpressing certain proteins remains poorly understood. In this work, this project examines how overexpression of the P27 gene influences atherosclerosis and explores how this effect may be mitigated through gene-silencing approaches. In this project, P27 was silenced in vitro using primer and siRNA design performed with NCBI, SIDIRECT, and Primer-BLAST. Experimental evaluation of P27 knockdown included: Immunofluorescence, Flow cytometry, qPCR, and Scratch assays. These methods confirmed effective P27 silencing. Finding supported by appropriate statistical analysis.

Keywords: *Arterial lesions, Cardiovascular disease, Vascular smooth muscle cells (VSMC), Protein overexpression, P27 gene, Atherosclerosis, qPCR, Statistical analysis*

BIP-29

Past, present, and future of CRISPR genome editing technologies

Kinjal Mahida

Department of Microbiology, Institute of Science and Technology for Advanced Studies and Research, The CVM University, V.V. Nagar, 388120, Anand,

Abstract

CRISPR genome editing has revolutionized modern biology by providing a rapid, precise, and cost-effective method for modifying DNA. Adapted from a natural bacterial defence system, CRISPR uses RNA-guided nucleases such as Cas9 to target specific genetic sequences, enabling the insertion, deletion, or correction of genes within living cells. Its ease of design and high efficiency have made it a leading tool compared with earlier gene-editing technologies. CRISPR has accelerated discoveries in functional genomics, disease modelling, and drug development. In medicine, it shows strong potential for treating inherited disorders, cancers, and infectious diseases. Recent improvements, including base editing and prime editing, further enhance accuracy while minimizing unwanted mutations. However, challenges remain, particularly in safe delivery methods, off-target effects, and ethical considerations. Addressing these issues is essential for successful clinical translation. Overall, CRISPR represents a transformative platform that continues to expand the boundaries of biotechnology and offers promising directions for next-generation therapeutics.

Keywords: *CRISPR, Genome editing, Cas9 nuclease, Functional genomics, Gene therapy*

BIP-30

PCR based detection and sequence analysis of tumor associated genes in saliva for early diagnosis of Head and Neck Cancer

Iwshika Ray, Priya Patel and Nisha Daxini*

Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar-388120, Gujarat, INDIA

Email: nisha.daxini@cvmu.edu.in

Abstract

Head and neck squamous cell carcinoma (HNSCC) is the sixth most common cancer worldwide and is strongly associated with tobacco consumption. The disease is often diagnosed at advanced stages due to the invasive nature of conventional diagnostic procedures, leading to a poor prognosis. Early detection using non-invasive molecular approaches, particularly among high-risk tobacco users, is therefore essential for improving clinical outcomes. Saliva has emerged as a promising diagnostic biofluid owing to its non-invasive collection, easy accessibility, and ability to reflect tumour-associated molecular alterations in the head and neck region. The present study evaluates the feasibility of using salivary genomic DNA for early molecular detection of HNSCC using polymerase chain reaction (PCR) and next-generation sequencing (NGS). Non-invasive saliva samples were collected from three groups: tobacco users, head and neck cancer patients, and healthy controls. Genomic DNA was isolated and assessed for quality and integrity. Gene-specific PCR amplification was performed targeting AJUBA, JUN, and NFE2L2, genes involved in cell signalling, oxidative stress response, and tobacco-associated tumour progression. The amplified products were subjected to NGS for detailed sequence analysis. Bioinformatics analysis was performed by comparing the obtained sequences with reference databases to identify genetic variants associated with HNSCC. The findings indicate that salivary genomic DNA is a reliable and suitable source of genetic material for molecular analysis. This study highlights the potential of saliva-based PCR and NGS approaches as sensitive, patient-friendly, and cost-effective strategies for early detection and risk assessment of head and neck cancer, particularly in high-risk tobacco users.

Keywords: *Salivary DNA, Non-Invasive Diagnosis, Polymerase Chain Reaction (PCR), Tumour-Associated Genes, Molecular Biomarkers.*

Photocatalytic Dye Removal Using Reusable Zinc Oxide Nanoparticles

Nikhil Maheraman, Ayush Tiwari, Vrushti Patel, Astha Rohit and Hiral Soni*
Institute of Science & Technology for Advanced Studies & Research (ISTAR),
The Charutar Vidya Mandal University, Vallabh Vidyanagar-388120
Corresponding Author E-mail: hiral.soni@cvmu.edu.in

Abstract

Industrial wastewater containing synthetic dyes is a major environmental concern due to its toxicity, persistence, and harmful effects on aquatic life and human health. Zinc oxide (ZnO) nanoparticles are widely studied as effective materials for wastewater treatment because of their low cost, stability, high surface area, and strong adsorption and photocatalytic properties. This study focuses on the synthesis of ZnO nanoparticles using a simple precipitation method and their application in dye removal from aqueous solutions. ZnO nanoparticles were synthesized under controlled conditions using a zinc precursor and a suitable precipitating agent. The prepared nanoparticles were characterized to confirm their formation and evaluate their basic physicochemical properties, including particle size and structure. The results confirmed the successful synthesis of ZnO nanoparticles in the Nano scale range, making them suitable for environmental applications. The efficiency of the synthesized nanoparticles was tested for the removal of two commonly used dyes, Safranin and Congo Red, which are frequently found in textile wastewater. Batch experiments were performed to study dye removal under optimized conditions. To improve reusability and ease of separation, ZnO nanoparticles were immobilized in sodium alginate beads using calcium chloride as a cross-linking agent. The results showed significant reduction in dye concentration, indicating that ZnO nanoparticles are effective for dye adsorption and degradation. This study offers promising, eco-friendly, and cost-effective materials for dye removal and wastewater treatment applications.

Keywords: ZnO nanoparticles; Dye removal; Precipitation synthesis; Congo Red; Safranin; Sodium alginate beads

Comparative Phytochemical analysis and In vitro α - amylase activity of *Cordia dichotoma* and *Holarrhena pubescens* seed

Ayushi Patoliya, Rushil Jamod and Nisha Daxini*
Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar- 388120 Gujarat INDIA
Email: nisha.daxini@cvmu.edu.in

Abstract

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, defective insulin action, or both. The increasing prevalence of diabetes in India, along with adverse effects associated with prolonged use of synthetic antidiabetic drugs, has accelerated the search for safer and more effective plant-based therapeutic alternatives. Medicinal plants are rich sources of bioactive phytochemicals capable of regulating blood glucose levels through enzyme inhibition mechanisms. The present comparative study aimed to evaluate the in-vitro antidiabetic potential of *Cordia dichotoma* and *Holarrhena pubescens*. Plant materials were collected from agricultural regions of Panchmahal, Gujarat, India, shade-dried, powdered, and subjected to Soxhlet extraction using methanol, chloroform, and ethyl acetate. The crude extracts were qualitatively screened for major phytoconstituents. Quantitative estimation of total phenolic and flavonoid contents was performed, followed by in-vitro α -amylase inhibitory assays to assess antidiabetic activity. Both

plants exhibited the presence of important secondary metabolites along with appreciable phenolic and flavonoid contents. The extracts demonstrated notable α -amylase inhibitory activity, indicating their potential to reduce post-prandial hyperglycemia. Comparative analysis revealed variability in phytochemical composition and enzyme inhibition efficiency between the two species. The findings provide preliminary scientific evidence supporting the traditional use of *C. dichotoma* and *H. pubescens* as natural antidiabetic agents and highlight their potential as promising sources for future pharmacological investigation and antidiabetic drug development.

Keywords: *Diabetes mellitus; Holarrhena pubescens; Cordia dichotoma* , *Phytochemical screening;*

BIP-33

Phytochemical screening and antioxidant evaluation of fruit pulp of *Limonia acidissima*: An in vitro and in silico study in relation of male infertility

Sandeep Choudhary, Nakul Dilipbhai Suthar and Nisha Daxini*

Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar-388120, Gujarat, India

Email: nisha.daxini@cvmu.edu.in

Abstract

Male infertility is commonly associated with oxidative stress-induced damage to spermatozoa, which manifests as reduced motility, abnormal morphology, and DNA fragmentation. Since oxidative stress plays a central role in male reproductive dysfunction, antioxidant-based approaches have attracted considerable scientific interest. Plant-derived antioxidants are especially important due to their natural origin and long history of traditional use. *Limonia acidissima* (wood apple) is a medicinal plant widely used in traditional systems of medicine; however, its relevance to male fertility has not been adequately explored. The present study aimed to investigate the phytochemical composition of *L. acidissima* fruit pulp as a preliminary step toward understanding its potential role in managing oxidative stress-related male infertility. The fruit pulp was collected, shade-dried, and pulverized into a fine powder. The powdered material was subjected to extraction using organic solvents. Qualitative phytochemical screening was then performed using standard chemical tests. The results confirmed the presence of several bioactive phytoconstituents, including flavonoids, phenolic compounds, alkaloids, and tannins. These classes of compounds are well documented in the literature for their antioxidant properties and their ability to neutralize reactive oxygen species. Following preliminary phytochemical screening along with quantification of total phenolic and total flavonoid contents, the study will extend to assess the antioxidant activity of the extract through in vitro antioxidant assays. Additionally, in silico molecular docking studies will perform to evaluate the interaction of key phytoconstituents with selected target proteins involved in oxidative stress pathways.

Keyword: *Medicinal Plant, Male Infertility, Limonia acidissima, Phytochemical, Antioxidant*

BIP-34

Plastics and Reproductive Health: A Crisis of Fertility and Development

¹Rutavi Pankaj Sharma and ²Dhruv Ketankumar Mehta

¹Department of Zoology, V. P. and R. P. T. P. Science College, Vallabh Vidyanagar-388120, Gujarat, India

²Department of Environmental Science and Technology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar-388120, Gujarat, India

ABSTRACT

The pervasive spread of plastics poses a critical threat to human health, with micro and nanoplastics infiltrating the body through inhalation, ingestion, and dermal contact. These particles, along with leached endocrine disrupting chemicals like bisphenols and phthalates, accumulate in reproductive organs such as the ovaries and testes, breaching physiological barriers like the blood-testis and placental barriers. This results in oxidative stress, inflammation, and hormonal dysregulation, impairing spermatogenesis, ovarian reserve, and overall fertility. The urgency to address this growing crisis demands robust regulatory action, multidisciplinary research, and heightened public awareness to protect reproductive health and future generations.

BIP-35

Production and characterization of antimicrobial peptide-producing microorganisms that strongly inhibit *Staphylococcus aureus* and *Salmonella typhi*

Kachhiya Vinayak, Aniket Tharesha, and Shilpa Gupte*

Department of Microbiology, Institute of Science and Technology for Advanced Studies and Research, The CVM University, V.V. Nagar-388120, Anand, shilpa.gupte@cvmu.edu.in

ABSTRACT

Conventional antibiotics cannot effectively eradicate harmful bacteria due to the quick emergence of resistance to multiple medications. The development of novel antimicrobial strategies is a current priority worldwide. Bacteriocins are the most varied of the antimicrobial peptides produced by bacteria. They are ribosomally synthesised peptides that exhibit significant antibacterial activity. In the present study, among 24 isolates, MSV5 and MSV2 showed maximum inhibitory activity against test pathogens *S. typhi* and *S. aureus*. They found gram-positive, catalase-negative, non-spore-forming cocci. Maximum bacteriocin activity was observed with supplementation of Malt extract and glucose as nitrogen and carbon sources in the media. When bacteriocins MSV5 and MSV2 were treated with different enzymes, their activity was significantly decreased with the treatment of Proteinase K, which confirms their proteinaceous nature. Furthermore, treatment with organic solvents, MSV5 and MSV2, resulted in maximum residual activity ($100\pm 0.00\%$ and $83.33\pm 0.12\%$) against *S. aureus*. However, both bacteriocins have shown stability against various surfactants, and $100\pm 0.00\%$ residual activity was observed in the case of Tween-20 against both test organisms. In the case of UV light exposure, both bacteriocins remained stable for up to 40 min with $96\pm 0.01\%$ residual activity and then slightly declined up to 90 min. Hence, the results indicate that isolates MSV5 and MSV2 possess strong antibacterial activity, broad stability, and significant characteristics of antimicrobial agents. So, more studies can be done to explore them for controlling antibiotic-resistant pathogens.

Keywords: *Antimicrobial peptides, Bacteriocin, Staphylococcus aureus, and Salmonella typhi*

BIP-36

Spirulina-Derived Phycocyanin and Lipids as Natural Cosmetic Ingredients

Twisha Patel and Dipeksha Macwan

Shri Alpesh N. Patel Post Graduate Institute of Science and Research,
Anand-388001, Gujrat-India.

E-mail: dipeksha77@gmail.com

Abstract

The growing demand for natural and sustainable cosmetic ingredients has promoted the exploration of microalgae-derived bioactive compounds. This study investigates *Spirulina platensis* derived phycocyanin and lipids for potential cosmeceutical applications. Phycocyanin

was extracted using ultrasonication in phosphate buffer saline and calcium chloride separately, and its concentration, yield, and purity were determined spectrophotometrically. The oil content from spirulina was extracted using Folch and Soxhlet methods, and extraction efficiency was evaluated based on yield and purity. *in vitro* experiments were used to evaluate the biological properties of both extracts. Ferric Reducing Antioxidant Power (FRAP), metal chelation, and DPPH radical scavenging assays were used to measure antioxidant activity. Oil and phycocyanin both exhibited powerful antioxidant properties. The agar diffusion method was used to assess antibacterial activity against *Staphylococcus aureus*, and the results showed substantial inhibition. The anti-hyaluronidase assay was carried out to evaluate the anti-aging potential, and both extracts displayed notable enzyme inhibition. Thus, Phycocyanin and oil obtained from spirulina are effective bioactive substances due to their antioxidant, antibacterial, and anti-aging qualities. These results led to the proposal of prototype cosmetic formulations using the extracted substances as natural active ingredients, such as face gel and serum. This study emphasizes spirulina's potential as a valuable and sustainable source for the development of natural cosmetics having useful skin-protective properties.

Keywords: *Phycocyanin, Spirulina oil, biological potential, Natural cosmetics, Cosmeceuticals*

BIP-37

Strain Improvement of *Saccharomyces cerevisiae* for better Bioethanol production using Saccharified lignocellulosic Hydrolysate

Dipika Borsa, Jalpa Purabiya, Nidhi Solanki and Snehal Ingale*

Department of Microbiology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), Vallabh Vidyanagar-388120, Anand, Gujarat. Email – snehal.ingale@cvmu.edu.in

Abstract

Saccharomyces cerevisiae is widely used for bioethanol production due to its high fermentation efficiency and tolerance to ethanol. In the present study, both parent and mutant strains of *Saccharomyces cerevisiae* were used for bioethanol production from lignocellulosic waste. This study focused on improving ethanol production from *Saccharomyces cerevisiae* for enhancing bioethanol production by the Physical method of UV mutagenesis. Yeast culture was exposed to UV light for 10 minutes to produce improved mutant strains. Positive mutated strains were mainly generated by the treatment of UV. The mutant no.16 was found to be 15-25% higher bioethanol than the parent strain under similar fermentation conditions. For lignocellulosic substrate, the invasive weed *Parthenium hysterophorus* was selected as a waste biomass source. The plant material was powdered to 0.1 mm particle size and subjected to chemical pretreatment using 0.1 N citric acid and 0.1 N sulfuric acid (H₂SO₄) to enhance delignification and improve saccharification efficiency. Saccharified hydrolysate with or without containing the components (sucrose 10%, K₂HPO₄ 0.5%, MgSO₄ 0.2%, yeast extract 0.3%) the production of bioethanol was carried out using parent and mutant of *Saccharomyces cerevisiae*. The produced Ethanol concentration was measured using the Solvent extraction method and dichromate oxidation method. Ethanol production increased up to 22.56% when citric acid treated particles were used along with Mutant No. 16. The fermentation process was carried out using saccharified hydrolysate for 72 hours at pH 3.2, which supported maximum ethanol production. UV-induced strain improvement in *Saccharomyces cerevisiae*, combined with effective pretreatment of lignocellulosic biomass, can significantly enhance bioethanol production. Bioethanol is a renewable, eco-friendly, and economically feasible fuel, and such approaches support circular economy strategies by utilizing agricultural and weed biomass waste for sustainable energy generation.

Keywords: *Bioethanol, Saccharomyces cerevisiae, UV irradiation mutation, Saccharification, Parthenium hysterophorus*

Understanding Silver nanoparticles toxicity through In Vitro approaches

Harsh Santoki, Krishna Goswami, Janki Ravalji and Hiral soni*

Institute of Science and Technology for Advanced Studies and Research (ISTAR), The Charutar Vidya Mandal University (CVM)

Abstract

Nanotechnology focuses on materials at the nanoscale (1–100 nm), where changes in size lead to remarkable improvements in physical, chemical, and biological properties. Among various nanomaterials, silver nanoparticles (AgNPs) have attracted widespread attention because of their strong antimicrobial activity and their growing use in medical products, food packaging, textiles, and environmental applications. As the use of AgNPs increases, it becomes important to understand how different synthesis methods influence their properties and biological effectiveness. In this study, silver nanoparticles were synthesized using two approaches: a green synthesis method using *Ocimum tenuiflorum* (Tulsi) leaf extract and a conventional chemical synthesis method using tri-sodium citrate. The formation of silver nanoparticles was initially confirmed by a visible color change in the reaction mixture from pale yellow to dark brown. The synthesized nanoparticles were further characterized using X-ray diffraction (XRD) to confirm their crystalline structure, scanning electron microscopy (SEM) to observe surface morphology. The antimicrobial activity of the synthesized AgNPs was evaluated against *Escherichia coli*, *Staphylococcus aureus*, and *Bacillus subtilis* using the agar well diffusion method. Both green- and chemically synthesized silver nanoparticles showed effective antibacterial activity, with differences in the zone of inhibition depending on concentration and synthesis route. Overall, this comparative study highlights that green synthesis offers a sustainable and biologically effective alternative to chemical synthesis for producing silver nanoparticles with promising antimicrobial potential.

Keywords: Silver nanoparticles; Green synthesis; Chemical synthesis; *Ocimum tenuiflorum*; Antimicrobial activity; XRD; SEM; DLS; Nanotechnology

Unlocking Rice Straw for a Circular Bioeconomy: RSM-CCD Optimization of Pretreatment, Sugar Release, and Lignin Valorization

Simarjit Sohal, Kumud Macwana and Nisha Daxini*

Department of Biotechnology, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand-388120, Gujarat INDIA
Corresponding Author: nisha.daxini@cvmu.edu.in

Abstract

Rice straw is an abundant agricultural residue with strong potential as a renewable feedstock for biorefinery applications. However, its recalcitrant lignocellulosic structure, particularly high lignin content, limits enzymatic digestibility and reduces fermentable sugar yield. This study presents an integrated biorefinery approach for efficient biomass valorization through optimized alkaline pretreatment, enzymatic saccharification, and lignin recovery. Pretreatment parameters including sodium hydroxide concentration, temperature, reaction time, and solid loading were optimized using Response Surface Methodology (RSM) based on a Central Composite Design (CCD). The process significantly enhanced delignification and improved cellulose accessibility. Enzymatic hydrolysis using commercial cellulase was performed for 72 h, and reducing sugar release was quantified via the DNS method to evaluate saccharification efficiency. Lignin dissolved in the black liquor was recovered by acid precipitation and further characterized using FTIR analysis. Statistical validation through ANOVA confirmed the reliability

of the predictive model and the effectiveness of the optimized conditions. The proposed strategy enables improved sugar recovery while generating lignin as a value-added co-product, supporting sustainable utilization of rice straw within a circular bioeconomy framework.

Keywords: Rice straw, Alkaline pretreatment, Response Surface Methodology (RSM), Enzymatic saccharification, Lignin recovery

BIP-40

Green Synthesis of Iron Nanoparticles Using *Microbacterium oryzae* and Their Promising Antibacterial Applications

Vaishnavi Ambhetia¹ and Anjana Ghelani*

Shree Ramkrishna Institute of Computer Education and Applied Sciences, Sarvajanik University, Surat 395001

* E-mail: anjana.ghelani@srki.ac.in

Abstract

Nanotechnology, particularly iron nanoparticles, has gained notable attention in biomedical research owing to their potent antibacterial properties. Despite this, the green synthesis of iron nanoparticles using bacterial extracts remains underexplored, especially in the context of biomedical applications. In the current study, iron nanoparticles were biosynthesized using *Microbacterium oryzae* extract and characterized by UV-Vis, FE-SEM, EDX, FTIR, and zeta potential analysis. A characteristic absorption peak of UV-Vis spectrophotometry at 240 nm confirmed nanoparticle formation, while FTIR results indicated the involvement of various functional groups with iron nanoparticles. The FE-SEM images showed particles are spherical in shape with average size of 41.24 nm and EDX verified the presence of elemental iron. Zeta potential value of 17.2 mV confirms its moderate colloidal stability. Nanoparticle synthesis was enhanced using Plackett–Burman Design (PBD) to identify significant factors, followed by Central Composite Design (CCD) to optimize key variables. Statistical analysis confirmed a significant improvement in yield and synthesis efficiency under optimized conditions. The synthesized iron nanoparticles had antibacterial activity against pathogenic bacteria by well diffusion method. Synthesized iron nanoparticles exhibited significant antibacterial activity against pathogenic bacteria, demonstrating their potential for biomedical applications.

Keywords: Nanotechnology; iron nanoparticles; green synthesis; antibacterial activity; *Microbacterium oryzae*

BIP-41

Reduction of Chemical Oxygen Demand of Effluent generated from production of pigment Suthol Red

Chavda Pratiksinh

Assistant Professor, College of Renewable Energy and Environmental Engineering, Sardar krushinagar Dantiwada Agricultural University, Sardar krushinagar.

Abstract

Effluents generated from pigment manufacturing industries are characterized by high chemical oxygen demand (COD), intense color, and complex chemical composition, posing significant challenges to conventional wastewater treatment systems. The present study investigates an effective and economical treatment strategy for the reduction of COD in effluent generated from the production of Pigment Red 49:1 (Suthol Red). Untreated effluent samples collected from a pigment industry exhibited an initial COD of approximately 3200 mg/L, pH of 6.68, and a dark red coloration, far exceeding the permissible discharge limits prescribed by the Central Pollution Control Board (CPCB). A laboratory-scale experimental study was conducted using a factorial

completely randomized design (FCRD) with two influencing factors, namely acid concentration and aeration. Effluent samples of 100 mL volume were treated with varying concentrations of hydrochloric acid, followed by filtration through sand and activated carbon, and subsequent aeration. The experiments were carried out in duplicate to ensure reproducibility. Statistical analyses, including analysis of variance (ANOVA) and Least Significant Difference (LSD) tests, were applied to evaluate the significance of treatment parameters on COD and pH reduction. The results demonstrated that treatment with 1% (v/v) hydrochloric acid, followed by sand and activated carbon filtration and 30 minutes of aeration, was most effective. This treatment combination successfully reduced COD levels to below 250 mg/L, meeting CPCB discharge standards, while maintaining acceptable pH values. The study highlights the importance of chemical conditioning coupled with physical filtration and aeration for effective treatment of pigment industry effluents. The proposed treatment approach is simple, cost-effective, and suitable for implementation as a pre-treatment or standalone treatment option in small- to medium-scale pigment manufacturing units.

BIP-42

Functional Bio-nanocoatings via MATH-guided Oil Selection

Divyesh Patel* and Anamika Jha*

Department of Biological Sciences, P. D. Patel Institute of Applied Sciences, Charotar University of Science and Technology (CHARUSAT), CHARUSAT Campus, Changa – 388 421, Gujarat, India.

*Corresponding author

E-mail: divyesh2794@gmail.com, anamikajha.bt@charusat.ac.in

Abstract

Post-harvest deterioration in climacteric fruits like sapota mainly results from rapid physiological decline and microbial decay due to their highly perishable nature. The current research focused on assessing the effectiveness of certain edible oils as natural coating agents to prolong the shelf life of sapota fruits and to enhance antimicrobial effectiveness through the formulation of nanoemulsions. Three different edible oils, such as sunflower oil, olive oil and rice bran oil, were applied as surface coatings on freshly harvested sapota fruits. Coated fruits were periodically analyzed for key physico-chemical parameters, including weight loss, titratable acidity, and ascorbic acid content, to determine the most suitable oil for preservation. In addition, the microbial adhesion to hydrocarbon (MATH) assay was performed to assess the affinity between microbial cells and the tested edible oils, providing insight into their potential role in inhibiting microbial attachment and colonization on fruit surfaces. Based on physico-chemical stability and reduced microbial affinity (Hydrophobicity 41.42%), the most promising edible oil (Rice bran oil) was selected for the preparation of a nanoemulsion using appropriate emulsification techniques. The developed nanoemulsion was subsequently evaluated for its anti-yeast and anti-fungal activities against visible fungi on the surface of the fruits. Overall, the results revealed that edible oil-based nanoemulsion form offers a safe, biodegradable, eco-friendly and effective strategy for extending the shelf life of sapota fruits while minimizing post-harvest microbial spoilage. This approach presents a sustainable alternative to synthetic chemical preservatives and holds significant potential for application in fruit preservation and post-harvest management.

Keywords: *Sapota, edible oils, nanoemulsion, anti-microbial, shelf-life extension*

BIP-43

Food Under The Microscope: The Problem Of Microplastics

Shreya Kalpit Padhiar¹, Aastha Jayeshbhai Shah², Vaidehi Nimeshbhai Trivedi³

¹UG Scholar Department of Food technology, Natubhai V.Patel College of Pure and Applied Science, The Charutar Vidya Mandal University, V V Nagar, Anand

²UG Scholar Department of Food technology, Natubhai V.Patel College of Pure and Applied Science, Natubhai V.Patel College of Pure and Applied Science,
The Charutar Vidya Mandal University,V V Nagar, Anand

³UG Scholar Department of Food technology, Natubhai V.Patel College of Pure and Applied Science, Natubhai V.Patel College of Pure and Applied Science,
The Charutar Vidya Mandal University,V V Nagar, Anand

Correspondence:*shreyapadhiar@gmail.com (9574938343*),
aasthashah0612@gmail.com (9428204482),
vaidutrivedi67@gmail.com (9104963145)

Abstract

Microplastics, defined as plastic particles smaller than 5 mm, have emerged as a growing concern for food safety and public health. Widespread plastic production and inadequate waste management have led to their accumulation in air, water, and soil, facilitating their entry into the food chain. Microplastic contamination has been detected in various food products such as seafood, sea salt, drinking water, milk, honey, and other packaged foods. Major sources include polluted aquatic environments, degradation of plastic packaging materials, food processing equipment, and airborne particles during handling and storage. Beyond being physical contaminants, microplastics can act as carriers of hazardous substances including bisphenol A (BPA), phthalates, heavy metals, and persistent organic pollutants. Their ingestion may pose potential health risks such as inflammation, oxidative stress, endocrine disruption, and immune system imbalance, although the long-term effects on human health are still under investigation. Detection of microplastics in food involves advanced analytical techniques such as microscopy, Fourier Transform Infrared Spectroscopy (FTIR), and Raman spectroscopy. From a food technology perspective, the adoption of sustainable packaging materials, reduction in plastic usage, and improved waste management practices are essential. Enhanced research, regulatory measures, and consumer awareness are crucial to mitigate this emerging food safety challenge.

Keywords: *Microplastics, Food Safety, Food Chain, Fourier Transform Infrared Spectroscopy (Ftir), Sustainable Packaging*

BIP-44

Edible seaweed packaging Film

Misariben Sanjaybharathi Goswami, Unnati Piyush Patel, Siddhi Naineshkumar Prajapati, Prajapati Shrutiben Vimalbhai

¹UG Scholar Department of Food technology, Natubhai V.Patel College of Pure and Applied Science, The Charutar Vidya Mandal University,V V Nagar, Anand
Correspondence:-misarigoswami18@gmail.com,

Abstract

The increasing environmental impact of single-use plastic packaging has accelerated the search for sustainable alternatives in the food industry. Seaweed-based and algae-derived packaging materials have emerged as a promising solution due to their biodegradability, renewability, and potential edibility. These materials are primarily produced from marine biopolymers such as alginate, agar, and carrageenan, which can be processed into films, coatings, and molded forms suitable for food packaging applications. Seaweed-based packaging is completely plastic-free and decomposes naturally within a short period without generating microplastics or toxic residues. In addition, certain forms are safe for human consumption, making them ideal for single-use applications such as sauce sachets, takeaway containers, and dry food packaging. Compared to conventional plastics, seaweed cultivation requires no arable land or freshwater and contributes to carbon sequestration, thereby reducing the overall environmental footprint. This abstract highlights the production process, functional properties, applications, and

environmental benefits of seaweed-based edible packaging, with reference to innovations such as Notpla. Despite challenges related to moisture sensitivity and scalability, seaweed-based packaging represents a significant step toward sustainable and circular packaging systems in the food sector.

Keywords: *Seaweed-based edible packaging, Biodegradable food packaging, Sustainable plastic alternative*

BIP-45

Jackfruit Seeds (*Artocarpus Heterophyllus*): A Nutrient-Rich Agro-Byproduct With Health And Industrial Applications

Vanshita Valani¹, Tejashri Trivedi² and Tanisha Sargar¹

¹Student, Department of Food Technology,

Natubhai V. Patel College of Pure and Applied Sciences,

The Charutar Vidyamandal (CVM) University, Vallabh Vidyanagar-388120, Gujarat, India

² Assistant Professor, Department of Food Technology,

Natubhai V. Patel College of Pure and Applied Sciences,

The Charutar Vidyamandal (CVM) University, Vallabh Vidyanagar-388120, Gujarat, India

Email of correspondence: tejashri@nvpas.edu.in

Abstract

Jackfruit (*Artocarpus heterophyllus*) seeds, is agro-waste which represent a nutrient-dense and underutilized by-product with significant potential for health, food, and industrial applications. Jackfruit seeds are rich in carbohydrates, dietary fiber, plant-based proteins, and essential minerals such as potassium, calcium, iron, and magnesium. They also contain bioactive compounds including phenolics, flavonoids, and resistant starch, which contribute to antioxidant, anti-inflammatory, and glycemic-regulating properties. Traditionally consumed in roasted or boiled forms in certain regions, jackfruit seeds are now gaining attention as a sustainable ingredient for value addition. Nutritionally, jackfruit seed flour has shown promise in improving digestive health, supporting glycemic control, and enhancing satiety, making it suitable for incorporation into functional and gluten-free food products. The starch extracted from jackfruit seeds exhibits desirable properties such as good water-binding capacity, gel formation, and thermal stability, enabling its application in food thickening, biodegradable films, and pharmaceutical formulations. Furthermore, emerging studies highlight the antimicrobial and prebiotic potential of seed extracts, broadening their relevance in health-oriented products. The utilization of jackfruit seeds aligns with circular economy principles by reducing post-harvest waste and promoting sustainable food systems. Despite their potential, large-scale exploitation is limited by lack of processing standardization, consumer awareness, and regulatory frameworks. This review underscores the nutritional, functional, and industrial significance of jackfruit seeds and emphasizes the need for further research and innovation to transform this agro-byproduct into a valuable resource for sustainable development.

Key words: *Jackfruit seeds, agro-waste, by-product*

BIP-46

Camel Milk As A Functional Nutraceutical: Scientific Evidence And Medical Benefits

Jay Rajgor¹, Tejashri Trivedi² and Nikunj Parmar¹

¹Student¹, Assistant Professor², Department of Food Technology,

Natubhai V. Patel College of Pure and Applied Sciences,

The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar-388120, Gujarat, India

Email of correspondence: tejashri@nvpas.edu.in

Abstract

Camel milk has gained increasing scientific attention as a functional nutraceutical owing to its unique nutritional composition and diverse therapeutic properties. It differs significantly from bovine milk in terms of protein profile, fat composition, vitamin content, and bioactive compounds. It is rich in immunoglobulins, lactoferrin, lysozyme, insulin-like proteins, vitamins C and E, and essential minerals such as zinc and magnesium, which collectively contribute to its health-promoting effects. Scientific evidence indicates that camel milk exhibits antidiabetic properties due to the presence of insulin-like peptides that remain stable during digestion, improving glycemic control. Its hypoallergenic nature, characterized by the absence of β -lactoglobulin and lower levels of β -casein, makes it suitable for individuals with cow milk protein allergy and lactose intolerance. It also demonstrates antimicrobial, antiviral, and anti-inflammatory activities, supporting its role in immune modulation and gut health. Emerging studies also highlight its potential benefits in managing gastrointestinal disorders, autism spectrum disorders, and oxidative stress-related diseases. The presence of antioxidant enzymes and bioactive peptides contributes to its protective effects against cellular damage and chronic inflammation. It has shown potential in cardiovascular health by improving lipid profiles and reducing oxidative stress. It represents a valuable natural nutraceutical with scientifically supported medical benefits. Its incorporation into functional food systems and therapeutic diets offers significant potential for improving human health, particularly in vulnerable populations.

Keywords: Camel milk, Nutraceutical properties, Functional food

BIP-47

Isolation, Identification And Detection Of Antibiotic Resistance Genes Using Polymerase Chain Reaction In *Staphylococcus Aureus*

Ravi Gavdha¹, A. C. Patel² and Nisha Daxini^{1*}

¹Institute of Science and Technology Advanced Studies and Research-ISTAR, The CVM University

² Department of Microbiology, Kamdhenu University

Abstract

Staphylococcus aureus is an important opportunistic pathogen affecting both humans and animals, responsible for a wide range of infections such as skin and soft tissue infections, pneumonia, bloodstream infections, and infective endocarditis. In recent decades, the emergence and rapid spread of antimicrobial-resistant *S. aureus* strains have become a major global health concern. Among these, methicillin-resistant *S. aureus* (MRSA) is particularly problematic due to its resistance to multiple classes of antibiotics and its presence in both hospital-acquired and community-associated infections. Antimicrobial resistance in *S. aureus* arises through diverse mechanisms, including β -lactamase production, modification of antibiotic target sites, reduced affinity of penicillin-binding proteins, active efflux systems, and biofilm formation, which collectively reduce treatment efficacy and enhance bacterial persistence. The present study aimed to isolate and identify *S. aureus* from veterinary clinical samples and to detect selected antimicrobial resistance genes using polymerase chain reaction (PCR). A total of 40 samples, comprising mastitis milk from cattle (n = 20) and skin samples from dogs (n = 20), were collected from Anand, Gujarat. Nineteen isolates (47.5%) were confirmed as *S. aureus* using cultural, biochemical, and molecular methods. Antibiotic susceptibility testing revealed complete resistance to penicillin (100%), while gentamicin and amikacin showed 100% sensitivity. Molecular analysis detected the *tetB* gene in 10.52% of isolates, whereas *mecA* and *blaTEM* genes were not observed. These findings highlight the presence of antibiotic-resistant *S. aureus* in veterinary.

PREPARATION OF SURFACE CLEANER FROM BIOBASED MATERIAL

Akshit C. Devani^a, Ansh A. Hirpara^a, Khodidas K. Bhanderi^{a*}

^{a*}Department of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120, Gujarat, India

Abstract

Traditional surface cleaner often contain synthetic chemicals that leads to environmental pollution, water contamination and health hazards. Biodegradable surface cleaner are formulated using natural renewable & non-toxic ingredients that safely decompose into environmentally harmless substances. This project reports the formulation of Eco-friendly surfactant cleaner using Bio Waste components such as Lemon Peel Extract, Aloe Vera Gel, Soapberry Surfactant, and Eggshell. These ingredients provide efficient removal of dirt, grease, stains, and microbial contaminants from various surfaces while ensuring user safety and surface compatibility, which enhance cleaning efficiency. The formulation exhibits effective degreasing, antimicrobial activity, and surface cleaning performance due to natural acids.

Biodiesel and Bioplastic Production from Waste-Cooking-Oil: An Environmentally Friendly Approach

Kavan R. Andodariya^a, Denish R. Pipalava^b

Department of Industrial chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University Vallabh Vidyanagar, Anand, Gujarat—388120

Abstract

The rapid depletion of fossil resources and the environmental impacts of conventional plastics have accelerated the search for sustainable and biodegradable alternatives. In this study, bioplastic was synthesized using glycerol obtained as a by-product of base-catalyzed transesterification of one-time-used waste cooking oil (WCO) with methanol and sodium hydroxide as the catalyst. Prior to biodiesel production, the quality of WCO was evaluated by determining its acid value, iodine value, saponification value, and peroxide value to assess the free fatty acid content, degree of unsaturation, average molecular weight of fatty acids, and oxidative stability, respectively. Biodiesel and glycerol were produced through the reaction of WCO with methanol in the presence of sodium hydroxide as a catalyst. The reaction mixture was allowed to separate into two phases, with glycerol settling at the bottom and biodiesel forming the upper layer. The resulting glycerol was purified using a simple and economical method. The purified glycerol was then utilized to synthesize a useful biopolymer. This study demonstrates an integrated and sustainable approach for valorizing waste cooking oil by converting it into biodiesel and biodegradable plastic, thereby supporting waste minimization and the development of renewable materials.

Bioadsorbent derived from Manilkara Zapota leaves for the removal of heavy metals from the Water

Vivekkumar R. Rana^a, Vidhi H. Patel^{*}

Department of Industrial chemistry , Institute of Science & Technology for Advanced Studies & Reserch (ISTAR), The Charutar Vidya Mandal (CVM) University Vallabh Vidyanagar, Anand, Gujarat—388120
Email: ranavivek623@gmail.com

Abstract

The removal of toxic heavy metals from wastewater is a significant environmental challenge, prompting the development of low-cost and eco-friendly adsorbents. In the present study, a chemically modified adsorbent was prepared from Manilkara zapota (sapodilla) leaves and evaluated for the batch adsorption of lead (Pb^{2+}) and cadmium (Cd^{2+}) ions from aqueous solutions. The leaves were thoroughly washed, shade-dried, and ground into a fine powder. Chitosan was dissolved in acetic acid to form a homogeneous solution, into which the leaf powder was added and stirred at 600 rpm for 6 hours. After filtration, 10 g of Manilkara zapota leaf powder was added to the filtrate, followed by the dropwise addition of sodium hydroxide until a basic pH of 10–12 was achieved. Glutaraldehyde was used as a cross-linking agent to enhance the stability and surface functionality of the adsorbent. Batch adsorption experiments were carried out using aqueous solutions of lead and cadmium under controlled pH and contact time conditions. After adsorption, the mixtures were filtered to separate the adsorbent, and the residual concentrations of Pb^{2+} and Cd^{2+} ions were quantitatively determined using Inductively Coupled Plasma–Mass Spectrometry (ICP-MS). The results indicate that the modified Manilkara zapota leaf-based adsorbent is an effective, biodegradable, and economical material for the removal of lead and cadmium from contaminated water, demonstrating its potential application in wastewater treatment and environmental remediation.

CHP-51

Cyclodextrin Inclusion Complex to Enhance Solubility of Poorly Water - Soluble Miconazole Nitrate Drug

Alpesh G. Bhadarka¹, Rohit L. Vekariya² Rohit H. Dave*

¹Dept. of Industrial Chemistry, Institute of Science & Technology for Advanced Studies and Research, The Charutar Vidya Mandal (CVM) University, Anand, Gujarat-388120.

²Dept. Organic Chemistry, Institute of Science & Technology for Advanced Studies and Research, The Charutar Vidya Mandal (CVM) University, Anand, Gujarat - 388120.

*Author of correspondence: Email: daverohit23@yahoo.com

ABSTRACT

Miconazole nitrate was introduced in 1970 for antifungal medications. Miconazole nitrate is second class Biopharmaceutics classification drug, which shows low solubility & high permeability. Improvement of aqueous solubility in such a case is a valuable goal to improve Bioavailability & Absorption. To achieve solubility we used Cyclodextrins to form the solid inclusion complex with Miconazole Nitrate. We have performed Co-Evaporation & Melting process respectively to prepare the complexes on the basis of UV analysis the result of Co-evaporation method is more favourable compare to melting process, and also the result of UV analysis shows that solubility of Hydroxypropyl B cyclodextrin (HP - CD) complex is more as compare to B-Cyclodextrin(B-CD) complex. The result of antibacterial analysis of different fungal as well as bacterial species shows favourable and satisfying outcomes on the both % reduction values and MIC (79.123% and 4 μ g/ml) and on that basis we conclude that our complex showing more effective inhibitory action against the strains compare to commercial MNZ.

Keywords: Miconazole Nitrate, Solubility, Cyclodextrins, Inclusion complex, Antibacterial Activity

BIOSTIMULANTS FROM LEAFY BIOMASS AND VEGETABLE SCRAP

Jaykumar Rajeshbhai Patel^a, Kishor Puri^a, Mandar Karve^{a*}

^{a*}Department of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120, Gujarat, India

Abstract

Biostimulants derived from leafy biomass provide a sustainable alternative to chemical fertilizers in modern agriculture. Leafy materials such as moringa and spinach materials along with vegetables residues like peels and discarded biomass are rich in bioactive compounds including amino acids, organic acids, vitamins and natural growth regulators. In this study, Biostimulants were prepared using simple processing methods such as fermentation and aqueous extraction to enhance nutrient availability, The resulting formulation promote seed germination, root growth, nutrient uptake and overall plant vigor while it improve soil microbial activity.

Potassium Supported Solid Base Catalyst from Rice Husk Silica for Green Synthesis

Krishkumar D. Patel ^a Ashishkumar Ajitsinh Parmar ^a, Khodidas K. Bhanderi^{a*}

^{a*}Department of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120, Gujarat, India

Abstract

Rice husk silica (RHS) was prepared from rice husk, an abundant agricultural waste, as a sustainable and low-cost silica source. The rice husk was initially washed, dried, and subjected to controlled thermal treatment to remove organic components, followed by calcination at high temperature (700 °C) to obtain rice husk ash rich in amorphous silica. To enhance the purity of silica, acid leaching pretreatment using dilute mineral acids was employed prior to calcination, effectively removing metallic impurities. The obtained RHS exhibited high surface area, porous structure, and strong thermal stability, making it suitable as a catalyst support. Further modification of RHS was carried out by impregnation with alkali metals such as potassium and sodium to generate solid base and solid acid catalysts. Base-loaded RHS materials were calcined to ensure proper dispersion and activation of active sites. Physicochemical characterization confirmed successful formation of silica and effective incorporation of catalytic species on the RHS surface. The modified RHS demonstrated tenable basic properties depending on the impregnated species, highlighting its versatility for catalytic applications. This study demonstrates that rice husk-derived silica is an environmentally friendly and efficient support material for developing heterogeneous catalysts in green chemical processes.

Biosorbent Derived from Coconut Shells for the Removal of Metal Ions from Aqueous Solutions

Krutarthkumar G. Kunbi^a, Dhavalsinh P. Puvar^b

Department of Industrial chemistry, Institute of Science & Technology for Advanced Studies & Reserch (ISTAR), The Charutar Vidya Mandal (CVM) University Vallabh Vidyanagar, Anand, Gujarat—388120

Abstract

The increasing contamination of water resources by heavy metals poses a serious threat to environmental and human health. In this study, an eco-friendly and low-cost adsorbent was prepared from coconut shell biomass and evaluated for its efficiency in removing selected heavy metal ions from aqueous solutions. The coconut shells were thoroughly cleaned, dried, carbonized, and processed to obtain an adsorbent suitable for adsorption studies. Batch adsorption experiments were carried out using aqueous solutions of zinc (Zn), copper (Cu), lead (Pb), and cadmium (Cd) salts. A specific dose of the prepared adsorbent was added to individual metal ion solutions and stirred continuously to ensure proper contact between the adsorbent and the adsorbate. After achieving adsorption equilibrium, the solutions were filtered, and the residual concentrations of metal ions were determined using titrimetric analysis. The adsorption performance was evaluated based on the reduction in metal ion concentrations. The results demonstrated that the coconut shell derived adsorbent exhibited a strong affinity for the studied metal ions, with effective removal observed for Zn, Cu, Pb, and Cd. The study confirms that coconut shell biomass can be successfully converted into an efficient adsorbent for heavy metal removal. Owing to its low cost, natural abundance, and environmentally benign nature, the prepared adsorbent shows promising potential for application in wastewater treatment and sustainable environmental remediation.

CHP-55

Synthesis of Cyclopropyl Methyl Ketone as an Important Pharmaceutical Intermediate

Naimish P. Vani ^a, Nirman N. Patel, Dr. Rohit H. Dave*

Department of Industrial chemistry, Institute of Science & Technology for Advanced Studies & Reserch (ISTAR), The Charutar Vidya Mandal (CVM) University Vallabh Vidyanagar, Anand, Gujarat—388120

Email: naimishvani23123@gmail.com

Abstract

Cyclopropyl methyl ketone is an important alicyclic ketone widely used as an intermediate in organic and pharmaceutical synthesis. The present work focuses on the stepwise laboratory synthesis of cyclopropyl methyl ketone starting from γ -butyrolactone as the initial raw material. In the first step, 2-acetylbutyrolactone was synthesized from γ -butyrolactone under controlled reaction conditions. This intermediate was subsequently converted into 5-chloropentan-2-one through acid-catalyzed ring opening followed by decarboxylation. In the final step, 5-chloropentan-2-one underwent base-induced intramolecular cyclization in the presence of aqueous sodium hydroxide to yield cyclopropyl methyl ketone. The reaction mixture was purified by solvent extraction and fractional distillation to obtain the desired product in good yield and purity. The synthesized cyclopropyl methyl ketone was characterized by its boiling point and physical properties, confirming successful cyclization. This study demonstrates an efficient multistep synthetic route for the preparation of strained alicyclic ketones and emphasizes the significance of reaction conditions in achieving high yield and purity.

CHP-56

Synthesis of Metformin Hydrochloride via a Condensation Reaction Using a Biocatalyst

Harnish Patel^a, Jay Dahima^a, Rohit H. Dave^{a*}

^aDepartment of Industrial Chemistry, Institute of Science and Technology for Advanced Studies and Research (ISTAR), Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120, Gujarat, India

Abstract

Metformin hydrochloride is a widely used oral antidiabetic drug and is employed as first-line therapy for type 2 diabetes mellitus. This study reports an efficient and scalable method for the

synthesis of metformin hydrochloride via a condensation reaction using a biocatalyst-assisted approach. Dimethylamine and cyanoguanidine were reacted in an aqueous medium under controlled temperature and pressure conditions to obtain metformin base, which was subsequently converted to its hydrochloride salt using hydrochloric acid. Optimisation of the reaction parameters resulted in high product yield and purity. The biocatalyst-assisted process offers advantages such as improved reaction efficiency, reduced side reactions, and enhanced environmental compatibility. This method demonstrates a cost-effective and sustainable approach suitable for the industrial-scale production of metformin hydrochloride.

CHP-57

A Comparative Review between Bio-based Plasticizers and Traditional Plasticizers

Ajit Solanki¹, Darshil Gohel¹, Mandar Karve*

¹*Department of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University Vallabh Vidyanagar, Anand, Gujarat—388120

ABSTRACT

In the past decades renewable sources are trend in market because it has lower hazard toward human and environment instead of fossil fuel based product. Therefore several value added product are produced from renewable sources. . The renewable sources include air, sunlight, water, bio mass. The Conventional plasticizers are predominantly derived from petroleum resources and, despite their widespread use, are associated with issues such as toxicity, migration into the environment, poor biodegradability, and increasing regulatory restrictions. This review summarizes recent developments in plasticizers with a special emphasis on bio-based plasticizers derived from renewable oils and waste cooking oil. Renewable oils such as soybean, castor, and sunflower oils, as well as waste cooking oil, are attractive raw materials due to their availability, low cost, and reduced environmental impact. Chemical modification routes including transesterification and epoxidation are discussed as effective methods for converting these oils into functional bio-based plasticizers. The review compares the physicochemical, thermal, mechanical, and migration properties of bio-based plasticizers with those of conventional plasticizers. The applications of bio-based plasticizers in PVC, PU, PLA products, biodegradable polymers, coatings, packaging materials, and medical and consumer goods are highlighted. The utilization of waste cooking oil not only addresses waste management and environmental pollution but also supports resource efficiency and circular economy concepts. Overall, this review emphasizes the potential of bio based plasticizers from renewable sources as sustainable, safe, and high-performance alternatives to conventional plasticizers for future industrial applications.

Keyword: *Bio based Plasticizer, phthalate based plasticizer, Renewable oil, Biodegradability*

CHP-58

Bioplastic Made From Seaweed Polysaccharides

Rasmika Vijaybhai Chaudhari^a, Dhvani Virendrabhai Rajput^a

^aDepartment of Industrial Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120, Gujarat, India

E- mail: chaudharirasmika3@gmail.com, dhvani3074@gmail.com

Abstract

We focus on the development of bioplastic films from seaweedderived polysaccharides using an environmentally conscious production process. The seaweed is processed via aqueous extraction without harmful solvents. Green additives Like glycerol (plasticizer) and citric acid

(naturalcrosslinker) are incorporated to improve material properties. The resulting bioplastic film exhibits flexibility, biodegradability, and packaging good mechanical integrity, suitable for single-use items or packaging.

Keywords: *Bioplastic Polysaccharides Glycerol Biodegradability*

CHP-59

Sodium ion-battery: Electrochemical Performance and Commercial Viability of Sodium-Ion Energy Storage

Rutik Baraiya^a, Rohit H. Dave*

^{1,*}Department of Industrial chemistry, Institute of Science & Technology for Advanced Studies & Reserch (ISTAR), The Charutar Vidya Mandal (CVM) University Vallabh Vidyanagar, Anand, Gujarat—388120

Email: baraiyarutik2004@gmail.com

ABSTRACT

As global demand for electrochemical energy storage scales toward the terawatt-hour level, the lithium-ion battery (LIB) supply chain faces unprecedented pressure from rising raw material costs and localized mineral scarcity. Sodium-ion batteries (SIBs) have emerged as a disruptive alternative, leveraging the geo-abundance and low cost of sodium precursors. We analyze the performance of next-generation layered oxide and Prussian Blue Analogue (PBA) cathodes paired with optimized hard carbon anodes. Current data indicates that SIBs have reached gravimetric energy densities of 160–175 Wh/kg, effectively bridging the gap with Lithium Iron Phosphate chemistries. Further more, SIBs exhibit superior rate capability and low-temperature performance, maintaining over 90% capacity at -20°C, and offer enhanced safety profiles through 0V transport capability.

KEYWORDS: *Sodium-ion battery, Global, Energy, Lithium battery*

CHP-60

Preparation and Characterization of LDPE/HDPE Polymeric Blends by Injection Molding

Mohmad Husain Diwan, Sandip Parmar, Akhil Vaishnav, Kunj Vachhani, Ronak Gareja, Kaushal J. Bavaliya*

Department of Polymer Chemistry- Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University Vallabh Vidyanagar – 388120, Gujarat, India.

Corresponding Author email ID: kaushal.bavaliya@cvmu.edu.in

Abstract

Polymeric blending is an effective approach to tailor material properties by combining polymers with complementary characteristics. In the present study, blends of low-density polyethylene (LDPE) and high-density polyethylene (HDPE) were prepared using an automatic injection molding machine to evaluate their processability, mechanical, thermal, and rheological behavior. LDPE provides flexibility and toughness, while HDPE contributes stiffness and strength; blending these polymers aims to achieve a balanced performance suitable for engineering and packaging applications. LDPE/HDPE blends with varying compositions were melt-processed under controlled injection molding conditions to obtain standard test specimens. The melt flow behavior of the blends was analyzed using Melt Flow Index (MFI) measurements to assess their processability and flow characteristics during molding. Mechanical properties were evaluated through tensile testing using a Universal Testing Machine (UTM) to determine tensile strength, elongation at break, and modulus. Impact resistance was studied using the Izod impact test, while surface hardness was measured by Rockwell hardness testing. Thermal performance of the blends was investigated by determining Heat Deflection Temperature (HDT) and Vicat

Softening Point (VSP), which are critical parameters for assessing service temperature and dimensional stability under load. The results demonstrated that blending LDPE with HDPE significantly influences flow behavior, mechanical strength, toughness, and thermal resistance. An increase in HDPE content improved tensile strength, hardness, HDT, and VSP, whereas higher LDPE content enhanced flexibility and impact resistance. Overall, the study confirms that LDPE/HDPE blends processed via automatic injection molding exhibit tunable properties depending on composition, making them promising candidates for applications requiring a balance of stiffness, toughness, and thermal stability.

Keywords: *Polymer blending, LDPE/HDPE blends, Injection molding, Mechanical and thermal properties, Rheological behavior*

CHP-61

Tuning Epoxy Processability and Properties Using Reactive Diluents

Mohammad Kaif, Dirgh Prajapati, Shubham Kothiya, Harshil Donga, Nisarg Parmar, Amit Thummar*

Department of Polymer Chemistry- Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University Vallabh Vidyanagar – 388120, Gujarat, India.

Email ID: amitkumar.thummar@cvmu.edu.in

Abstract

Reactive diluents are commonly incorporated into epoxy resin systems to modify viscosity, enhance processability, and tailor mechanical performance. In this study, epoxy formulations containing varying concentrations of a reactive diluent were prepared to systematically evaluate their rheological, mechanical, and thermal properties. The primary objective of incorporating reactive diluents is to reduce the inherently high viscosity of epoxy resins, thereby improving handling, mixing, impregnation, and application characteristics without introducing volatile organic components. Epoxy-reactive diluent blends were formulated through thorough mixing to ensure homogeneous dispersion and effective participation of the diluent in the curing reaction. The systems were subsequently cured with a suitable curing agent under controlled conditions to produce specimens for characterization. Viscosity measurements were conducted to assess flow behavior and processing efficiency. Mechanical properties were determined using a Universal Testing Machine (UTM) to measure tensile strength, tensile modulus, and elongation at break. Impact resistance was evaluated using standard impact testing methods, while surface hardness was measured using Shore or Barcol hardness tests. Thermal performance was analyzed through Heat Deflection Temperature (HDT) and glass transition temperature (T_g) measurements to assess thermal stability and service temperature capability. Results showed that increasing reactive diluent content significantly reduced resin viscosity, enhancing flow and processing characteristics. However, excessive diluent levels decreased tensile strength, modulus, hardness, HDT, and T_g due to reduced crosslink density. Moderate diluent content improved elongation and impact strength, indicating enhanced toughness. Thus, controlled reactive diluent incorporation enables optimization of epoxy system performance.

Keywords: *Reactive Diluent, Epoxy Resin System, Viscosity Reduction, Mechanical Properties, Crosslink Density, Thermal Stability*

CHP-62

Cardanol Based Fiber Reinforced Composites

Rudresh Trivedi^a, Mahendrasinh Raj*

Department of Polymer Chemistry- Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University Vallabh Vidyanagar – 388120, Gujarat, India.

Email ID: Mahendrasinh.raj@cvmu.edu.in

Abstract

This study investigates fiber reinforced composites developed using a blended matrix composed of cardanol based resin and epoxy resin, cured with a range of aliphatic and cycloaliphatic hardeners. The objective was to evaluate the influence of reinforcement type and curing system on the thermal, mechanical, morphological, and chemical resistance properties of sustainable composite materials. Natural jute fiber mats, woven glass fabrics, and woven carbon fiber fabrics were employed as reinforcements to represent lightweight, moderate performance, and high performance composite systems, respectively. Thermal characterization demonstrated that composites reinforced with carbon fibers exhibited superior thermal resistance, retaining higher structural stability at elevated temperatures compared to glass and jute fiber reinforced systems. Mechanical testing revealed a clear reinforcement dependent performance trend, with carbon fiber composites showing the highest tensile strength, flexural strength, and impact resistance, followed by glass fiber and jute fiber composites. The enhanced mechanical performance of carbon fiber composites was attributed to their high stiffness and effective stress transfer at the fiber matrix interface. Morphological analysis using scanning electron microscopy confirmed strong interfacial adhesion and minimal void formation in composites cured with polyamidoamine hardener, indicating efficient crosslinking and improved fiber wetting. In contrast, composites cured with more rigid amine hardeners exhibited increased brittleness and microcrack formation. Chemical resistance studies further highlighted the superior stability of carbon fiber reinforced composites, which maintained structural integrity across a wide range of chemical environments. Overall, the results demonstrate that cardanol based epoxy composites reinforced with appropriate fibers and cured using optimized hardener systems offer a balanced combination of sustainability, mechanical performance, thermal stability, and chemical resistance. These materials show strong potential for applications in lightweight structural components, marine systems, automotive parts, and environmentally conscious engineering solutions.

Keywords: *Cardanol based epoxy resin, Fiber reinforced composites, Interfacial adhesion, Thermal and mechanical performance, Sustainable composite materials*

CHP-63

Effect of Plasticizer Content on the Properties of Polypropylene

Jaymit Parmar, MuhammadFuzail Godar, Tushar Gosai, Kiran Rathva, Rohan Baria, Himanshu Vaja, Amit Thummar*

Department of Polymer Chemistry- Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University Vallabh Vidyanagar – 388120, Gujarat, India.

Corresponding Author email ID: amitkumar.thummar@cvmu.edu.in

Abstract

Plasticization is an effective method to modify the flexibility, toughness, and processability of semi-crystalline polymers such as polypropylene (PP). In the present study, polypropylene was compounded with varying amounts of a plasticizer using a co-rotating twin-screw extruder, and the influence of plasticizer content on rheological, mechanical, and thermal properties was systematically investigated. The addition of plasticizer aims to improve ductility and impact resistance of PP, which is inherently stiff and brittle at low temperatures. PP-plasticizer blends with different plasticizer concentrations were prepared by melt compounding in a twin-screw extruder to ensure uniform dispersion and effective interaction between the polymer and plasticizer. The extrudates were subsequently injection molded into standard test specimens for characterization. Melt Flow Index (MFI) measurements were conducted to evaluate changes in melt viscosity and processability resulting from plasticizer addition. Mechanical properties were assessed using tensile testing on a Universal Testing Machine (UTM), providing tensile strength, tensile modulus, and elongation at break. Impact performance was evaluated using the Izod impact test, while surface hardness was determined by Rockwell hardness measurements.

Thermal behavior of the plasticized PP samples was examined through Heat Deflection Temperature (HDT) and Vicat Softening Point (VSP) analyses to assess dimensional stability under elevated temperatures. The results demonstrated that increasing plasticizer content led to an increase in MFI, indicating enhanced melt flow and reduced viscosity. Tensile modulus, hardness, HDT, and VSP decreased with plasticizer addition due to reduced intermolecular interactions and crystallinity. Conversely, elongation at break and impact strength improved significantly, confirming enhanced flexibility and toughness. Overall, the study demonstrates that controlled plasticizer incorporation effectively tailors the processing and performance characteristics of polypropylene, making it suitable for applications requiring improved flexibility and toughness.

Keywords: Polypropylene, Plasticizer, Twin-screw extrusion, Mechanical and thermal properties, Plasticization effect

CHP-64

Sustainable Polyethylene Chitosan Blends

Rushik Patel^a, Mahendrasinh Raj*

Department of Polymer Chemistry- Institute of Science & Technology for Advanced Studies & Research (ISTAR), CVM University Vallabh Vidyanagar – 388120, Gujarat, India.

Email ID: Mahendrasinh.raj@cvmu.edu.in

Abstract

Sustainable materials research increasingly emphasizes polymer blends incorporating biodegradable components to reduce environmental impact while retaining functional performance. In this study, high density polyethylene blends containing modified chitosan were developed to evaluate their morphological, mechanical, thermal, chemical, and biodegradation behavior. The blends were compatibilized using high density polyethylene grafted maleic anhydride, while chitosan was chemically modified through grafting with methacrylamide and tert butyl acrylate. The resulting chitosan grafted copolymers were processed with high density polyethylene through melt extrusion to improve interfacial compatibility. Mechanical characterization revealed a reduction in tensile strength for all modified chitosan blends compared to neat high density polyethylene, indicating decreased ductility. However, flexural strength showed a notable improvement, suggesting enhanced stiffness and load bearing capability in the compatibilized systems. Impact strength decreased, reflecting restricted chain mobility due to stronger interfacial interactions between the polymer phases. Thermogravimetric analysis demonstrated improved thermal stability in compatibilized blends, particularly at higher compatibilizer content, with increased char residue at elevated temperatures. Biodegradation studies conducted under soil burial conditions showed significantly higher weight loss for blends containing chitosan grafted tert butyl acrylate compared to chitosan grafted methacrylamide, confirming enhanced biodegradability. Morphological analysis using scanning electron microscopy revealed improved interfacial adhesion and finer dispersion of the chitosan phase in compatibilized blends, especially for chitosan grafted methacrylamide, resulting in reduced microvoid formation. Overall, the results indicate that high density polyethylene and modified chitosan blends compatibilized with grafted polyethylene successfully balance biodegradability and mechanical integrity. These materials demonstrate strong potential for use in sustainable packaging and structural applications where environmental performance and material durability must coexist.

Keywords: High density polyethylene, Modified chitosan, Reactive compatibilization, Interfacial adhesion, Biodegradable polymer blends

Design, Synthesis and Docking Evaluation of 7-Chloro-4-Substituted Quinoline Derivatives as Antimalarial Leads

Yashkumar J. Prajapati¹, Ankitkumar J. Patel^{1,*}

¹Department of Organic Chemistry, Shri Alpesh N. Patel Post Graduate Institute of Science & Research, Anand (Gujarat), India

*Corresponding Author E-mail: yashpraj2212@gmail.com

ABSTRACT

Drug resistance has reduced the effectiveness of current antimalarial therapies, necessitating new drug candidates. In this study, novel 7-chloro-4-substituted quinoline derivatives were synthesized using a base-catalysed coupling approach and characterized by IR, ¹H NMR, and ¹³C NMR spectroscopy. Drug-likeness was evaluated using MolSoft predictions. Molecular docking studies against Plasmodium vivax *Sub1 protease* (PDB ID: 8COZ) using CB-Dock2 revealed favourable binding interactions, indicating the potential of these quinoline derivatives as promising antimalarial leads.

Keywords: 7-chloro-quinoline, Docking, Anti-malarial

Design, Synthesis, and Evaluation of Thiazolo[3,2-a]pyrimidine Derivatives as Potent Anticancer Agents

Ms. Mrugisha Rathod¹, Dr. Vishant Patel^{1,*}

¹Department of Organic Chemistry, Shri Alpesh N. Patel Postgraduate Institute of Science and Research, Anand (Gujarat), India

*Corresponding Author Email id: vish.ckpatel@gmail.com

Abstract

The BRCA1 BRCT domain is a pivotal regulator of DNA damage response, making it an attractive target for sensitizing cancer cells to chemotherapy. We report the design and synthesis of novel **thiazolo[3,2-a]pyrimidine** derivatives as small-molecule inhibitors of this domain. A library of novel derivatives was synthesized via a sequential protocol involving a Biginelli reaction, followed by cyclization and an aldol-type condensation. The structures were confirmed using IR, ¹H NMR, ¹³C NMR, and Mass Spectrometry. Molecular docking studies were performed against the BRCA1 BRCT domain (**PDB ID: 3K0K**) to predict binding affinity. Molecular docking studies indicated strong binding affinity mediated by critical residues ARG1737, PHE1695, and PHE1717 through Pi-Cation and Pi-Pi interactions. Biological screening identified Compound 9b as the most potent derivative, exhibiting an excellent efficacy, comparable to the standard drug Doxorubicin. The study identifies novel thiazolo[3,2-a]pyrimidine derivatives as promising BRCA1 inhibitors, offering a potential scaffold for developing targeted anticancer therapeutics.

Keywords: Biginelli reaction, thiazolo[3,2-a]pyrimidine, molecular docking, anticancer agent, dihydropyrimidone

Design, Synthesis and Cytotoxic Evaluation of Quinazoline Derivatives as Anticancer Agents

Krishna Barot, Aryan Patel and Dr.Niraj Patel*

Department of Organic Chemistry, Institute of Science & Technology for Advanced Studies & Research, abbreviated (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar.

Email: barotkrishna2710@gmail.com, aryancpatel1310@gmail.com

Abstract

This paper intended to explore and discover recent therapeutic agents in the area of medicinal chemistry for the treatment of cancer. Quinazoline scaffold is one of the most significant motifs with diverse chemical reactivities and many biological applications. Its structural flexibility is a major advantage in anti-tumor drug development. A novel series of quinazoline derivatives were design and synthesized as anticancer candidates. FDA approved anticancer agents such as Gefitinib, erlotinib, Nilotrexed are widely used. AstraZeneca's medication is an inhibitor of the protein kinase of the epidermal growth factor receptor (EGFR). It binds to the EGFR ATP-binding site inactivating and stopping cancer cells from growing further. Because of large number of protein targeted, some high structural diversity is observed in quinazoline compounds. Due to the vast applications of quinazoline derivatives, development of novel quinazoline compounds as anticancer drugs remains a promising field.

CHP-68

Methods for Preparation of Piperazine Derivatives

Mudra R. Bhimani, Maitri Patel and Kinnari Bhatt*

Department of Organic Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar.

Email: mudrabhimani57@gmail.com

Abstract

FDA reported that roughly 60% of small molecules are N-containing heterocyclic compounds. Piperazine, a class of heterocyclic compounds have gained significant attention in the field of organic synthesis due to their diverse pharmacological activities and wide spread applications in medicinal chemistry. Researchers endeavored to adopt environmentally benign green methods for synthesis of piperazine as nitrogen containing heterocyclic derivatives. The syntheses of piperazines have witnessed remarkable progress, with a focus on developing efficient and sustainable synthetic routes. The synthetic strategies for piperazine are use of microwave assisted techniques, photo-redox catalysis, Bio-inspire methods, transition-metal catalyzed reactions, multi component single pot reactions and catalyst free synthesis. These contents summarize the various synthetic reported methods used for the preparation of piperazine derivatives.

CHP-69

Removal of anionic/cationic dyes by chitosan poly (acrylamide-co-crotonic acid)/Fe₃O₄ composite hydrogel: kinetics, isotherm and removal mechanism

Isha R. Patel¹, Shital R. Patel², Bhavinkumar V. Patel², Niraj H. Patel^{1*}

¹Department of Organic Chemistry, Institute of Science & Technology for Advanced Studies & Research, The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand, Gujarat 388120, India.

² Natubhai V. Patel College of Pure and Applied Sciences, The Charutar Vidya Mandal (CVM)University, Vallabh Vidyanagar, Anand, Gujarat 388120, India.

Abstract

The release of toxic dyes into water sources poses serious environmental risks. In this work, a chitosan-based poly(acrylamide-co-crotonic acid)/Fe₃O₄ composite hydrogel was developed for efficient removal of both anionic (Methyl Orange) and cationic (Malachite Green) dyes. The hydrogel was synthesized via free radical polymerization, incorporating Fe₃O₄ nanoparticles for magnetic separation. Characterization by FTIR, SEM, XRD, and VSM confirmed structural integrity, surface functionality, and magnetic behavior. Batch adsorption studies evaluated the

effects of pH, contact time, and dye concentration. The adsorption kinetics followed a pseudo-second-order model, while the Langmuir isotherm best described equilibrium data, suggesting monolayer adsorption. The removal mechanism was attributed to electrostatic interactions, hydrogen bonding, and π - π stacking. The hydrogel exhibited high dye uptake and retained performance over multiple regeneration cycles. This study highlights the potential of magnetically responsive chitosan-based hydrogels as effective, reusable adsorbents for treating dye-contaminated wastewater.

Keywords: Chitosan hydrogel, Fe_3O_4 , Nanoparticles, adsorption kinetics, isotherm models, dye removal.

CHP-70

Comparative Thermal Characterization of Novel Hybrid Polymer Composites Reinforced with Coconut Shell Powder, Bagasse, and Groundnut Shell

Upasi D Patel ¹, Vivekanand Mishra ^{*2}

¹Department of Physics, C.U. Shah University, Wadhwan city-363 030, (Gujarat) India

²Department of Science, Alliance University, Bengaluru- 562106

Abstract

The increasing demand for sustainable and thermally stable engineering materials has stimulated extensive research into polymer composites reinforced with agro-industrial residues. In the present investigation, novel hybrid polymer composites were fabricated using a three-resin hybrid matrix system, wherein coconut shell powder, bagasse, and groundnut shell were incorporated individually as reinforcing fillers. The study was undertaken to perform a comparative evaluation of the thermal behaviour of these agro-waste reinforced hybrid composites and to assess their suitability for applications requiring improved thermal resistance. Thermal characterization was carried out using thermogravimetric analysis (TGA), differential thermal analysis (DTA), and derivative thermogravimetric analysis (DTG) under controlled heating conditions. The obtained thermograms revealed distinct degradation stages associated with moisture volatilization, decomposition of hemicellulosic and cellulosic constituents, and the progressive degradation of lignin and polymeric matrix phases. Noticeable variations in degradation temperature, peak decomposition behaviour, and residual mass were observed among the different composite systems, primarily governed by filler composition, interfacial adhesion, and the inherent thermal stability of the reinforcing materials. A significant aspect of this investigation lies in the systematic comparative thermal analysis of three distinct agro-waste reinforcements incorporated individually within a three-resin hybrid matrix, an approach that provides deeper insight into degradation mechanisms and remains relatively underexplored in sustainable composite research. The findings highlight the potential of agro-waste reinforced hybrid composites as thermally stable, economically viable, and environmentally sustainable alternatives for engineering applications.

Keywords: Natural Fibre composites, Hybrid resin, Differential Thermal Analysis (DTA), Thermal stability, Thermogravimetry Analysis (TGA).

CHP-71

Polyaniline embedded with nano PbS/PbS-Ag/PbS-Cu and CdS/CdS-Ag/CdS-Cu preparation, characterization and applications

Vishal Patel, Archana shah, Natubhai V Patel Collage Of Pure And Applied Sciences,, CVM University,Vallabh Vidyanagar, Anand, Gujarat, India.

Abstract

An easy way of preparing polyaniline nano composites embedded with nano PbS and CdS is presented here. Each of the polymer nano composites was further doped with nano Ag and nano Cu to improve the conductivity of the pellet made from the composites. The inorganic nano particles were characterized with XRD. For a few composites SEM data were also obtained. The size dependent band gap of the semiconductors PbS & CdS have been found from diffused reflectance study. The IR spectra of the composites were analysed to understand the interactions of polyaniline (PANI) and dopants. The I-V characteristics of nano PbS/CdS embedded polymers in dark and in presence of infrared radiation were studied. When polymer nano composites were further doped with NPs Ag/Cu, significant variations in I - V characteristics of the materials in dark and in presence of light were observed. The importance of polyaniline doped with PbS/PbS-Ag/PbS-Cu/CdS/CdS-Ag/CdS-Cu was analysed. TGA traces of the composites were employed to calculate the energy of activation which was correlated with the size of the inorganic NPs. The responsivity (R) of various PANI composites with two different intensities of incident radiation was obtained experimentally. It was inferred that PANI containing PbS should be better detectors for low energy radiations.

Keywords. *Polymer nanocomposites; Nano PbS; Nano CdS; XRD; SEM*

CHP-72

Phytochemicals Synergy for Sustainable Mosquito Repellency

Neel Bhatt^a

^aITM Vocational University, Vadodara.

Abstract

In India Mosquito-borne diseases such as malaria, dengue, Chikungunya and Zika are a major problem, particularly in tropical and subtropical regions. Over using the synthetic mosquito repellents, containing DEET and permethrin like components have raised up alarms due to their potential toxicity, environmental persistence, and the development of insect resistance. This study aims to develop an eco-friendly, plant-based mosquito repellent using medicinal flora and green chemistry principles. Bioactive mosquito-repelling compounds were extracted from neem leaves and tobacco leaves using solvents like ethanol and methanol which eco-friendly. For qualitative analysis of abstract Thin Layer chromatography method was employed. Characteristic chromatographic spots were exhibited from Neem leaf which indicates the presence of azadirachtin-like compounds, whereas tobacco leaf extract showed spots corresponding to nicotine-based alkaloids responsible for insecticidal and repellent activity. Preliminary formulation experiments were carried out to create herbal mosquito coils utilizing both single and blended combinations of neem and tobacco extracts. The coils that were produced showed satisfactory burning properties, consistent smoke distribution, and effective mosquito repellency in a laboratory setting. The polyherbal formulation showed improved efficacy in repelling mosquitoes in comparison to the single-extract formulations, indicating a synergistic effect among the constituents derived from the plants. The results validate the feasibility of developing a biodegradable, cost-effective, and environmentally safe mosquito repellent using medicinal plants. This study supports sustainable vector control strategies and promotes the use of natural alternatives to synthetic repellents. The findings highlight the potential of plant-based formulations for eco-friendly mosquito management, offering a safer approach for public health protection and environmental sustainability.

Keywords: *Mosquito repellent; Agricultural waste; Orange peel; Neem; Tobacco; Green chemistry; Vector control.*

Synthesis and Composite Performance of Catechol-Based Unsaturated Polyester Resin Reinforced with Carbon Fiber

Mansi Sheth & Lata Raj,
Shri C.N.P.F. Arts & D.N. Science College, Dabhoi, Vadodara, Gujarat, India
Corresponding Author: Lata Raj
Corresponding Author email ID: lataraj1972@gmail.com

ABSTRACT

In this study, catechol based tri-functional epoxy resins were synthesized and subsequently reacted with maleic anhydride and various dibasic acids to develop modified multifunctional unsaturated polyester resins (UPRs). The synthesized resins were characterized using Fourier transform infrared spectroscopy (FT-IR), epoxy equivalent weight (EEW), and viscosity measurements. Carbon fiber-reinforced composites were fabricated by the hand lay-up technique using methyl ethyl ketone peroxide (MEKP) as the curing agent. The mechanical, thermal, and chemical properties of the resulting composites were systematically evaluated. Composites derived from aromatic dibasic acid-based UPRs exhibited higher molecular weights, improved thermal stability, and superior mechanical performance compared to those prepared with aliphatic dibasic acids. Thermogravimetric analysis and differential scanning calorimetry confirmed thermal stability of the composites up to 400 °C, while chemical resistance studies demonstrated excellent resistance toward aggressive reagents. Scanning electron microscopy revealed strong fiber-matrix interfacial adhesion, particularly in composites prepared with the modified resins. These findings demonstrate that catechol-based modifications significantly enhance resin performance and provide a promising route for the development of high-performance carbon fiber-reinforced composites for demanding industrial applications.

Keywords: *Modified multifunctional unsaturated polyester resin, Carbon fiber, TGA, DSC, SEM*

Sulphonamides (Sulpha Drugs): Development, Chemistry, Classification and Therapeutic Importance

Patel Jeelkumar Hiteshbhai
Industrial Chemistry Department, Natubhai V. Patel College of Pure and Applied Sciences,
Vallabh vidyanagar-388120, India.
E-mail: jeelpatel9638@gmail.com

Abstract

Sulphonamides, commonly known as sulpha drugs, are synthetic chemotherapeutic agents containing the sulphonamide ($-\text{SO}_2\text{NH}_2$) functional group. They represent the first class of effective antibacterial drugs used systematically in the treatment of bacterial infections. The discovery of sulphonamides originated from studies on synthetic dyes, particularly the azo dye prontosil, which was later found to be metabolized in vivo to sulphanilamide, the actual active antibacterial agent. This discovery marked a major milestone in medicinal chemistry. Sulphonamides exhibit bacteriostatic activity against a wide range of gram-positive and gram-negative organisms by inhibiting folic acid synthesis in bacteria. Chemically, these drugs are synthesized through reactions involving sulphonyl chlorides, amination, condensation, and hydrolysis. Based on absorption, excretion, and therapeutic use, sulphonamides are classified into short-acting, intermediate-acting, long-acting, poorly absorbed, and special-purpose compounds. Important members such as sulphanilamide, sulphapyridine, sulphathiazole, and sulphadiazine have been widely used in systemic, gastrointestinal, and topical infections. Although modern antibiotics have largely replaced them, sulphonamides continue to hold historical, chemical, and therapeutic significance.

Nanotechnology: Applications in Various Fields

Pritiben Sindha, Nilaxi Sindha and Rohit Vekariya
Department of Organic Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar.
sindhapriti@gmail.com, sindhachetna@gmail.com, rohitvekariya@cvmu.edu.in

Abstract

Nanotechnology is an emerging and rapidly advancing field that involves the modification of the matters at the Nano scale level typically between 1 to 100 nanometers. The future of nanotechnology holds immense potential to revolutionize various sectors including medicine, electronics, energy, environmental science and materials engineering. In medicine, nanotechnology is expected to enable targeted drug delivery, early diseases detection and advanced regenerative therapies, improving treatment efficiency while minimizing side effects. In electronics nanoscale components will allow the development of faster, smaller and more energy efficient devices. Nanomaterials such as graphenes and carbon nanotubes offer exceptional mechanical, electrical and thermal properties opening new possibilities in manufacturing and engineering. Furthermore, nanotechnology can contribute to sustainable energy solutions through improved solar cells, energy storage systems and efficient catalyst. Environmental applications include water purification, pollution control, and environmental monitoring using Nano sensors. Despite its promising future, challenges such as toxicity, environmental impact, ethical concerns and high production costs must be addressed. Nanotechnology is expected to play a crucial role in shaping the future of science, technology and human life.

Impact of Aromatic Counterions in Micellization and Anti-cancer Activity of Morpholinium-Based Surface Active Ionic Liquids

Divya M. Shah¹, Ravi A. Viradiya¹, Sanjay H. Panjabi^{1*}
¹Chemical Sciences Department, P D Patel Institute of Applied Sciences, Charotar University of Science and Technology, Changa, Gujarat, India -388421
E-mail: sanjaypanjabi_27@yahoo.co.in*

Abstract

This Study represents morpholinium-based surface-active ionic liquids (SAILs) containing different aromatic counterions: N-dodecyl-N-methylmorpholinium salicylate [C₁₂mmor][Sal], N-dodecyl-N-methylmorpholinium 3-hydroxy-2-naphthoate [C₁₂mmor][3-H-2-n], N-dodecyl-N-methylmorpholinium benzenesulfonate [C₁₂mmor][Bs], and N-dodecyl-N-methylmorpholinium β -naphthalenesulfonate [C₁₂mmor][β -Nsa]. The aggregation behavior of SAILs was carefully examined using a range of analytical techniques, including surface tension measurements and electrical conductivity. The obtained data enabled a wide range of thermodynamic, micellar, and interfacial parameters, including the degree of counterion binding (β), critical micelle concentration (CMC), minimum area per molecule (A_{min}), surface excess concentration (Γ_{max}), standard Gibbs free energy of adsorption (ΔG_{ad}°), aggregation number (N_{agg}), standard Gibbs free energy of micellization (ΔG_m°), standard enthalpy of micelle formation (ΔH_m°), and standard entropy of micellization (ΔS_m°). The experimental evidence suggests that adding aromatic counterions enhances the micellization properties compared to conventional halogenated SAILs such as [C₁₂mmor][Br]. Thermogravimetric analysis (TGA) assessed the generated SAILs thermal stability. The TGA results for all synthesized SAILs demonstrated excellent thermal stability, which is crucial for their potential use in a range of high-temperature processes. The Structural characterizations of SAILs are done by ¹H NMR. An in silico study of SAILs evaluates their strong binding affinity for EGFR using docking and simulations. In-vitro

cytotoxicity of Synthesized SAILs was tested on MCF-7 and A-549 cell lines using the MTT Assay. The study reveals that aromatic counterions in morpholinium-based SAILs enhance micellization, offering insights into developing effective and sustainable surfactants. The findings impact materials science, drug discovery, and catalysis.

Keywords: *Surface Active Ionic Liquids, Aromatic Counterions, Micellization, In-silico study, Cytotoxicity.*

CHP-77

A Study On Microwave-Assisted Synthesis And Characterization Of Acyclovir Co-Crystals To Enhance Bioavailability

Ralph Rajesh¹

¹Department of Chemistry, St. Xavier's College (Autonomous)(SXCA), Gujarat University, Ahmedabad – 380009, India

E-mail: ralphsj2908@gmail.com

ABSTRACT

Having learned the gravity of the neurological disorder; Herpes Zoster, and the number of people suffering around the globe; the presented study aims to synthesize the Co-Crystals to enhance the Bioavailability of the poorly soluble drug. Co-Crystallization of the drug has been carried out via Solvent Evaporation method, grinding method, and Microwave-Assisted Co-Crystallization method. It was observed that the Microwave-Assisted synthesis gave better results than conventional methods. The PART-I of the paper, which is theoretical, focuses preciously on the general Biochemical aspects of the alimnt, its etiology and its metabolic pathways whereas, the PART-II which is experimental, typically provides the idea of how to enhance the solubility of the drug molecule. It gives various ways for Co-Crystallization. The second portion of the paper also facilitates with the characterization of the formed Co-Crystals by UV and FT-IR analysis, proving that the better Co-Crystals have been formed by Microwave-Assisted method and much higher percentage solubility than the original drug.

Keywords: *Herpes Zoster, Bioavailability, Microwave-Assisted, Co-Crystals*

CHP-78

Extraction and Isolation of Okra (*Abelmoschus esculentus*) Mucilage: FTIR Characterization and Prospective Applications

Shiv Patel, Kinnari A. Bhatt*

Department of Organic Chemistry, Institute of Science & Technology for Advanced Studies & Research (ISTAR), The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Anand 388120 Gujarat, India.

Email: Shivpatel99117@gmail.com, kinnari.bhatt@cvmu.edu.in

Abstract

Natural polysaccharides obtained from plant sources have garnered considerable interest owing to their biodegradability, biocompatibility, and sustainability. Okra (*Abelmoschus esculentus*) pods are a significant source of mucilage, a hydrophilic polysaccharide with notable functional attributes. The current work presents the extraction and isolation of okra mucilage from fresh okra pods utilizing an acetone-based precipitation technique. The pods were first treated in an aqueous solution to extract mucilage, then acetone was added to promote precipitation and enable the separation of the polysaccharide. The separated mucilage was desiccated and analysed using Fourier Transform Infrared (FTIR) spectroscopy for structural characterisation. FTIR spectrum signifies the existence of intricate carbohydrate chains that account for the physicochemical features of okra mucilage. The acetone-assisted isolation method

demonstrated simplicity, cost-effectiveness, and efficiency, resulting in a reasonably pure biopolymer without the use of harsh chemicals. Okra mucilage, owing to its natural origin and functional groups, possesses significant promise for future uses in pharmaceuticals (as a binder, thickening, or drug delivery matrix), food industries (as a stabilizer or emulsifier), water treatment, and the production of biodegradable materials. This research emphasizes okra mucilage as a sustainable biomaterial and advocates for its continued investigation for environmentally friendly and value-enhancing uses.

Computer Sciences

COP-79

Cloud Computing: Powering The Digital Transformation

Riya Parakhiya¹, Janavi Patel²

Abstract

Cloud computing is a revolutionary technology that delivers computing services such as servers, storage, databases, networking, software, and analytics over the internet. Instead of relying on traditional physical infrastructure, organizations can access scalable and flexible resources on demand. This reduces the need for heavy investments in hardware and maintenance, making technology more affordable and accessible for businesses, educational institutions, startups, and governments. One of the key advantages of cloud computing is its scalability and cost-efficiency. Users can increase or decrease resources based on their requirements, paying only for what they use. Cloud services are generally offered through three main models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). These models provide customized solutions for different operational needs, from application development to data storage and software usage. Cloud computing plays a central role in digital transformation by supporting emerging technologies such as Artificial Intelligence (AI), Big Data analytics, the Internet of Things (IoT), and machine learning. It enables remote work, real-time collaboration, secure data management, and disaster recovery solutions. Businesses can innovate faster, improve customer experiences, and expand globally with minimal technical barriers. In today's digital era, cloud computing is not just a technological advancement but a strategic foundation for modern development. It empowers organizations to become more agile, competitive, and efficient. By driving innovation and enabling smart digital solutions, cloud computing continues to power digital transformation across industries and contributes significantly to economic growth and technological progress.

Keywords: *Cloud Computing, Digital Transformation, IaaS (Infrastructure as a Service), PaaS (Platform as a Service), SaaS (Software as a Service), Scalability, Cost Efficiency, Data Storage, Artificial Intelligence (AI), Big Data Analytics, Internet of Things (IoT), Virtualization, Remote Collaboration, Innovation, IT Infrastructure*

COP-80

Edtech: Redefining Learning In The Digital Age

Patel Namra Achyutbhai¹

Smt. Chandaben Mohanbhai Patel Institute of Computer Applications

Corresponding Author: 25bsit083@charusat.edu.in

Abstract

Educational Technology (EdTech) refers to the integration of digital tools and technologies into the teaching and learning process to improve the quality, accessibility, and effectiveness of education. In the digital age, EdTech has become an essential part of modern learning systems,

transforming traditional classroom methods into more interactive, flexible, and student-centered approaches. With the rapid growth of the internet, smartphones, and digital platforms, education is no longer limited to physical classrooms or fixed schedules. EdTech includes a wide range of tools such as online classes, learning applications, video lectures, e-books, virtual classrooms, and smart boards. These tools help students understand concepts more clearly through visual content, animations, and real-life examples. One of the major advantages of EdTech is that it allows learners to study anytime and anywhere, making education more accessible to students from different backgrounds. It also supports self-paced learning, enabling students to revise topics according to their own speed and learning capacity. In addition, EdTech plays an important role in developing digital skills, which are essential in today's technology-driven world. Teachers benefit from EdTech as well, as it helps them deliver lessons more effectively, track student progress, and use innovative teaching methods. Online assessments, interactive quizzes, and digital feedback systems further enhance the learning experience. Overall, EdTech is redefining learning in the digital age by making education more inclusive, engaging, and efficient. As technology continues to advance, EdTech will play an even greater role in shaping the future of education, bridging the gap between traditional learning and modern technological needs.

Keywords: *EdTech, Digital Learning, Online Education, Educational Technology, E-Learning, Smart Education, Learning Apps, Virtual Classrooms*

COP-81

Impact of Data Quality and Privacy Constraints on the Adoption of Artificial Intelligence Technologies

Ms. Drashti Mitul Malli¹

¹Research Scholar, Shri D. N. Institute of Computer Application, Sardar Patel University-V.V.Nagar
Corresponding Author: drashtimalli@gmail.com

Abstract

The rapid growth of Artificial Intelligence (AI) technologies has reshaped decision-making processes across various sectors, including healthcare, education, finance, and smart systems. While these advancements offer significant benefits, the large-scale adoption of AI continues to be limited by persistent challenges related to data quality and data privacy. High-quality data serves as the foundation of effective AI systems; however, problems such as incomplete, inconsistent, biased, and insufficient data negatively influence model accuracy, reliability, and generalization capabilities. At the same time, increasing concerns regarding data privacy, regulatory compliance, and the ethical use of personal information present additional barriers to the deployment of AI-driven solutions. Strict data protection regulations, coupled with the growing risk of data breaches, have led organizations to restrict data sharing and usage, thereby limiting opportunities for AI training and innovation. This study explores the impact of data quality challenges and privacy constraints on the adoption of Artificial Intelligence technologies through a comprehensive review and analysis of existing literature. The paper consolidates findings from recent studies to identify major data-related issues, assess their effects on AI system performance, and examine the trade-offs between data usability and privacy preservation. Furthermore, it discusses emerging solutions, including data governance frameworks, privacy-preserving machine learning techniques, and secure data-sharing mechanisms, aimed at addressing these challenges. The study emphasizes that effectively managing data quality and privacy concerns is crucial for promoting trustworthy, ethical, and scalable AI adoption.

Keywords: *Artificial Intelligence, Data Quality, Data Privacy, AI Adoption, Ethical AI, Privacy-Preserving Machine Learning*

Machine Learning Applications in Smart Cities

Harshil Alpeshbhai Bhimani¹, Praptiben Miteshkumar Parmar²
Student, BCA, VP & RPTP SCIENCE COLLEGE, V.V.Nagar, Gujarat

Abstract

Smart cities aim to improve the quality of urban life by using advanced technologies to manage resources efficiently and provide better services to citizens. Machine Learning (ML), a key branch of Artificial Intelligence, plays an important role in analyzing large volumes of data generated by smart city infrastructure such as sensors, cameras, and connected devices. This paper presents an overview of major machine learning applications in smart cities and their impact on urban development. Machine learning algorithms are widely used in traffic management systems to predict congestion, optimize traffic signals, and reduce travel time. In smart surveillance, ML-based computer vision techniques help in crowd monitoring, accident detection, and public safety enhancement. Energy management is another important area where ML models are used to predict energy consumption, optimize power distribution, and support the use of renewable energy sources. ML is also applied in waste management systems to improve collection routes and reduce operational costs. Environmental monitoring is enhanced through machine learning by analyzing air quality, noise levels, and weather patterns to support sustainable urban planning. In addition, smart healthcare, water management, and disaster prediction systems benefit from predictive analytics and real-time data processing enabled by ML. The use of machine learning in smart cities offers several advantages, including efficient resource utilization, reduced operational costs, improved public safety, and enhanced citizen services. However, challenges such as data privacy, security risks, algorithm bias, and infrastructure complexity must be carefully addressed. In conclusion, machine learning technologies are essential for building intelligent, sustainable, and resilient smart cities, supporting better decision-making and improved urban living.

NVPAS AI Voice Calling Agent

RAJDIPSINH JITENDRASINH MORI¹, PATEL MANSI HITESHKUMAR¹

Abstract

This project presents the design and implementation of an AI Voice Calling System developed for Natubhai V. Patel College of Pure and Applied Sciences (NVPAS) to automate and enhance the handling of student enquiries. Educational institutions often receive a high volume of repetitive queries related to admissions, courses, fees, eligibility criteria, and office timings. Managing these calls manually requires significant staff time and may lead to delays or inconsistent responses. The proposed AI Voice Calling system addresses this challenge by using artificial intelligence and speech technologies to provide instant, accurate, and consistent information to callers. The system can automatically initiate outbound calls, understand user queries through speech recognition, and respond using a natural, human-like voice. It supports multiple languages such as English, Hindi, and Gujarati, making it accessible to a wider audience. The AI agent is trained on college-specific data, ensuring that all responses are relevant and reliable. It can operate 24/7, reducing dependency on human operators and improving the overall efficiency of the enquiry management process. Additionally, the system can log call details and user interactions, which helps the college analyze enquiry trends and improve services. This project demonstrates how AI-driven voice automation can modernize communication systems in educational institutions. By implementing this solution, NVPAS College can improve student satisfaction, reduce workload on administrative staff, and adopt a scalable, technology-driven approach to enquiry management.

WiVo Bot

Zeel Agrawal 1 , Parshwa Patel 2 , Dr. Kavindra Jain 3

¹²³Department of Electronics and Communication Engineering, GCET, India

Email: zeelagrwal21@gmail.com, patelparshwa00@gmail.com

Abstract

This paper presents the design and implementation of a Wi-Fi Talking Robot that demonstrates the practical application of microprocessors and microcontrollers in an integrated robotic system. The proposed system combines wireless communication, motion control, and voice output to enable real-time interaction through a smartphone interface. The robot operates over a Wi-Fi network, allowing flexible and remote operation without physical constraints. Motor control mechanisms are employed to achieve directional movement, while audio feedback enhances human-robot interaction. The system acts as a learning platform for embedded and IoT-based robotic systems. The system employs an ESP Node-MCU module for Wi-Fi communication and an Arduino Uno for control and processing. The ESP Module connects to a Wi-Fi network and receives control commands from a smartphone, which are transmitted to the Arduino via serial communication. The Arduino interprets these commands and drives the robot's motion through a motor driver interfaced with geared motors and wheels. Audio interaction is provided using a Bluetooth sound module and speaker. The entire system is powered by a 3.7 V supply, assembled on a sun-board platform, and programmed using the Arduino IDE. The robot supports real-time multi-directional movement and audio output. The wireless control system introduces minimal delay while maintaining reliable communication, ensuring smooth and effective interaction between the user and the robot through a mobile device. During implementation, challenges were encountered in ESP Module programming, Wi-Fi control, real-time movement, audio output, and hardware interfacing. Addressing these issues enhanced practical understanding of embedded programming, wireless communication, and system integration. The project further demonstrates effective real-time coordination among multiple system modules. The Wi-Fi Talking Robot effectively demonstrates core concepts of microprocessors, microcontrollers, and wireless communication. This system's potential applications could be in healthcare assistance, home automation and interactive robotic platform.

Willow Chips: The Power of Processing

Vaidehi Patel¹

¹Student, MCA, ISTAR College, The CVM University

Abstract

Willow chips represent a significant advancement in next-generation computing, designed to deliver unprecedented processing power and efficiency. Developed as part of advanced research initiatives by companies such as Google, Willow chips are associated with breakthroughs in quantum and high-performance computing architectures. These chips aim to overcome the limitations of classical processors by leveraging innovative designs that enable faster computation, enhanced parallelism, and improved energy efficiency. The power of Willow chips lies in their ability to process complex algorithms and massive datasets at speeds unattainable by traditional silicon-based systems. Such capabilities open new possibilities in scientific research, cryptography, artificial intelligence, climate modeling, and large-scale simulations. By reducing computational time for highly complex problems, Willow chips demonstrate the transformative potential of advanced processing technologies, marking a significant step toward the future of intelligent and quantum-enabled computing systems.

DevOps Life Cycle and Its ApplicationsJay Suthar¹¹Student, MCA, ISTAR College, The CVM University**Abstract**

DevOps is a collaborative software development methodology that integrates development (Dev) and operations (Ops) to enhance the speed, quality, and reliability of software delivery. The DevOps life cycle consists of continuous phases including planning, development, building, testing, integration, deployment, monitoring, and feedback. These stages are interconnected through automation and continuous practices such as Continuous Integration (CI) and Continuous Deployment (CD), enabling rapid and reliable software releases. Tools such as Git for version control, Jenkins for CI/CD automation, Docker for containerization, and Kubernetes for orchestration play a significant role in implementing the DevOps pipeline efficiently. The DevOps approach emphasizes collaboration, automation, infrastructure as code, continuous monitoring, and rapid feedback to minimize errors and reduce deployment cycles. Its applications extend across various industries including cloud computing, e-commerce, banking, healthcare, and telecommunications, where organizations require scalable, resilient, and secure systems. By promoting faster time-to-market, improved system stability, and enhanced customer satisfaction, the DevOps life cycle has become a critical framework for modern software engineering and digital transformation initiatives.

Types and Applications of Machine LearningAparna Sanjaybhai Machhi¹¹Student, MCA, ISTAR College, The CVM University**Abstract**

Machine learning (ML) is a core subfield of Artificial Intelligence that focuses on developing algorithms capable of learning patterns from data and making predictions or decisions without explicit programming. ML techniques are broadly categorized into supervised learning, unsupervised learning, semi-supervised learning, and reinforcement learning. Supervised learning involves training models on labeled datasets for tasks such as classification and regression, while unsupervised learning identifies hidden structures or patterns in unlabeled data through clustering and dimensionality reduction. Semi-supervised learning combines limited labeled data with abundant unlabeled data to improve performance, and reinforcement learning enables agents to learn optimal actions through interaction with dynamic environments based on reward mechanisms. Recent advancements, particularly in Deep Learning, have significantly enhanced the capability of ML systems to process large-scale and complex data such as images, text, and audio. Machine learning applications span diverse domains, including healthcare for disease diagnosis and drug discovery, finance for fraud detection and algorithmic trading, transportation for autonomous vehicles, retail for recommendation systems, and cybersecurity for threat detection. As data availability and computational power continue to expand, machine learning remains a transformative technology driving innovation, automation, and intelligent decision-making across industries.

Artificial Intelligence in HealthcarePatel Miteshkumar Gordhanbhai¹¹Student, M.Sc.(Cyber Security), ISTAR College, The CVM University

Abstract

Artificial Intelligence (AI) is transforming the healthcare industry by improving the quality, speed, and accuracy of medical services. With the rapid growth of digital health records, medical imaging systems, wearable devices, and online consultation platforms, a large amount of healthcare data is generated every day. AI technologies such as Machine Learning (ML), Deep Learning (DL), and Natural Language Processing (NLP) help in analyzing this complex data and support healthcare professional in making better clinical decisions. AI-based systems are widely used for early disease detection, medical image analysis, and predictive diagnosis. Machine learning algorithms can analyze X-rays, CT scans, and MRI images to detect diseases such as cancer, pneumonia, and heart conditions at an early stage. AI is also used in predicting chronic diseases by studying patient history, genetic information, and lifestyle patterns. Virtual health assistants and chatbots provide 24/7 support to patients, while remote monitoring systems track vital signs and alert doctors in emergency situations. The integration of AI in healthcare offers several benefits, including reduced human errors, faster diagnosis, personalized treatment, and cost-effective healthcare delivery. However, challenges such as data privacy, ethical concerns, algorithm bias, and system security must be carefully managed. Proper regulations and collaboration between medical experts and AI developers are essential for responsible implementation. In conclusion, Artificial Intelligence has the potential to revolutionize healthcare by making it more intelligent, efficient, and patient-centered. With continuous research and technological advancement, AI can significantly improve healthcare outcomes and accessibility worldwide.

COP-89

Agentic AI Systems for Autonomous Automation

Het Bhimani¹, Darsh Boghara²

^{1,2}Student, M.Sc.IT, CMPICA, CHARUSAT

Abstract

Agentic Artificial Intelligence (AI) systems are a major breakthrough in the area of intelligent computing, as they empower autonomous decision-making, planning, and execution. Unlike conventional AI systems, which work in a reactive manner based on explicit user inputs, agentic AI systems are goal-oriented and have the ability to break down complex goals into organized tasks independently. These systems combine Large Language Models (LLMs), memory components, reasoning engines, and tool execution layers to support seamless interaction with dynamic environments. This poster examines the conceptual underpinnings, system architecture, and functional dynamics of agentic AI systems for autonomous automation. The poster describes how agent-based architectures support multi-step reasoning, adaptive workflows, and self-reflexive feedback cycles, which enable AI agents to refine their actions and optimize performance through continuous improvement. A typical example of autonomous DevOps automation is discussed to illustrate the applicability of agentic AI systems, which can enable AI agents to analyse system logs, identify anomalies, diagnose problems, and perform corrective actions with minimal human supervision. The poster discusses the revolutionary impact of agentic AI systems in areas such as software development, cybersecurity, enterprise workflow automation, and intelligent systems integration.

Keywords: *Agentic AI, Autonomous Systems, Intelligent Automation, AI Agents, Goal-Driven AI*

COP-90

Agentic AI for Scientific Discovery

KUNJ ASHISHBHAI BUDDHBHATTI¹, MEETKUMAR ANILBHAI KACHOT²

¹Student, MCA, CMPICA, CHARUSAT University

²Student, MSc.IT, CMPICA, CHARUSAT University

Abstract

Agentic AI has shown significant potential across various scientific domains, including drug discovery, materials science, climate research, and genomics, where it accelerates innovation by exploring complex data spaces and identifying novel patterns beyond human capabilities. However, challenges such as transparency, reliability, reproducibility, and ethical control remain critical concerns. This poster presents the architecture, applications, advantages, and challenges of agentic AI, highlighting its role as a collaborative partner that enhances human-driven scientific discovery rather than replacing human researchers. Agentic Artificial Intelligence (Agentic AI) introduces a transformative approach to scientific discovery by enabling AI systems to function as autonomous research agents. Unlike traditional AI models that rely on predefined instructions, agentic AI systems can independently set research goals, plan experiments, analyze results, and refine hypotheses through continuous feedback loops. By integrating large language models, reinforcement learning, memory, and tool-based reasoning, these agents actively participate in the research process.

Keywords: *Agentic Artificial Intelligence, Autonomous Research Agents, Scientific Discovery, Large Language Models, Human-AI Collaboration*

COP-91

Cardiac Arrest Detection and Heart Disease Prediction Monitoring System with the Use of IoT, Deep Learning and Deep Convolutional Neural Network

Mihir Harishbhai Rajyaguru

Assistant professor, Department of Computer Engineering, Madhuben and Bhanubhai Patel Institute of Technology (MBIT) - The Charutar Vidhyamadal (CVM) University, New V. V. Nagar, Anand, Gujarat, India.

mihir.rajyaguru@gmail.com, mihir.rajyaguru@cvmu.edu.in

Orcid Id -0000-0003-2761-1541

Abstract

Cardiovascular diseases account for 18 million deaths annually, with sudden cardiac arrest demonstrating 80-90% out-of-hospital mortality due to delayed detection and inadequate continuous monitoring. This research presents a unified IoT-deep learning framework addressing both acute cardiac arrest detection and chronic heart disease prediction through dual-task architecture. The published work introduces an IoT-enabled Deep Convolutional Neural Network (DCNN) system achieving 96.5% accuracy and 97.8% sensitivity for real-time signal analysis with sub-3-second latency across MIT-BIH, PhysioNet, and hospital datasets (468 patients, 484K beats). The three-tier edge-cloud architecture integrates wearable sensors (ECG/PPG/HRV), MQTT protocol for low-bandwidth transmission, and multi-stage preprocessing improving SNR by 162%. The PhD extension proposes a novel CNN-LSTM hybrid architecture for image-based ECG analysis, enabling deployment in resource-limited settings with paper records. The model employs 3×3 lead slicing generating nine sub-images, custom CNN extractors per lead, and LSTM for inter-lead temporal sequence modelling, targeting 94-96% accuracy on ECG image datasets (35K+ images). Grad-CAM explainability validates QRS/ST-segment focus, ensuring clinical trust and regulatory compliance. The system addresses critical gaps in dual-task integration, IoT-ML fusion, multi-dataset generalizability, and explainable AI for cardiovascular monitoring. Clinical impact includes 2.4-second emergency alerts, tiered risk stratification for preventive interventions, rural healthcare equity, and potential savings of \$500K per averted cardiac arrest, establishing a scalable paradigm for AI-driven cardiovascular care.

Keywords: *Cardiac Arrest Detection, Internet of Things (IoT), Deep Convolutional Neural Network (DCNN), CNN-LSTM Hybrid Architecture, ECG Image Analysis, Explainable AI (Grad-CAM)*

Role of IoT in AgricultureAARCHI ARORA¹, AARZU PATHAN²

12Student, BSc CA&IT, Department of Computer Science, NVPAS College, The CVM University, V.V.Nagar, Anand, Gujarat. Email:aarchiarora399@gmail.com

Abstract

The rapid integration of the Internet of Things (IoT) in agriculture is transforming traditional farming practices into intelligent, data-driven systems. This paper explores the pivotal role of IoT in enabling smart farming solutions for a sustainable and productive future. By connecting sensors, devices, and cloud-based platforms, IoT facilitates real-time monitoring, automation, and informed decision-making across various agricultural operations. Smart irrigation systems leverage soil moisture sensors and mobile applications to optimize water usage, ensuring efficient water conservation while maintaining crop health. Precision farming techniques utilize drones, satellite imaging, and connected machinery to provide accurate field monitoring, improving yield and reducing resource wastage. Weather monitoring systems offer climate forecasting capabilities, allowing farmers to anticipate environmental changes and minimize risks associated with unpredictable weather patterns. Additionally, IoT-driven soil health monitoring supports nutrient analysis and timely fertilization, enhancing soil productivity and long-term sustainability. Livestock tracking solutions enable continuous animal monitoring, improving health management and operational efficiency. Farm automation technologies, including smart machinery and robotics, streamline agricultural processes, reduce labor dependency, and increase overall farm productivity. By integrating these interconnected technologies, IoT fosters resource optimization, cost reduction, environmental sustainability, and enhanced crop and livestock management. This study highlights innovative applications, practical challenges, and future prospects of IoT in agriculture, emphasizing its transformative potential in addressing global food security and climate resilience. Through collaborative research and technological advancement, IoT-driven smart farming paves the way for a more efficient, resilient, and sustainable agricultural ecosystem.

Keywords: *Weather Monitoring, Soil Health Monitoring, Livestock Tracking, Farm Automation, Resource Optimization, Weather Monitoring, Soil Health Monitoring, Livestock Tracking.*

IoT Enabled Soil Cu²⁺ Screen Printed SensorDivyang Ka. Patel^{1, 2*} and Himanshu Kapse¹^{1*} Department of Instrumentation and Control

Institute of Science & Technology for Advanced Studies & Research, CVM University, Vallabh Vidyanagar, Gujarat, India Email: kachhiadivyang@gmail.com ORCID iD:0009-0008-7894-6038

² Departments of Information Technology

Silver Oak College of Engineering & Technology, Silver Oak University, Ahmedabad, Gujarat, India

Abstract

This study presents the development of a highly sensitive, cost-effective, and screen-printed electrochemical sensor for the selective detection of Cu²⁺ ions in soil matrices. The sensing electrode was fabricated by incorporating a graphite-based composite containing phenanthroline (Phen), sodium tetraphenylborate (NaBPh₄), and sodium diethyldithiocarbamate (NaDDC) onto a silver basal track using a scalable screen-printing technique. A two-electrode configuration, comprising a silver working electrode and an Ag/AgCl reference electrode, was employed to ensure stable and reproducible potentiometric measurements. The fabricated sensor exhibited excellent analytical performance over a wide

linear concentration range, with a low detection limit of 4×10^{-6} mol L⁻¹ sensitivity of 70.78 ± 0.5 mV decade⁻¹, indicating efficient ion-selective response toward Cu²⁺. To enhance practical applicability, the screen-printed sensor was integrated with an Internet of Things (IoT) platform, enabling real-time data acquisition, visualization, and wireless transmission of Cu²⁺ concentration values to remote locations. The sensor's performance further validated through the analysis of real soil samples, where the obtained results showed good agreement with those measured using the conventional inductively coupled plasma optical emission spectroscopy (ICP-OES) method. The high sensitivity, low detection limit, portability, and IoT-enabled remote monitoring highlight the strong potential of the developed sensor for in-situ monitoring of Cu²⁺ in soils.

Keywords: *Cu²⁺ sensor, IoT, Screenprint*

Interdisciplinary Sciences

INP-94

The first urbanites: Engineering the harappan civilization.

Aarya Manojkumar Saidva, Jay Jagdishchandra Rana - (M.sc Rev- sem- 2)

Abstract

The Harappan Civilization, representing the first urbanization in South Asia from c. 3300–1300 BCE, transitioned from early farming communities to complex urban centers around 2600 BCE, marked by advanced engineering, meticulous town planning with a grid system and standardized bricks, and elaborate hydraulic engineering including covered drainage systems and iconic structures like the Great Bath. Characterized by a centralized, non-hierarchical socio-economic organization focused on trade, agriculture, and craft, along with a high degree of standardization in weights and measures, the civilization prioritized sanitation and civil engineering before its gradual decline between 1900–1300 BCE, likely due to environmental factor.

INP-95

Impact of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 on Land Valuation

Deepali Jain , Toushy Bajaj
M.Sc. in Real Estate Valuation, Sem II

Abstract

The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, reshaped **land valuation** practices in India by ensuring equitable **compensation**, enhanced **transparency**, and mandatory **rehabilitation** measures. This legislation emphasised fairness in acquisition, integrating socio-economic concerns into valuation processes. Its **social impact** extended beyond monetary aspects, safeguarding livelihoods and promoting accountability. By introducing standardised valuation methods and higher compensation multiples, the Act balanced developmental imperatives with justice for affected communities. Consequently, land valuation evolved into a multidimensional framework, reflecting both market value and social considerations, thereby redefining acquisition practices and influencing long-term policy outcomes.

Immovable Property Valuation by Cost Approach

Kirti Ram Tarachandani & Manu Solanki
MSC (REV)-4th Sem

Abstract

The Cost Approach is a fundamental real estate valuation method that estimates property value based on the present replacement cost. This study focuses on the Depreciated Replacement Cost (DRC) method and explains the application of three depreciation techniques — Straight Line Method, Sinking Fund Method, and Written Down Value Method. By calculating building depreciation and adding land value, the final property value is derived in a systematic and logical manner. The Cost Approach is one of the fundamental methods of real estate valuation and is based on the economic principle of substitution. According to this principle, a prudent buyer will not pay more for a property than the cost of acquiring land and constructing a similar building with equivalent utility. This approach determines property value by estimating the current replacement or reproduction cost of the building and deducting depreciation arising from physical deterioration, functional obsolescence, and external factors. The resulting figure, known as Depreciated Replacement Cost (DRC), is then added to the market value of land to derive the final property value. The Cost Approach is particularly useful for new constructions, special-purpose properties, institutional buildings, and industrial structures where reliable market comparisons or income data may not be readily available. The method provides a benchmark value that can be compared with income and market approaches.

Liquidation Value vs Auction Value (Property Valuer's Perspective - Indian Banking & NPA Context)

Tanay Agrawal
Class: M. Sc. (PMV) Sem II

1. Liquidation Value (LV)

Liquidation Value is the estimated price a property would fetch if it must be sold urgently, usually under distress conditions, with limited marketing time. It represents a worst-case recovery scenario used mainly by banks in NPA, SARFAESI, DRT and IBC matters.

2. Auction Value (AV)

Auction Value is the expected price a property may fetch in a public auction where multiple bidders are invited. Though still under recovery or enforcement proceedings, the process allows some competition and transparency.

3. Key Differences between Liquidation Value and Auction Value

Aspect	Liquidation Value (LV)	Auction Value (AV)
Nature of Sale	Forced, distressed and urgent sale	Public auction with competitive bidding
Marketing Time	Very short or negligible	Short but structured and advertised
Buyer Competition	Very limited buyers	Moderate level of competition
Seller's Bargaining Power	Nil	Limited but present
Risk Level	Very high	High but controlled
Basis of Assessment	Worst-case recovery scenario	Realistic auction outcome
Discount from FMV	Heavy discount	Moderate discount
Use in Banking	Internal risk assessment	Reserve price fixation
Public Disclosure	Not disclosed publicly	Disclosed through auction notice
Relative Value Level	Lowest among all values	Higher than LV but lower than FMV

4. Value Hierarchy (Important for Valuers)

Fair Market Value

↓

Auction Value

↓

Liquidation Value

5. Practical Valuer's Note (Bank Reports)

Auction Value is not equal to Liquidation Value.

Liquidation Value should never be adopted as reserve price.

Banks rely on Liquidation Value only for internal risk assessment.

Percentage reductions must always be clearly justified in valuation reports.

INP-98

Manufacturing Process of inner and outer rings for various bearing types - A Case Study at Rajkot

Deep Patel

M. Sc. (PMV), Sem IV

Abstract

M/s. Galaxy Agrico Exports Limited is a public limited company primarily engaged in the high-precision manufacturing of forged rings for ball bearings. Headquartered in the industrial hub of Rajkot, Gujarat, the company has built a significant global footprint by exporting its production to over 39 countries. The company operates as an integrated manufacturing unit specializing in metallurgical processes. It is recognized for its ability to produce high-carbon chromium steel (SAE 52100) forged rings. These rings are the critical structural components of ball bearings, designed to withstand heavy radial and axial loads. Survey No. 236, Jai Kishan Industrial Estate, Behind Murlidhar Weigh Bridge, Veraval (Shapar), Rajkot, Gujarat - 360024. Forging Unit: Equipped with single-piece forging presses and ring rolling machines. Heat Treatment: Features induction hardening and continuous conveyor hardening/tempering furnaces for achieving uniform metallurgical properties. Machining Shop: Includes automatic lathes, screw machines, and CNC turning centers for rough and finish shaping. Surface Treatment: Facilities for powder coating, epoxy coating, and enamel paint finishing, primarily for the agricultural tool line. Capacity: Historically, the plant had an installed capacity to process roughly 2,400 tonnes of bearing rings per annum. The manufacturing of inner and outer rings follows a precise sequence to ensure dimensional accuracy and fatigue resistance:

1. Sourcing/Forging: Raw material (typically tubes or bars) is cut and heated, then forged or rolled into "green" rings.
2. Turning (Green Machining): Automatic machines or lathes cut the ring to basic shapes, leaving a small margin for post-heat treatment grinding.
3. Annealing, Hardening & Tempering: Rings are heated to approximately 1565°F (850°C), quenched in oil, and tempered at lower temperatures to achieve a hardness of 58–64 HRC.
4. Face Grinding: Both faces of the ring are ground to ensure parallel surfaces and precise width.
5. OD & Bore Grinding: The Outside Diameter (for outer rings) and the Bore (for inner rings) are ground to micron-level tolerances.
6. Race Grinding: The "track" or raceway where the balls will roll is ground to a specific radius and geometry.
7. Honing/Super-finishing: The final step to achieve a mirror-like surface finish, reducing friction and noise in the final bearing assembly.

A Study on Valuation of Residential Immovable Property for Capital Gains Tax Purposes

Prasad Vithaldas Malkar
Siddhesh Nitin Rathod
M. Sc. (REV) Sem IV

Abstract

This valuation report addresses the estimation of the Government Guideline Value (GGV) of a residential immovable property, namely Flat No. 197, located at D. N. Nagar Saptashrunji Co-operative Housing Society Ltd., Andheri (West), Mumbai, as on 1st April 2001, for the purpose of Capital Gains Tax assessment. The subject property was originally held under single ownership by Mr. Satish Sakharam Prabhu and subsequently formed part of a redevelopment project involving permanent alternate accommodation. Documentary evidence including allotment records, redevelopment agreements, and ownership transfer instruments was examined to establish legal title, interest valued, and valuation assumptions. Where documentary limitations existed, reasonable assumptions consistent with valuation practice have been adopted and clearly disclosed.

Impact of planning regulations on land value

Shuchita Sharaff , Anjali Verma
M.Sc. (REV) – Sem II

Abstract :

Zoning defines land use – Residential, Commercial, and Industrial, Mixed-use. Land use affects demand – Commercial zoning generally has higher value than residential. FSI (FAR) determines development potential – Higher FSI = More buildable area. Higher FSI increases land value due to greater revenue-generating capacity. Restrictive zoning lowers development scope and may reduce land value. Change in zoning classification can cause value appreciation. Premium FSI / TDR impact feasibility and valuation calculations. Infrastructure development influences zoning revisions and land price growth. Environmental / heritage restrictions may negatively affect valuation. Valuers must analyze DCR, master plans, and local regulations before valuation.

A Study on Market Valuation of a Residential Property at Australia

Mohamadafzal Mohamadrafik Sandhisama
Vatsal Kiritkumar Vaghasiya
M.Sc. (Real Estate Valuation), Sem IV, ISTAR

Abstract

Valuation of residential immovable property is an essential professional exercise undertaken to determine the present market worth of a property as on a specified date. It plays a significant role in mortgage lending, financial reporting, taxation, investment analysis, and regulatory compliance. The process of valuation involves systematic examination of legal title, location, land attributes, building characteristics, town planning controls, market trends, and comparable sales evidence. Among the recognized valuation approaches, the Direct Comparison Approach is widely applied for residential properties, as it reflects prevailing market transactions, while the Investment Method serves as a supporting tool based on rental potential and yield analysis. This study focuses on the practical application of these accepted valuation principles and methodologies in estimating the Current Market Value of a residential property, ensuring objectivity, reliability, and professional compliance with established valuation standards. \ This

valuation report focuses on the estimation of the Current Market Value of a residential immovable property located at 15 Rosemeath Avenue, Kingsgrove, NSW 2208, as on 01 July 2021. The valuation has been carried out for the purpose of determining the Current Market Value for mortgage security (academic purpose), valuing the 100% Freehold Interest on a Vacant Possession basis.

INP-102

Comprehensive valuation and technical appraisal of a mixed-use commercial and residential development

AKSHAY PATNI, SHREYANSH JAIN
M. Sc. (REV) Sem IV

Abstract

This project presents a comprehensive valuation and technical appraisal of a mixed-use commercial and residential development using the three principal approaches to property valuation: the Market (Sales Comparison) Approach, the Cost Approach, and the Income Approach. The study aims to develop an in-depth understanding of the planning, design, and functional integration of commercial and residential components within a single development framework. The Market Approach is applied to determine the property's market value by analyzing comparable sales transactions in the surrounding area. The Cost Approach is used to estimate the replacement cost of the building, taking into account construction costs, land value, and depreciation factors such as physical deterioration, functional obsolescence, and economic obsolescence. The Income Approach evaluates the income-generating potential of the property by analyzing rental income, operating expenses, capitalization rates, and projected returns. The study further examines the importance of valuation and LIE reports in supporting bank financing and lending decisions. Finally, the values derived from different valuation approaches are compared and analyzed to understand variations and establish a reliable estimate of market value. This project enhances practical knowledge in real estate valuation, construction estimation, project appraisal, and risk assessment, providing a comprehensive understanding of professional practices in the real estate and banking sectors.

INP-103

Development Plans and Their Importance in Urban Management.

Tejas Patil
E-mail: tejaspatil.inbox@gmail.com
M.Sc. (REV) Sem II, ISTAR

Abstract

Development Plans play a central role in guiding urban growth by providing a long-term, statutory framework for land use, infrastructure provision, environmental protection, and socio-economic development. In rapidly urbanizing Indian cities, Development Plans act as a bridge between policy intent and on-ground implementation, helping urban local bodies manage growth in an organized, efficient, and sustainable manner. They integrate spatial planning with infrastructure planning, ensuring that residential, commercial, industrial, recreational, and public utility uses evolve in a balanced way while complying with planning regulations and development control norms. This presentation examines the importance of Development Plans in urban management, with reference to Vadodara as a case example. Vadodara's Development Plan illustrates how zoning regulations, road networks, public amenities, green spaces, and reservation of land for public purposes can shape orderly urban expansion. The city's planning approach highlights the role of Development Plans in controlling urban sprawl, improving connectivity, supporting economic activities, and enhancing overall quality of life. It also demonstrates how Development Plans assist local authorities in decision-making related to

building permissions, infrastructure investment, and redevelopment. The study emphasizes that effective Development Plans are not static documents but dynamic instruments that require periodic revision to respond to population growth, changing land demands, environmental concerns, and emerging urban challenges. Through the Vadodara reference, the abstract underlines how well-prepared and properly implemented Development Plans are essential tools for sustainable urban management in Indian cities.

INP-104

Valuation For Capital Gain Tax Purpose

MOHAMMAD ARSH VAHORA
M. Sc. (REV) Sem IV

Abstract

Capital gain tax is in fact not a separate tax but it is part of Income Tax Act. Income received by the assesses by the by the way of sale of any asset (shares, machinery, immovable property) in the previous year are not taxed at regular income tax rates but are charged under a separate head of 'Capital Gain Tax'. Rates of this Capital Gain Tax are different than rates of Income Tax. This study focuses on the methodology of valuation for the purpose of determining Capital Gains occurred on transfer of a capital asset – viz. immovable property.

INP-105

Valuation Of Different Types Of Immovable Properties By Different Approaches

Joelmarx Justin & Vatsal Sunil Selarka

ABSTRACT

This study provides a comprehensive overview of how various immovable properties—ranging from residential bungalows to complex industrial machinery—is valued using distinct methodologies. By applying specific approaches, such as calculating replacement costs for unique structures or capitalizing income for commercial assets, appraisers can quantify value that reflects investor expectations, market risk, and physical depreciation. The correct application of these methods ensures that the final valuation is reliable, measurable, and predictable for all stakeholders. Real estate valuation is the distinct science and art of estimating the market value of a property based on established economic principles, market trends, and professional judgment. Unlike liquid assets (like stocks or gold), immovable property is heterogeneous and illiquid, requiring specialized analysis. To achieve an accurate assessment, three internationally accepted valuation approaches are utilized: The Cost Approach, The Sales Comparison Approach, The Income Approach. The selection of the method depends on the nature of the property (residential, commercial, or special use) and the purpose of the valuation (sale, mortgage, taxation, or insurance). CONCEPT OF VARIOUS APPROACHES” The value of an asset is not intrinsic; it is created by human needs and desires. It is determined by the interplay of Utility (usefulness), Scarcity (supply), and Desirability (demand). The fundamental premise of all valuation approaches is the Principle of Substitution: A rational buyer will not pay more for a property than the cost of acquiring an equally desirable substitute, whether that be by building a new one (Cost Approach), buying an existing one (Sales Comparison), or buying a different income stream (Income Approach). Fundamental Equation: Value = Application of the most relevant market based methodology.

Valuation of Commercial Property

Rajesh Kumar Pandey
M. Sc. (REV) Sem IV

Abstract

Valuation of commercial property is required to determine the fair market value of real estate used for business purposes such as offices, retail shops, shopping complexes, warehouses, hotels, and industrial buildings. The objective of commercial property valuation is to estimate the most probable price that the property would fetch in an open and competitive market under normal conditions. Commercial property valuation plays a vital role in various financial and legal matters including sale and purchase transactions, mortgage and loan security, taxation, financial reporting, insurance, compulsory acquisition, and investment analysis. Unlike residential properties, the value of commercial property is primarily driven by its income-generating potential, location, market demand, lease terms, and overall economic conditions. In conclusion, valuation of commercial property is a systematic and analytical process that requires professional judgment, market knowledge, and adherence to established valuation principles and standards. Since commercial properties are income-oriented assets, accurate assessment of rental income, occupancy levels, market trends, and risk factors is essential in arriving at a reliable value. A well-prepared valuation report not only ensures transparency and credibility but also supports informed decision-making for investors, lenders, businesses, and government authorities. Therefore, commercial property valuation serves as a crucial tool in financial planning, investment appraisal, and regulatory compliance.

Income Approach of Real Estate Valuation

Rounak Sinha Roy
Yash Patel
M.Sc. (REV) Sem IV, ISTAR

Abstract

Real estate valuation is the process of estimating market value of a property based on established principles and professional judgment. Among the three internationally accepted approaches - Cost approach, Market approach and Income approach, income approach is particularly significant for income producing properties. Income approach is based on the principle that the value of a property is directly related to its ability to generate future economic benefits in the form of rental income or cash flows. This approach converts expected future income into present value by considering factors such as risk, time value of money, operating expenses, and required rate of return. This project is aimed at doing valuation of an income producing property by income approach, understanding the methodology as well as limitations of the approach.

Comparative Study Of Change In Pattern Of Land-Use And Land Cover Of Kalimpong District West Bengal Over A Decade (2015-2025)

Anish Pradhan#, Sujal Thapa#, Krunal Suthar*
Department of Geoinformatics,
Institute of Science & Technology for Advance Studies & Research (ISTAR),
The Charutar Vidya Mandal (CVM) University,

Vallabh Vidyanagar-388120, Gujarat, India.

#Presenting Author: pradhan.anish.2004@gmail.com, sujalthapa093@gmail.com

*Corresponding Author: krunal.suthar@cvmu.edu.in

ABSTRACT

Economic development and population growth plays a significant role in land use and land cover profile in today's century. The growth has been rapid over the world creating new opportunities and boosting the economy of the countries and advancement in sciences can also be seen, which makes living of the humankind easier. The land use and land cover of the earth has been changing drastically and causing many problems like the change in the weather, decrease in the water level, decline in the agricultural soil quality, increase in the natural disasters etc.. In this paper the LULC map of the district has been prepared using the Landsat-8 (level-2) satellite data for the year 2015 and Landsat-9 (level-2) satellite data for the year 2025 using Quantum GIS software. The district of Kalimpong, West Bengal has been classified and characterized into five different categories: water bodies, built-up, dense forest, semi-dense forest and barren land. These categories are later converted into percentages and the values are compared to observe change in LULC. The aftermath of the statistical analysis shows the changes in the LULC data extracted over a decade. It shows that the change in percentage of the water bodies has been decreased over the years, the build-up area has also surprisingly decreased along with the semi dense forests and the percentage of dense forest and the barren land has grown over the past decade. This study shows that the district may face scarcity of the water resources in the future and as the barren lands are increasing which might result in the further increase of vegetation cover in the district of Kalimpong.

Keywords: *Kalimpong, Land-use, Land cover, Landsat, LULC, Urban Sprawl, Vegetation Cover.*

INP-109

Land Surface Temperature Of Kalimpong Town Using Landsat 8/9 Oli/Tirs Collection 2 Level 2 Satellite Imagery Data

Sujal Thapa#, Anish Pradhan#, Krunal Suthar*

Department of Geoinformatics,

Institute of Science & Technology for Advance Studies & Research (ISTAR),

The Charutar Vidya Mandal (CVM) University,

Vallabh Vidyanagar-388120, Gujarat, India.

#Presenting Author: sujalthapa093@gmail.com, pradhan.anish.2004@gmail.com

*Corresponding Author: krunal.suthar@cvmu.edu.in

ABSTRACT

The objective of this study is to measure and analyze the Land Surface Temperature (LST) of Kalimpong town and its surrounding areas over the past decade (2015–2025). The research provides insights into the spatio-temporal variation of LST during this period. Urbanization and climate change have significantly altered thermal patterns, resulting in fluctuations in both maximum and minimum temperatures in Kalimpong, West Bengal, India. Certain regions, particularly urban areas, exhibit higher heating compared to surrounding regions. Additionally, cold-year conditions were observed in 2025. Multitemporal satellite data (Landsat 8/9 OLI/TIRS Collection-2 Level 2) were used to derive surface thermal emissivity and estimate LST. Cloud contamination was minimized through manual inspection, and unavoidable cloud-covered areas were masked using the Quality Assessment (QA) pixel band. The multitemporal analysis of the month of December reveals an overall increasing trend in LST throughout the study period, although some years recorded lower mean temperatures while others remained above average. For April, the temperature shows a general increasing trend with slight decreases in mean temperature during certain years. Similarly, the analysis for May indicates an increase in mean temperature consistent with previous datasets. Overall, the study concludes

that Kalimpong experiences significant fluctuations in mean monthly temperature. The temperature variation does not follow a linear increasing or decreasing trend but instead exhibits inter-annual variability with noticeable year-to-year ups and downs.

Keywords: Kalimpong, Land Surface Temperature, Landsat, satellite imagery, Urban Heat

INP-110

Spatiotemporal Analysis of Forest Cover Dynamics in Jalpaiguri District of West Bengal (for years 2021-2025) Using Sentinel-2 Data

Ashwin Bara#, Indranil Mondal#, Krunal Suthar*
Department of Geoinformatics,
Institute of Science & Technology for Advance Studies &
Research (ISTAR),

The Charutar Vidya Mandal (CVM) University,
Vallabh Vidyanagar-388120, Gujarat, India.

#Presenting Author: ashwinbara229@gmail.com, indnet2004@gmail.com

*Corresponding Author: krunal.suthar@cvmu.edu.in

ABSTRACT

The forest ecosystems of Jalpaiguri District, West Bengal, are increasingly vulnerable to anthropogenic pressures, leading to a complex mix of deforestation and cryptic forest degradation. Traditional monitoring often fails to distinguish between absolute canopy loss and gradual thinning, requiring advanced spatiotemporal analysis to guide conservation efforts effectively. This study aims to qualitatively assess and map the trajectory of forest cover dynamics over the study period, specifically distinguishing between zones of deforestation, stable vegetation, and afforestation to determine the overall ecological trend of the region Jalpaiguri in West Bengal. Harmonized Sentinel-2 Level-2A surface reflectance data were processed using cloud-based geospatial platforms. A change detection approach was employed by calculating the difference in the Normalized Difference Vegetation Index (NDVI) between the start and end of the study timeline. High-resolution optical bands were utilized to derive vegetation health indices, followed by zonal statistical analysis to characterize the direction and magnitude of change. The analysis reveals a predominant negative trend in vegetation cover, indicating a district-wide decline in forest health. The distribution of pixel values highlights a distinct disparity while isolated pockets of successful afforestation and regrowth are visible, they are significantly outweighed by widespread areas of degradation. The statistical skew towards negative values confirms that forest thinning and clearing are the dominant processes currently shaping the landscape. The study concludes that Jalpaiguri is currently in a state of "net forest loss." Although regeneration initiatives have yielded positive results in specific locales, the prevailing spatial pattern indicates that degradation rates currently exceed natural or artificial recovery rates, threatening the district's ecological balance. The generated spatiotemporal change maps serve as a critical tool for the West Bengal Forest Department. By pinpointing specific high-intensity loss zones, authorities can prioritize ground patrolling and allocate conservation resources to the most vulnerable "hotspots" identified in the analysis.

INP-111

Spatiotemporal Analysis of Urban Dynamics in Gujarat (1990–2030): Integrating GHSL Data and GIS for Mapping Degrees of Urbanization and Future Projections

Sujal Thakor#, Krunal Suthar*
Department of Geoinformatics,
Institute of Science & Technology for Advance Studies & Research (ISTAR),
The Charutar Vidya Mandal (CVM) University,
Vallabh Vidyanagar-388120, Gujarat, India.

#Presenting Author: sujalthakor13@gmail.com

*Corresponding Author: krunal.suthar@cvmu.edu.in

Abstract

This research investigates the multi-decadal evolution of urban landscapes in Gujarat, India, from 1990 to 2030. Utilizing the Global Human Settlement Layer (GHSL) dataset—specifically the Degree of Urbanization (GHS-SMOD) product—this study leverages the computational power of Google Earth Engine (GEE) to extract and process high-resolution settlement layers at five-year intervals. The methodology involves transitioning these multi-temporal datasets into a Geographic Information System (QGIS) environment for advanced spatial analysis, classification, and cartographic visualization. By applying the UN-recommended "Degree of Urbanization" framework, the study categorizes land into urban centers, urban clusters, and rural areas to quantify the transition of land-use patterns over four decades. Preliminary findings highlight significant urban expansion along the Golden Corridor and major industrial hubs, alongside a projected intensification of built-up areas by 2030. The resulting series of thematic maps provide a comprehensive visual and statistical record of Gujarat's transition from rural-dominant landscapes to organized urban systems. This study serves as a critical spatial baseline for urban planners and policymakers to address the challenges of sustainable infrastructure development and land resource management in one of India's most rapidly industrializing states.

INP-112

MEDIWING

Anushka Shah¹, Huzefa Parekh², Dr. Kavindra Jain³

Affiliation: Department of Electronics and Communication Engineering, GCET, India

Email: anushkashah.1221@gmail.com , huzefaparekh125@gmail.com

Abstract

Unmanned Aerial Vehicles (UAVs), particularly quadcopters, have recently gained significance in the civilian and healthcare sectors due to their maneuverability, portability, autonomy, and remarkably fast delivery speed compared to other modes of transport like road vehicles. Semi-autonomous quadcopters with navigation and stabilization systems are effective tools for time-critical tasks like the delivery of health-related materials in distant or populated areas where timely action is critical. In addition to performance benefits, the proposed system is remarkably cost-efficient—so economical that its operational expense is almost negligible compared to traditional logistics methods, making it an attractive solution for large-scale deployment. The proposed semi-autonomous quadcopter system uses GPS control, altitude hold systems, A return-to-launch (RTL) feature for efficient navigation and recovery. A live video transmission system enables real-time monitoring, and optimized propulsion. Design systems enable the system to support a payload of upto 2 kg. The communication system enables a flight range of upto 20 kilometers while ensuring fast transit speeds that are substantially shorter than traditional transport systems. The experimental results demonstrated the capability of the quadcopter to maintain: A stable altitude, precise GPS positioning, stable hovering in the presence of moderate environmental disturbances. The quadcopter successfully transported medical payloads while transmitting live video footage, and it maintained high stability and control throughout the entire mission. The RTL (return-to-launch) function enhanced the safety factor and ensured the prevention of loss. Moreover, the time taken for the completion of the mission was significantly shorter than ground delivery systems, thereby demonstrating the superior speed efficiency of the system. The system is highly effective for medical delivery and surveillance applications. With a 2200 mAh battery, the average flight time is about 15 minutes, which can be further increased by using higher-capacity batteries or charging stations. Although the battery life restricts the mission duration, the quadcopter's incredible speed efficiency, intelligent navigation, stability, and astonishing cost-effectiveness make it an extremely promising tool for rapid healthcare delivery.

Development of IoT-based Methane Sensing for Smart Agriculture

Ankita J. Mahaliya*, H. N. Kapse

Department of Instrumentation & Control, Institute of Science & Technology for Advanced Studies & Research (ISTAR) - The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, 388120, Gujarat

*Email: ankita@istar.edu.in

Abstract

The adoption of Internet of Things (IoT) technology has significantly transformed smart agriculture by enabling real-time monitoring and data-driven farm management. Methane and other greenhouse gases must be continuously detected in agriculture to increase crop yields and reduce environmental damage. With an emphasis on real-time methane monitoring in agriculture, this work introduces an Internet of Things-based methane sensing intended for smart agriculture applications. The system integrates an Arduino Uno microcontroller for data processing and sensor interface with a methane gas sensor. IoT connectivity allows the collected data to be transmitted wirelessly to a remote monitoring platform, enabling continuous observation, data logging, and analysis. The system is developed to be scalable, easy to deploy and affordable, making it suitable for smart agriculture. The developed system supports smart agriculture by delivering timely insights into methane emission variations through the integration of IoT technology with gas sensor-based monitoring. This supports more effective farm management decisions, promotes sustainable agricultural practices, and enhances smart farming technologies alongside environmental monitoring.

Keywords: *Arduino Uno, Internet of Things (IoT), Methane Sensor, Smart Agriculture.*

Organ-on-a-Chip Platforms: Current Horizons and Future Trajectories in Drug Delivery and Toxicity Testing

Parin Jadhav

Department of Applied and Interdisciplinary Sciences, Sardar Patel University
Vallabh Vidyanagar-388120, Anand

Email: parindjadhav2345@gmail.com

ABSTRACT

In the traditional drug development process, the "preclinical gap" exists due to the failure of conventional animal-based systems and 2D cell cultures in predicting the response of drugs in humans. In this review article, this review highlights recent advances in Organ-on-a-Chip (OoC) technology, which is characterized by micro-engineered devices that combine elements of microfluidics with living human cells to produce devices that mimic 3D tissue structures, as well as mechanical forces like stretch in the lung, fluid shear stress as seen in the circulation. This review aims to highlight different bio-inspired models like the lung. OoC platforms are associated with superior predictability for characterizing drug toxicities and delivery, especially for nanomedicine transport and pharmacokinetic/pharmacodynamic (PK-PD) modeling. For example, the dynamic interface between tissues and blood vessels is simulated well by OoC, which ensures a high-fidelity environment for observing cellular health under human-relevant conditions. Organ-on-a-Chip, in short, signifies a new era of pharmacology. It bridges the gap between benchtop studies and clinical trials, thereby offering an ethical and economic way of doing pharmacology, avoiding animal testing, and paving the way for personalized medicine.

Keywords: *Organ-on-a-Chip (OoC), Microfluidics, Toxicity testing, Biomimicry, Microphysiological Systems (MPS)*

Drugging the Undruggable: Leveraging AI-Based Knowledge Graphs and PROTAC Technology to Target Fusion Oncogenes in Rare Sarcomas

Devanshi Dave, Khushi Rathava

Rare sarcomas comprise a heterogeneous group of malignancies frequently driven by chromosomal translocations that generate oncogenic fusion proteins. These fusion oncoproteins often function as aberrant transcription factors or scaffolding proteins lacking conventional enzymatic pockets, rendering them largely “undruggable” by traditional small-molecule inhibitors. Consequently, therapeutic options remain limited, and clinical outcomes are often poor, particularly among pediatric and young adult populations. Addressing this unmet clinical need requires integrative and innovative therapeutic strategies. Recent advances in artificial intelligence (AI) and systems biology have enabled the development of biomedical Knowledge Graphs (KGs), which integrate multidimensional datasets including genomics, proteomics, transcriptomics, drug-target interactions, and disease phenotypes. AI-driven KG frameworks facilitate network-based analyses, uncover hidden biological relationships, predict novel drug-target interactions, and prioritize actionable fusion oncogenes. By leveraging graph-based machine learning and link prediction algorithms, these models enhance target validation and accelerate rational drug discovery. Concurrently, Targeted Protein Degradation (TPD), particularly through Proteolysis-Targeting Chimeras (PROTACs), has emerged as a transformative therapeutic modality. Unlike conventional inhibitors that suppress protein activity, PROTACs induce ubiquitin-mediated proteasomal degradation of pathogenic proteins, enabling complete and sustained removal of disease-driving fusion oncoproteins. This approach is especially advantageous for transcription factors and scaffolding proteins traditionally considered intractable. This study highlights the synergistic potential of integrating AI-powered knowledge graphs with PROTAC-based degradation strategies to systematically identify, validate, and therapeutically target fusion oncogenes in rare sarcomas. The convergence of computational oncology and targeted protein degradation represents a paradigm shift toward precision oncology, offering a scalable framework to overcome biological complexity and expand the druggable proteome in rare and aggressive cancers.

Keywords: Rare Sarcomas, Knowledge Graphs, Artificial Intelligence, Undruggable Targets, Fusion Oncogenes, Drug Discovery, Targeted Protein Degradation, PROTACs, Precision Oncology, Computational Biology

Evaluation of sol-gel synthesized Fe₃O₄ nanoparticles as antimicrobial agents

Priyansh N. Brahmhatt and Mehul S. Dave*

Natubhai V. Patel College of Pure and Applied Sciences, The Charutar Vidya Mandal (CVM) University, Vallabh Vidyanagar, Gujarat-388120, India.

Corresponding's Authors' Email:- mehul@nvpas.edu.in

ABSTRACT

Magnetite (Fe₃O₄) nanoparticles were synthesized via a sol-gel method and systematically characterized to evaluate their biomedical and antimicrobial potential. X-ray diffraction analysis confirmed a single-phase cubic spinel structure with an average crystallite size of 16.75 nm, while electron microscopy revealed nearly spherical nanoparticles with slight agglomeration. Energy-dispersive X-ray spectroscopy verified elemental composition and phase purity. Magnetic measurements demonstrated superparamagnetic behaviour at room temperature with a saturation magnetization of 37.21 emu·g⁻¹, indicating suitability for magnetic-assisted biomedical applications. The antimicrobial activity of the Fe₃O₄ nanoparticles was assessed using the agar well diffusion method against *Staphylococcus aureus* and *Enterobacter aerogenes* at concentrations ranging from 50 to 200 µg mL⁻¹. A clear concentration dependent antibacterial

response was observed, with maximum zones of inhibition of 23 ± 1 mm for *S. aureus* and 18 ± 1 mm for *E. aerogenes* at $200 \mu\text{g mL}^{-1}$, while the minimum inhibitory threshold was identified between 100 and $150 \mu\text{g mL}^{-1}$. The results demonstrate that sol-gel synthesized Fe_3O_4 nanoparticles exhibit effective antimicrobial activity and promising physicochemical properties, highlighting their potential for biomedical applications.

INP-117

Systems Biology Modelling of Blood–Brain Barrier Disruption in Multiple Sclerosis Using Computational Network Analysis

Khushi Rathava, Devanshi Dave

Abstract

The blood–brain barrier (BBB) controls the movement of substances between the blood and the brain and it plays an important role in brain development and disease. Damage to this barrier can affect brain health and contribute to disorders such as multiple sclerosis (MS). Multiple sclerosis (MS) is a chronic, autoimmune neurological disorder that damages the central nervous system, leading to progressive disability and long-term physical and cognitive impairment. Despite advances in treatment, current therapies show limited effectiveness and vary between patients. To address these challenges, computational and systems biology approaches offer powerful tools for understanding disease mechanisms and predicting clinical outcomes. This study integrates neurobiology, immune system modelling, and computational simulations to investigate MS pathogenesis and disease progression. The neurovascular unit (NVU) will be systematically analysed, and immune system interactions will be tracked using computational modelling to capture the dynamic interplay between neural, vascular, and immune components. Multi-scale models will integrate molecular signalling pathways, cellular interactions, and system-level dynamics to provide a holistic view of disease evolution. This interdisciplinary framework enables the simulation of disease trajectories, prediction of relapse patterns, and evaluation of treatment responses across different patient profiles. By combining biological data with computational intelligence, the model supports personalized medicine approaches, improves therapy selection, and enhances clinical decision-making. Ultimately, this work aims to contribute to precision neuromedicine by advancing predictive modelling strategies that improve patient outcomes, optimize treatment planning, and deepen our understanding of complex neuroimmune diseases such as multiple sclerosis.

Keywords: *Multiple sclerosis, Computational biology, Systems biology, Neurobiology, Immune system modelling, Artificial intelligence, Neuroimmunology, Interdisciplinary science*



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NADIAD BRANCH OFFICE

F - 137 / 138, First Floor, Ghantakarna Complex,
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Vellabh Vidyanager, Anand - 388120.
✉ principal.istar@cvmu.edu.in
☎ +91 9427062790
☎ +91 02692-234955

PRINCIPAL INFO

Dr. Mahendrasinh Raj
☎ +91 9427062790

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Mr. Keyur Patel
☎ +91 9998039325
Dr. Niraj Patel
☎ +91 9427980656
Dr. Amit Thummar
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