December 04-05, 2025

PTICCS2025

Hybrid Event
(In-person+Virtual)

# 5th Pak-Turk International Conference on Chemical Sciences

A networking platform from south and -west Asia to host chemical scientist and Engineers from around the world with slogan -'Chemistry for Global Good'

# ABSTRACT BOOK

## Jointly Organized by

National Centre of Excellence in Analytical Chemistry,
University of Sindh, Jamshoro,
&
ICCBS-University of Karachi,
Karachi, Pakistan

Selçuk University, Konya Technical University
&
Necmettin Erbakan University, Konya, Turkiye

## Message from the Chief Organizers

It is a matter of great pride to present the Abstract Book of the **5th Pak-Turk International Chemistry Conference (PTICCS-2025)**. This conference stands as a testament to the enduring academic partnership between Pakistan and Türkiye, and to our shared vision of promoting high-quality research, innovation, and scientific exchange.

PTICCS-2025 brings together a dynamic community of researchers, educators, and professionals who are contributing to the advancement of chemical sciences and allied fields. The abstracts compiled in this volume reflect the diversity and strength of our collective scholarship—ranging from fundamental chemistry to applied research addressing real-world challenges in industry, environment, health, and materials science.

As Chief Organizer, I am deeply grateful to our esteemed collaborators, organizing committees, supporting institutions, and all participants who have contributed to the success of this event. Their commitment, hard work, and academic spirit have shaped PTICCS-2025 into a meaningful platform for knowledge sharing and international cooperation.

I am confident that this Abstract Book will serve as an important reference for researchers and a foundation for future collaborations between our scientific communities. I wish all participants a productive and inspiring experience at PTICCS-2025.

**Prof. Dr. Amber R. Solangi & Prof. Dr. Raza Shah**
Chief Organizers
PTICCS-2025

## Message from the Chief Organizers

It is my sincere pleasure to contribute this note to the Abstract Book of the 5th Pak-Turk International Chemistry Conference (PTICCS-2025). The friendship between Türkiye and Pakistan is rooted not only in history and shared values but also in our growing scientific cooperation. This conference stands as a meaningful symbol of that partnership, bringing together researchers from both nations in a spirit of mutual respect, collaboration, and academic harmony.

The abstracts collected in this volume reflect the dedication, scientific depth, and strong research culture of scholars from both countries. Covering a wide range of topics in fundamental and applied chemistry, these contributions demonstrate the high academic standards of PTICCS-2025 and the commitment of our scientific communities to advancing knowledge for the benefit of society.

I extend my heartfelt appreciation to our colleagues in Pakistan for their warm cooperation and gracious hospitality throughout the preparation of this event. I am also grateful to the organizing teams on both sides whose tireless efforts have made this conference possible. Above all, I congratulate all participants whose valuable research enriches this important academic gathering.

I sincerely hope that this Abstract Book will not only record the scientific work presented at PTICCS-2025 but also serve as an inspiration for new collaborations, stronger ties, and future joint projects between the scholars of Türkiye and Pakistan.

**Prof. Dr. Mustafa Yilmaz & Prof. Dr. Huseyin Kara**
Chief Organisers (Turkish Side)
PTICCS-2025

# Foreword

As the Organizing Secretary of the **5th Pak-Turk International Chemistry Conference (PTICCS-2025)**, it is an honour to present the Abstract Book for this significant academic event. PTICCS-2025 reflects our shared commitment to strengthening scientific cooperation between Pakistan and Türkiye, and to providing a vibrant platform where researchers can exchange ideas, showcase innovations, and build pathways for future collaboration.

This volume brings together contributions from a diverse group of participants—distinguished professors, early-career scientists, postgraduate students, and industry professionals—each offering insights into emerging trends and critical challenges in the chemical sciences. The abstracts included here demonstrate not only the depth of expertise across our institutions but also the enthusiasm with which our scientific community approaches research, innovation, and problem-solving.

Organizing this conference has been a collective effort. I extend my sincere gratitude to our academic partners, advisory committees, supporting organizations, and the dedicated teams whose hard work has transformed this vision into reality. I am especially thankful to the authors whose contributions enrich the scientific quality of PTICCS-2025.

I hope that this Abstract Book serves not only as a record of scholarly contributions but also as an inspiration for new collaborations and meaningful academic engagements. I wish all participants a productive, engaging, and memorable conference.

**Prof. Dr. Najma Memon**
Organizing Secretary
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# Program

## *Day-1 : Thursday 4th December 2025*

| | |
|---|---|
| **8:30 a.m. -10:00 a.m.** | **Registration**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* |
| **10:00 a.m. – 11:30 a.m.** | **Inauguration Ceremony**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* |
| **11:30 a.m. - 11:45 a.m.** | **Reception**<br>*(Golden Jubilee Hall) ICCBS* |
| **11:45 a.m. -1:30 p.m.** | **Plenary Lectures**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* |

| ***Prof. Dr. Muhammad Iqbal Bhanger*** | ***Co-Chair: Prof. Dr. Amber Rehana Solangi*** |
|---|---|
| **Time** | **Speaker/ Title** |
| 11:45 a.m. -12:20 p.m. | **Prof. Dr. Huseyin Kara**<br>Selçuk University, Faculty of Science, Department of Chemistry<br>PL-1: Novel and Selective Supercritical Fluid Extraction Methods |
| 12:20 p.m. - 12:55 p.m. | **Prof. Dr. Raza Shah**<br>HEJ, Institute of Chemical & Biological Sciences, University of Karachi, Karachi, Pakistan<br>PL-2: Custom designed Drug Delivery System by Using Supramolecular Approach |
| 12:55 p.m. – 1:30 p.m. | **Prof. Dr. Mustafa Tuzen**<br>Tokat Gaziosmanpaşa University, Tokat<br>PL-3: Environmentally friendly and green extraction techniques for organic and inorganic species in water, food and environmental samples |

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|---|---|
| **1:30 p.m. – 2:15 p.m.** | **Prayers / Lunch Break**<br>*(Golden Jubilee Hall) ICCBS* |
| **2:15 p.m. – 3:00 p.m.** | **Poster Session** |
| **3:00 p.m. – 3:50 p.m.** | **Concurrent Technical Sessions-I** |
| **3:50 p.m. – 4:10 p.m.** | **Tea Break** |
| **4:10 p.m. - 5:40 p.m.** | **Concurrent Technical Sessions-II** |

| ***Chair: Prof. Dr. Huseyin Kara*** | ***Co-Chair: Prof. Dr. Farah Naz Talpur*** |
|---|---|
| **Time** | **Speaker/ Title** |
| **Concurrent Technical Session-IA**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* | **Analytical Chemistry and Sensors for Society-I** |
| ***Chair: Prof. Dr. Huseyin Kara*** | ***Co-Chair: Prof. Dr. Farah Naz Talpur*** |
| **Time** | **Speaker/ Title** |
| 3:00 p.m. – 3:20 p.m. | **Prof. Dr. Zeeshan Khatri**<br>Department of Textile Engineering, Mehran University of Engineering and Technology, Jamshoro, Pakistan<br>KN-8: From Recognition to Relevance: How Research Creates Real-World Impact |

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|---|---|
| 3:20 p.m. - 3:40 p.m. | **Dr. Muhammad Imran Malik**<br>HEJ, Institute of Chemical & Biological Sciences, University of Karachi, Karachi, Pakistan<br>KN-1: Polymer–Metal Nanocomposite-Based Electrochemical Sensors: Emerging Frontiers in Biomedical Diagnostics |
| 3:40 p.m. – 3:55 p.m. | **Dr. Tahira Qureshi**<br>Government College University, Hyderabad, Pakistan<br>OP-4: Biocatalytic remediation of diclofenac and related pollutants |
| **Concurrent Technical Session-IB**<br>*L.E.J Hall A* | **Advanced Materials for a Better Future** |
| ***Chair: Prof.  Dr. Arfana Mallah*** | ***Co-Chair: Dr. Tanveer Ahmed*** |
| **Time** | **Speaker/ Title** |
| 3:00 p.m. – 3:20 p.m. | **Prof. Dr. Sirajuddin**<br>HEJ, Institute of Chemical & Biological Sciences, University of Karachi, Karachi, Pakistan<br>KN-2: The best things come in small packages |
| 3:20 p.m. – 3:35 p.m. | **Prof. Dr. Ambreen Shah**<br>Dr. M. A. Kazi Institute of Chemistry, University of Sindh, Jamshoro, Pakistan<br>OP-3: Emerging trends in coordination bonding of newer bi-pyridine ligands with metal ions: Synthesis, Characterizations and Applications |
| 3:35 p.m. – 3:50 p.m. | **Dr. Waheed Baig**<br>Department of Computer Science, UIT University, Karachi, Pakistan.<br>OP-1: Fabrication of Metal Oxide-Doped with Nano-Graphite Humidity sensor |
| **Concurrent Technical Session-IC**<br>*L.E.J Hall B* | **Chemistry in Health and Life Sciences-I** |
| ***Chair: Prof. Dr. Syed Tufail Hussain Sherazi*** | ***Co-Chair: Prof. Dr. Najma Memon*** |
| **Time** | **Speaker/ Title** |
| 3:00 p.m. – 3:20 p.m. | **Prof. Firdous Imran Ali**<br>Department of Chemistry, University of Karachi, Karachi, Pakistan<br>KN-3: Ionic Liquids from plant derived components |
| 3:20 p.m. – 3:35p.m. | **Dr. Fakhar N. Memon**<br>Department of Chemistry, University of Karachi, Karachi, Pakistan<br>OP-5: Adsorption of Paracetamol using CaO nanoparticles |
| 3:35 p.m. – 3:50 p.m. | **Dr. Syeda Sara Hassan**<br>USPCASW Mehran University of Engineering and Technology, Jamshoro, Pakistan<br>OP-2: Polymer-Modified Nanofiber Membranes for Efficient Removal of Atrazine Pesticide from Aqueous Environments |

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| **3:50 p.m. – 4:10 p.m.** | **Tea Break**<br>*(Golden Jubilee Hall) ICCBS* |
| **4:10 p.m. - 5:40 p.m.** | **Concurrent Technical Sessions-II** |

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| **Concurrent Technical Session-IIA**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* | **Education, Ethics, and Policy in Chemistry for Global Good** |
| ***Chair: Prof. Dr. Shahabuddin Memon*** | ***Co-Chair: Prof. Dr. Zeeshan Khatri*** |

| Time | Speaker/ Title |
|---|---|
| 4:10 p.m. – 4:35 p.m. | **Prof. Dr. Jamil Anwar**<br>University of Management and Technology, Lahore, Pakistan<br>KN-5: Climate Change: Risks & Impacts on Life in Pakistan |
| 4:35 p.m. – 5:00 p.m. | **Prof. Dr. M. Iqbal Bhanger**<br>National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro<br>KN-6: Science education in Pakistan; challenges and opportunities |
| 5:00 p.m. - 5:20 p.m. | **Prof. Dr. Arfana Mallah**<br>M.A. Kazi Institute of Chemistry, University of Sindh, Jamshoro, Pakistan<br>KN-7: Cultural Transformation for Inclusive STEM Leadership |
| 5:20 p.m. – 5:40 p.m. | **Prof. Dr. Tufail Sherazi**<br>National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan<br>KN-4: Health Benefits of pomegranate fruit and its seed oil |

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| **Concurrent Technical Session-IIB**<br>*L.E.J Hall A* | **Water, Environment & Climate Solutions** |
| ***Chair: Prof. Dr. Duri Şehvar ÜNAL*** | ***Co-Chair: Prof. Dr. Saima Qayoom Memon*** |

| Time | Speaker/ Title |
|---|---|
| 4:10 p.m. – 4:25 p.m. | **Dr. Imdadullah Qureshi**<br>Department of Chemistry, University of Science & Technology, Bannu-28100-Pakistan<br>OP-6: Synthesis of Graphene Oxide/Titinium Oxide Based Catalyst and Exploring its Degradation Ability towards Methylene Blue |
| 4:25 p.m. – 4:40 p.m. | **Dr. Mansoor Khan**<br>University of Science and Technology, Kohat, KP, Pakistan<br>OP-11: Synthesis and Characterization of Advanced Magnetic Max Phase (Fe3O4- Ti3AlC2) and It's Application in Microextraction of Heavy Metals |
| 4:40 p.m. – 4:55 p.m. | **Dr. Abdullah**<br>Department of Chemistry, Faculty of Sciences, Engineering and Technology, University of Gwadar, Gwadar 91200, Balochistan, Pakistan<br>OP-8: Ultrasonic-assisted synthesis of (Fe3O4@SiO2@NH2-BPA-MIP) and Their Analytical Practicality as a Selective Magnetic Adsorbent for The Removal of Bisphenol A From Water systems |

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| 4:55 p.m. -5:10 p.m. | **Dr. Abdul Hameed Kori**<br>National Centre of Excellence in Analytical Chemistry University of Sindh, Jamshoro, Pakistan<br>OP-9: Fabrication of Barium Titanium Oxide Nanoflowers as an efficient adsorbent material for the selective Solid-phase Microextraction of Copper from real environmental and food Samples |
| 5:10 p.m. – 5:25 p.m. | **Dr. Maira Naz**<br>Department of Chemistry, University of Karachi<br>OP-19: Molecular docking insights of Schiff base–copper(II) complexes: exploring lipoxygenase enzyme inhibition |
| **Concurrent Technical Session-IIC**<br>*L.E.J Hall B* | **Green & Sustainable Chemistry** |
| ***Chair: Prof. Dr. Liaquat Zardari*** | ***Co-Chair: Prof. Dr. Syed Iqleem Hyder*** |
| **Time** | **Speaker/ Title** |
| 4:10 p.m. – 4:30 p.m. | **Prof. Dr. Farooq Anwar**<br>Institute of Chemistry, University of Sargodha, Sargodha- Pakistan.<br>KN-9: Green extraction for optimal recovery of phenolics from selected food plants and agro-wastes |
| 4:30 p.m. – 4:50 p.m. | **Prof. Tajnees Pirzada**<br>Institute of Chemistry, Shah Abdul Latif University Khairpur, Sindh, Pakistan<br>KN-10: Chemical studies on Humic substances from Pakistani shilajit |
| 4:50 p.m. – 5:05 p.m. | **Dr. Fatih Erci**<br>Necmettin Erbakan University, Konya, Türkiye<br>OP-12: Synthesis and Characterization of Nano-Biochar from Waste Plant Biomass |
| 5:05 p.m. – 5: 20 p.m. | **Dr. Ammara Aftab**<br>Pro AI Global AI Strategy Consultant Karachi, Pakistan<br>OP-13: Mind Under Machine Influence: When AI Starts Rewiring Executive Decision-Making |
| 5:20 p.m. – 5:35 p.m. | **Dr. Mohammad Younis Talpur**<br>Dr. M. A Kazi Institute of Chemistry, University of Sindh, Jamshoro, 76080, Sindh, Pakistan<br>OP-14: Eco-friendly Synthesis of ZnO-TiO2 Nanocomposites for the Efficient Removal of Toxic Metal Ions from Aqueous Solutions |
| **Day 1 Ended.**<br>**Have a Nice Stay in Karachi, Pakistan** | |

*We cordially invite all conference participants to join us for the Conference Dinner, an evening of fine hospitality, meaningful conversations, and shared celebration.*

*Time: 7:00 p.m.*

## Day-2 : Friday 5th December 2025

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|---|---|
| **9:00 a.m. - 9:35 a.m.** | **Plenary Lecture**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* |
| **9:45 a.m. -12:20 p.m.** | **Concurrent Technical Sessions-III** |
| **12:20 p.m. – 1:30 p.m.** | **Plenary Lectures**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* |
| **1:30 p.m. – 3:00 p.m.** | **Prayers & Lunch Break** |
| **3:00 p.m. – 4:30 p.m.** | **Concurrent Technical Sessions-IV** |
| **4:30 p.m. - 5:30 p.m.** | **Concluding Ceremony** |

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|---|---|
| ***Chair: Prof. Dr. Mustafa Soylak*** | ***Co-Chair: Prof. Dr. Jamil Anwar*** |

| **Time** | **Speaker/ Title** |
|---|---|
| 9:00 a.m. - 9:35 a.m. | **Prof. Dr. Fatih Demirci,**<br>Anadolu University, Faculty of Pharmacy, Pharmacognosy Department<br>PL-4: Phyto-Aroma-Dermatological Applications |
| **9:35 a.m. – 9:45 a.m.** | **Short Break** |

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|---|---|
| **Concurrent Technical Session-IIIA**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* | **Online Session-I** |
| ***Chair: Prof. Dr. Najma Memon*** | ***Co-Chair: Prof. Dr. Uzma Ashique*** |

| **Time** | **Speaker/ Title** |
|---|---|
| 9:45 a.m. – 10:05 a.m. | **Prof. Abdou Lachgar**<br>Department of Chemistry, Wake Forest University, NC, USA<br>KN-11: Green Hydrogen Production Using Semiconductor Heterojunctions Technology |
| 10:05 a.m – 10:25 am | **Dr. Haider A. Khwaja**<br>Department of Environmental Health Sciences, College of Integrated Health Sciences, University at Albany, Albany, New York, United States<br>KN-12: Association of Ambient Fine Particulate Air Pollution (PM2.5) with Cardiovascular Morbidity in a Megacity Karachi, Pakistan |
| 10:25 a.m. – 10:40 am | **Ms. Maha Sharif**<br>Department of Chemistry, Wake Forest University, Winston-Salem, 27109, North Carolina<br>OP-15: Visualizing Ultrafast Spectral and Spatial Heterogeneity in Photoexcited Nanomaterials via Broadband Transient Absorption Microscopy |
| 10:40 a.m. -11:00 a.m. | **Prof. İbrahim Ender Mülazımoğlu**<br>Necmettin Erbakan University, Chemistry Department, Konya, Türkiye<br>KN-25: From Waste Leather to Electrochemical Sensors: Green Approach For Sustainable Electroanalytical Chemistry |
| 11:00 a.m. – 11:20 a.m. | **Prof. Dr. Karim Adil**<br>Mohammed VI Polytechnic University, Ben Guerir, Morocco<br>KN-14: Fluorinated MOF Materials for Gas Separation |

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| 11:20 a.m. – 11:40 a.m. | **Prof. Dr. Ayşe Müge Andaç**<br>Molecular Science Research Hub, Imperial College London, 82 Wood Lane, London<br>KN-15: Molecular Recognition-Based Biosensors |
| 11:40 a.m. – 12:00 p.m. | **Prof. Dr. İsmail Murat Palabıyık**<br>Ankara University, Türkiye<br>KN-26: Green Synthesis of Nanoparticles from Plant-Based Wastes: Characterization and Evaluation of Biological Activities |
| 12: 00 p.m. – 12:20 p.m. | **Prof. Ayşen Demir Mülazımoğlu**<br>Necmettin Erbakan University, Konya<br>KN-27: The use of pencil graphite electrodes as sensor electrodes in electroanalytical chemistry |

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|---|---|
| **Concurrent Technical Session-IIIB**<br>**L.E.J Hall A** | **Analytical Chemistry & Sensors for Society-II** |
| ***Chair: Prof. Dr. Nasreen Fatima*** | ***Co-Chair: Dr. Muhammad Imran Malik*** |

| **Time** | **Speaker/ Title** |
|---|---|
| 9:45 a.m. – 10:05 a.m. | **Prof. Dr. Syed Ghulam Musharraf**<br>H.E.J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences, University of Karachi, Karachi, Pakistan.<br>KN-16: High-throughput and Sensitive Detection of Plant and Human-based Metabolome: Few interesting Mass Spectrometry-based Pipelines |
| 10:05 a.m – 10:25 am | **Prof. Duri Şehvar ÜNAL**<br>Istanbul University, Istanbul, Türkiye<br>KN-17: Genotoxic Impurities in Drug Subtances |
| 10:25 a.m. – 10:45 am | **Prof. Dr. Saima Q. Memon**<br>Dr. M. A Kazi Institute of Chemistry, University of Sindh, Jamshoro, 76080, Sindh, Pakistan<br>KN-18: Deep Eutectic Solvents in Catalysis and Material Development |
| 10:45 a.m. -11:05 a.m. | **Prof. Mustafa Topkafa**<br>Konya Technical University, Vocational School of Technical Sciences<br>KN-19: The Graphene Oxide Derivative Liquid Chromatography Stationary Phases And Application Of Carotenoids Separation |
| 11:05 a.m. – 11:20 a.m. | **Dr. Zainab Manzoor Memon**<br>Liaquat University of Medical & Health Sciences Jamshoro, 2University of Sindh, Jamshoro<br>OP-16: A green ultrasonic-assisted liquid–liquid microextraction technique based on deep eutectic solvents for flame atomic absorption spectrometer determination of trace level of lead in tobacco and food samples |
| 11:20 a.m. – 11:35 p.m. | **Dr. Nazar Hussain Kalwar**<br>Institute of Chemistry, Shah Abdul Latif University Khairpur<br>OP-17: Copper Oxide-Based Anodes for Highly Sensitive Electrochemical Detection of Amlodipine |

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| 11:35 p.m. – 11:50 p.m. | **Dr. Naved Iqbal**<br>International Center for Chemical and Biological Sciences, University of Karachi<br>OP-18: Unveiling sustainable methodology for the synthesis of Dihydropyrimidinones utilizing Biginelli reaction |
| 11:50 p.m. – 12:05 p.m. | **Dr. Ayisha Aman Ullah**<br>Department of Biotechnology, Jinnah University for Women<br>OP-25: Fabrication of a calcium alginate–based immobilization system for novel alkaline β-amylase derived from bacillus subtilis |
| 12:05 p.m. – 12:20 p.m | **Dr. Jamshed Ali**<br>Institute of Chemistry, Shah Abdul Latif University, Khairpur Mir's-66020. Sindh, Pakistan<br>"Dispersive Solid Phase<br>OP-30: Microextraction Method for the Determination of Arsenic in Food Samples Using a Gadolinium Oxide based Block Copolymer as a composite adsorbent |
| **Concurrent Technical Session-IIIC**<br>*L.E.J Hall B* | **Health & Life Sciences / Medicinal Chemistry** |
| ***Chair: Professor Mustafa YILMAZ*** | ***Prof. Dr. Rafia Azmat*** |
| **Time** | **Speaker/ Title** |
| 9:45 a.m. – 10:05 a.m. | **Prof. Dr. Aysegul Golcu**<br>Istanbul Technical University, Istanbul, Türkiye<br>KN-20: Voltammetric Strategies for Quantitative Determination of some Anti-Diabetic Drugs |
| 10:05 a.m. – 10:25 am | **Dr. Khalida Parveen**<br>Institute of Chemistry, Shah Abdul Latif University Khairpur, Pakistan<br>KN-21: Development and Validation of an RP-HPLC Method for the Determination of Organic α-Keto Acids in Serum of Diabetic Patients |
| 10:25 a.m. – 10:45 am | **Dr. Zaheer Ahmed**<br>Gpgc Timergara Higher Education, Archives And Libraries Department Government Of Khyber Pakhtunkhwa, Pakistan<br>KN-22: Hypoxia and pH responsive polyamino acid-based polymers: synthesis, characterization and drug delivery applications |
| 10:45 a.m. – 11:05 a.m. | **Prof. Imtiazullah Khawaja**<br>Department of Physics, Hazara University Manasehra, KPK, Pakistan<br>KN-23: Morphological Properties of Laser Irradiated Biomaterials |
| 11:05 a.m. – 11:25 a.m. | **Prof. Dr. Abdul Majeed Khan**<br>FEDERAL URDU UNIVERSITY, Karachi, Pakistan<br>KN-24: Development of Green Energy Technologies: An Alternative Approach to Development of Green Energy Technologies: An Alternative Approach to Promote Green Energy and Waste Management |

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| 11:25 p.m. – 11:40 a.m. | **Dr. Abdul Rauf Jamali**<br>Department of Materials Engineering, NEDUET, Karachi, University of Karachi<br>OP-27: Mitigation of Thermal Fatigue Cracking in Automotive Brake Discs (GCI, FC250-A) : A Case Study on Material Optimization Using Alloyed Grey Cast Iron |
| 11:40 a.m. – 11:50 a.m. | **Dr. Shagufta Noreen**<br>Department of Biotechnology, Jinnah University for Women<br>OP-28: Exploring textile dyes and effluent-treating bacteria: isolation, characterization, and phytotoxic impact of treated effluent |
| 11:50 a.m. – 12:05 p.m. | **Dr. Qurat-ul-ain Shaikh**<br>Institute of Chemistry, Shah Abdul Latif University, Khairpur Mir's, Sindh 66020, Pakistan<br>OP-24: Silk fibroin-graphene oxide composite membranes for selective separation of ions and molecules from water |
| 12:05 p.m. – 12:20 p.m. | **Dr. Muhammad Farooque Lanjwani**<br>Department of Human & amp; Rehabilitation Sciences, The Begum Nusrat Bhutto WomenUniversity, Sukkur, Sindh, Pakistan<br>OP-29: Photocatalytic degradation of Sudan black B dye by using synthesized SnO2 nanoparticles as a catalyst: factorial design model |
| **12:20 p.m. - 1:30 p.m.** | **Plenary Lectures**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* |
| **1:30 p.m. – 3:00 p.m.** | **Prayers and Lunch Break** |
| **3:00 p.m. – 4:30 p.m.** | **Concurrent Technical Sessions-IV** |

| ***Chair: Prof. Dr. Mustafa Tuzen*** | ***Co-Chair: Prof. Dr. Syed Ghulam Musharraf*** |
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| **Time** | **Speaker/ Title** |
|---|---|
| 12:20 p.m. - 12:55 p.m. | **Prof. Dr. Mustafa YILMAZ**<br>Department of Chemistry, Selcuk University, Konya 42075, Turkiye<br>PL-5: Nanobasket Fluorescent calixarenes: Drug carriers and anticancer properties |
| 12:55 p.m. – 1:30 p.m. | **Prof. Dr. Mustafa Soylak**<br>Erciyes University, Faculty of Sciences, Department of Chemistry, 38039 Kayseri, Turkey<br>PL-6: Green extraction procedures for trace species from environmental samples |

| **Concurrent Technical Session-IVA**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* | **Online Session-II** |
|---|---|
| ***Chair: Prof. Dr. Mustafa Topkafa*** | ***Co-Chair: Prof. Dr. Abdul Majeed Khan*** |

| **Time** | **Speaker/ Title** |
|---|---|
| 3:00 p.m. - 3:20 p.m. | **Prof. Dr. Renata Adami**<br>Department of Physics "E.R. Caianiello", University of Salerno, Itally<br>KN-13: Hydrocarbon from waste cooking oil by electro-assisted reaction process |

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| 3:20 p.m. – 3:40 p.m. | **Prof. Naseer Ahmed Khan**<br>University Of Engineering and Technology, Peshawar, Pakistan<br>KN-28: Process development for recovering and purifying vanadium pentoxide ($V_2O_5$) from spent sulphuric acid catalysts |
| 3:40 p.m. – 3:55 p.m. | **Dr. Ismail Tarhan**<br>Selçuk University, Konya<br>OP-20: Investigation of the effects of high intensity ultrasound on the secondary structures of proteins using FTIR spectroscopy |
| 3:55 p.m. – 4:10 p.m. | **Dr. Fatih Durmaz**<br>Selçuk University, Konya<br>OP-21: Investigation of some chemical removals in domestic wastewater treatment plants |
| 4:10 p.m. – 4:20 p.m. | **Dr. Muhammad Balal Arain**<br>Department of Chemistry, Faculty of Sciences, Erciyes University, 38039 Kayseri, Türkiye<br>OP-22: g-$C_3N_4$@LDH Nanocomposite for Efficient trace and toxic metal Extraction from Environmental and Food Samples |

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|---|---|
| **Concurrent Technical Session-IVB**<br>*L.E.J Hall A* | **Artificial Intelligence, Data Science & Automation** |
| ***Chair: Prof. Dr. Sirajuddin*** | ***Co-Chair: Prof. Firdous Imran Ali*** |

| Time | Speaker/ Title |
|---|---|
| 3:00 p.m. - 3:20 p.m. | **Prof. Dr. Rafia Azmat**<br>Department of Chemistry, University of Karachi, Pakistan<br>KN-29: Role of Artificial Intelligence (AI) in Research: A Human AI Collaboration |
| 3:20 p.m. – 3:35 p.m. | **Dr. Faraz H. Buririo**<br>ProAI Global Karachi, Pakistan<br>OP-23: AI Models for Basic Sciences: Where the Journey Begins |
| 3:35 p.m. – 3:50 p.m | **Dr. Arshad Fazal**<br>Department of Chemistry, University of Karachi<br>OP-26: Appraising Wintertime Gaseous Air Pollution Episodes in Karachi: Diurnal Variability, Meteorological Effects, and Health Risk Assessment |

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| **Concurrent Technical Session-IVC**<br>*L.E.J Hall B* | **Industrial Chemistry & Process Innovation** |
| ***Chair: Prof. Dr. Fatih Demirci*** | ***Co-Chair: Prof. Dr. Farooq Anwar*** |

| Time | Speaker/ Title |
|---|---|
| 3:00 p.m. - 3:20 p.m. | **Dr. Tahir Rafique**<br>Applied Chemistry Research Center, PCSIR laboratories Complex Karachi, Pakistan<br>KN-30: Ensuring Casting Integrity: The Critical Role of Silica Sand for the Automobile Industry |

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|---|---|
| 3:20 p.m. – 3:35 p.m. | **Dr. Gulfam Nasar**<br>BUITEMS, Quetta Pakistan<br>OP-10: Synthesis and characterization of ferrite-polymer nanocomposites |
| 3:35 p.m. – 3:50 p.m. | **Dr. Sadaf Iqbal**<br>Department of Chemistry, University of Karachi, Karachi-75720, Pakistan<br>OP-7: Modeling and simulation of biocompatible composite material for wastewater treatment |
| **4:30 p.m. – 5:30 p.m.** | **Concluding Ceremony**<br>*(Prof. Salimuzzaman Siddiqui Auditorium) ICCBS* |
| **5:30 p.m. - 5:50 p.m** | **Farewell Tea** |

We hope attending this conference was fruitful for your career growth!

Allah Hafiz

Güle Güle

Good Bye

# Table of Contents

## Planary Lecture

## Keynote Lecture

**Oral Presentaion**

**Poster Presentation**

**PL-1**

# New Supercritical Fluid Selective Extraction Technique

**Hüseyin Kara[a]* & Muhammed Raşit Bakır[b]**
[1]Department of Chemistry, Faculty of Science, Selcuk University, Konya, Türkiye
[2]Department of Analytical Chemistry, Faculty of Pharmacy, Selcuk University, Konya, Türkiye
[*]*Corresponding author: huskara@gmail.com*

## Abstract:

Deodorized distillate (DD), a low-value by-product of vegetable oil refining, is in fact a rich source of high-value bioactive compounds such as tocopherols (vitamin E homologs), squalene, and sterols. For instance, olive oil deodorized distillates typically contain 3–5% tocopherols and 8–10% squalene. Despite this potential, their selective recovery remains highly challenging due to the structural similarity of the compounds, their low concentrations, and the complex lipidic matrix.

This study proposes a novel selective extraction strategy based on green chemistry principles. In the first step, saponification will be applied to eliminate free fatty acids, reducing matrix interferences. Subsequently, ionic liquids (ILs) will be employed as co-solvents in supercritical $CO_2$ extraction, providing a more selective and environmentally friendly medium compared to conventional modifiers. Extraction parameters including temperature, pressure, $CO_2$ flow rate, and IL alkyl chain length will be systematically optimized using Response Surface Methodology (RSM).

The enriched fractions obtained will be subjected to semi-preparative chromatography to isolate high-purity tocopherol and squalene. Throughout the process, spectral data (UV-Vis, FTIR) will be monitored and analyzed using advanced chemometric methods such as Principal Component Analysis (PCA), Partial Least Squares (PLS), and Soft Independent Modeling of Class Analogy (SIMCA). These approaches will allow robust evaluation of extraction performance, quantitative/qualitative characterization of the compounds, and a data-driven optimization of the process. Additionally, bioavailability studies will be performed to assess the industrial applicability of the recovered bioactives.

Overall, this work addresses an urgent need to valorize waste streams of the edible oil industry, creating a sustainable route to produce natural antioxidants and immune-supportive compounds. The proposed approach not only supports the green transition through environmentally friendly processes but also establishes a technological platform for the local production of strategic biomolecules with applications in the food, pharmaceutical, and cosmetic industries.

***Keywords:*** SFE, IL, DD, PCA, SIMCA

**PL-2**

# Custom designed Drug Delivery System by Using Supramolecular Approach

**Raza Shah**
*ICCBS, University of Karachi, Karachi, Pakistan*
*Corresponding author E-mail:* raza_shahm@yahoo.com

**Abstract:**

Tethered bilayer lipid membranes (*tBLMs*) have been developed in the past decade as a model system of the biological membrane. They provide a fluid, stable, and electrically sealing platform for the study of membrane related processes, specifically, the function of incorporated membrane proteins. The *tBLM* has been studied extensively but the corresponding monolayer of *tBLM* is less understood. We developed a synthetic methodologies to synthesis various anchor synthetic lipids for attachment to silicon or gold surface and we have used AFM, to study the growth process of several self-assembled monolayer of thiolipids (Thiolipids monolayer used for the formation of *tBLMs*), consisting of a lipid tail (phytanyl group) and a hydrophilic spacer (polyoxyethylene) attached to the metal substrate of gold via thiol or lipoic acid-linker and bilayer. We also studied the functional incorporation of membrane protein with the help of AFM. Time-dependent *in situ* AFM images, of samples immersed in ethanol solution of thiolipids, bilayer and protein, performed in a liquid cell or *ex situ* in air showed that before forming a complete monolayer the thiolipids molecules aggregated in the form of small islands, in which 2D aggregates of adsorbate molecules nucleate, grow, coalesce, etc. on the substrate. With the proceeding of immersion, these islands gradually grew and merged into larger patches. Finally, a close-packed film with uniform appearance and few defects was formed.

PL-3

# Environmentally Friendly and Green Extraction Techniques for Organic and Inorganic Species in Water, Food and Environmental Samples

**Mustafa Tuzen**
*Tokat Gaziosmanpaşa University, Faculty of Arts and Sciences, Department of Chemistry, 60250 Tokat, Turkiye*
*Corresponding author E-mail:* mustafa.tuzen@gop.edu.tr

## Abstract:

Environmentally friendly and green extraction techniques are very important for the control of environmental pollution which is increased in recent years sourced from organic and inorganic species. Direct determination of organic or inorganic species in food, water and environmental samples is a big problem because of very low concentration of analytes, which may be lower than the detection limit of instruments and the interfering effects of the matrix components. These problems can be solved by using extraction and preconcentration methods. Environmentally friendly and green extraction techniques have recently great interest due to their simplicity, cost effective, high efficiency and reduced exposure of toxic chemicals to the environment. A new and green vortex-assisted liquid phase microextraction procedure based on deep eutectic solvent was developed for the determination of arsenic in water, honey and rice samples by using hydride generation-atomic absorption spectrometry (1). A novel block copolymer containing gadolinium oxide nanoparticles was used for ultrasound assisted-dispersive solid phase microextraction of total arsenic in food samples (2). A novel solid phase microextraction in a portable syringe system was developed for removal of malachite green by using spectrophotometer (3). Dispersive solid-liquid extraction method was developed based on organic polymers followed by deep eutectic solvents elution; application in extraction of some pesticides from milk samples (4). Multivariate optimized poly(3-hydroxybutyrate)-graft-poly(2-ethyl oxazoline)-zinc oxide nanocomposite was used for high-efficiency malachite green adsorption (5). The optimized method was applied to different water samples including drinking water, tap water, canal water and wastewater. In this presentation above studies will discussed.

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**PL-4**

# Phyto-Aroma-Dermatological Applications

**Fatih Demirci**
*Anadolu University, Faculty of Pharmacy, Pharmacognosy Department*
**Corresponding author E-mail: demircif@gmail.com*

## Abstract:

In recent decades, natural dermatological preparations are preferred by consumers according to new trends popularly, not only due to fashion and influences, but also due to their enhanced efficacy. Natural dermocosmetics are explored both by big companies as well as dedicated research centers among others. This trend urges the use of natural ingredients and actives such as essential oils, plant oils and extracts as well as pure compounds for prevention as well as extended therapeutics for serious dermal conditions, too. In this presentation, not only own essential oil based data, but also carrier oils and selected plant extract as well as pure natural products like kojic acid, allicin, marrubiin will be elaborated. Also, recent data on probiotic *Lactobacillus paracasei* GMNL 133 supplementation for skin conditions will be presented. However, it will be also highlighted that essential oils and their major constituents such may also cause skin irritation and allergic reactions. Albeit natural products have therapeutic activity when used correctly, unwanted effects may also be observed due to several factors. The quality of natural product preparations and their indicative application by heath professionals consultation may contribute to their safe utilization.

***Keywords:*** Essential oils, Terpenes, Phytocosmetics, Nanotechnology, Biotechnology

## References:

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PL-5

# Nanobasket Fluorescent Calixarenes: Drug Carriers and Anticancer Properties

**Mustafa YILMAZ**
*Department of Chemistry, Selcuk University, Konya 42075, Turkiye*
*Corresponding author E-mail:* myilmaz42@yahoo.com

**Abstract:**

Breast cancer is one of the types of cancer that causes high rates of death all over the world. Therefore, studies were carried out to investigate isatin derivatives, which are a promising structure equipped with various biological activities, including anticancer activity, and are widely used in breast cancer research. It is known that compounds containing the isatin group show a wide range of biological activities and are used especially in anticancer studies. Derivatives of this compound, which is found in the structure of some commercially used anticancer drugs (Sunitinib, Nintedanib, Orantinib), show a strong anti-proliferative effect, especially against breast cancer. Considering this situation, the synthesis of isatin derivatives adds significant value to research-oriented drug discovery studies. In recent years, supramolecules have also been used in cancer studies. As is known, calixarenes, which are macrocyclic compounds of interest in supramolecular chemistry, are cyclic compounds synthesized from phenol and formaldehyde under suitable conditions, and they can be functionalized unlimitedly from both the phenolic O-position and the p-position of phenolic units. Within the scope of the study, calixarene molecules were converted from the phenolic O-position to the diazide derivative and then functionalized with 1,4-dimethylpyridinium iodine from the p-position to give them cationic and fluorescent properties. Then, target compounds (8a-e) were synthesized by interacting isatin with propargyl derivatives with different substitutions (F, Cl, Br, I and Me) under click reaction conditions. In order to investigate the effect of the cationic pyridinium unit in anti-cancer studies, compounds that did not contain this group were synthesized. The cytotoxic effects of these successfully synthesized compounds were determined on MCF-7 and MDA-MB-231 breast cancer cell lines as well as on epithelial cell line PNT1A cells, IC50 values were calculated, and fluorescence imaging studies were also performed. In the localization study performed with MDA-MB-231 cell to see that the synthesized compound (8b) was mitochondria-targeted, it was observed that this compound easily entered the cell and accumulated in the mitochondria. In the continuation of the study, 'Comet Assay' studies were carried out in order to determine the effects on DNA structure and the way in which the cells were driven to death was determined by apoptosis studies. In addition to anticancer studies, enzyme inhibition was evaluated in vitro with the aromatase enzyme. In the study, 8b exhibited a significant inhibition capacity on the aromatase enzyme (0.104 ± 0.004 uM). As a result, it was observed that cationic, mitochondria-targeted fluorescence calix[4]arene-isatin derivatives, which are effective against breast cancer cells, inhibited the viability of the cells through various means, especially the apoptosis pathway. Due to the serious side effects and inadequate treatment of existing commercial drugs, targeted calix[4]arene derivatives bearing the isatin group are promising in the pharmaceutical field as new and alternative agents.

PL-6

# Green Extraction Procedures for Trace Species from Environmental Samples

**Mustafa Soylak**
*Erciyes University, Faculty of Sciences, Department of Chemistry, 38039 Kayseri, Turkey*
*Corresponding author E-mail: soylak@erciyes.edu.tr*

**Abstract:**

The green solvent microextraction and/or microsolid phase extraction of traces organic and inorganic species from environmental samples is a necessity prior to their spectroscopic detection due to their low levels and influences of matrix components. In recent years, green solvent microextraction and/or microsolid phase extraction has been developed as an environment friendly alternative method to other separation and preconcentration techniques. The green solvent microextraction and/or microsolid phase extraction provide unique properties like high extraction capability and short extraction time, low cost, simple preparation at room temperature using conventional laboratory. The microextraction techniques are low the consumption of green organic solvents, accurate and precise. In this presentation, the green solvent microextraction and/or microsolid phase extraction strategies for the separation and preconcentration of organic and inorganic species from water, food, soil and sediment samples established by our research group have been discussed.

***Keywords**:* Microextraction; Separation; Preconcentration; Nanocomposites; Green Solvents.

KN-1

# Polymer–Metal Nanocomposite-Based Electrochemical Sensors: Emerging Frontiers in Biomedical Diagnostics

**Muhammad Imran Malik**
*Third World Center for Science and Technology, H.E.J Research Institute of Chemistry, International Center for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi, 75270, Pakistan*
*Corresponding author E-mail:* mimran.malik@iccs.edu

**Abstract:**

The integration of nanotechnology with electrochemical sensing has revolutionized biomedical diagnostics by enabling highly sensitive, rapid, and cost-effective detection of clinically significant biomarkers. Conventional electrodes, however, often face challenges such as low selectivity, limited stability, and interference from complex biological matrices. To address these limitations, our research focuses on the development of **polymer–metal nanocomposite-based electrochemical sensors**, which combine the exceptional catalytic and electrical properties of metal nanoparticles with the stability, flexibility, and functional versatility of conductive polymers and carbon nanomaterials.

This lecture highlights the design, synthesis, and analytical applications of advanced nanocomposites, including Ag@GO/$TiO_2$ for creatinine detection**,** rGO/PLA–Au for miRNA-122 sensing, and P3HT–PdNPs-modified ITO electrodes for cholecalciferol (vitamin $D_3$) quantification**.** These hybrid materials demonstrate remarkable analytical performance, featuring ultralow detection limits (from zeptomolar to nanomolar levels), wide linear dynamic ranges, excellent reproducibility, and minimal interference from coexisting biomolecules. Their performance has been validated against established analytical techniques, confirming strong correlation and clinical reliability.

The lecture will further discuss synthesis methodologies—such as in situ polymerization and electrostatic assembly—used to achieve homogeneous nanoparticle dispersion and enhanced electroactive surface area. Structural and morphological characterization using XRD, FTIR, SEM, TEM, and AFM will be correlated with electrochemical behavior to understand charge-transfer dynamics and surface interactions.

Finally, the talk will outline the future perspectives of these nanocomposite-based sensors for point-of-care and wearable diagnostic devices, emphasizing their scalability, environmental sustainability, and potential for multiplexed biomarker detection. These advances mark a significant step toward the realization of intelligent, portable, and reliable biosensing platforms for early disease diagnosis and continuous health monitoring.

***Keywords:*** Electrochemical sensor; Polymer–metal nanocomposite; Biomedical diagnostics; Graphene oxide; Conductive polymer; Biosensing; Point-of-care analysis.

KN-2

# The Best Things Come in Small Packages

**Sirajuddin**
*H.E.J.R.I.C., I.C.C.B.S. University of Karachi, Pakistan*
*Corresponding author E-mail: drsiraj03@gmail.com*

**Abstract:**

The augmented revolutions and innovations in science and technology have stormed the globe by changing the living standards to such a high status where many fictions have been transformed into realities. The highly efficient atomic and molecular machines have been manufactured through clever assemblage of atoms and molecules. Although nanotechnology consider as an older technology, but its improved innovative status after the manufacturing of STM, TEM, SEM and AFM has speeded up the discovery of extremely useful safer and greener nano-products, and their exceptional unbelievable applications have delivered miraculous advantages. A high competition has been witnessed in producing best quality patents along with 100-500 fold production of nanotechnology based publications as compared to other field of science and technology. Shape and size are the two magical aspects of nanomaterials and considered to be responsible for research floods throughout the research communities. Through this talk, I would illustrate some work based the size aspect of nanomaterials for useful applications in nanocataysis and nanosensing. Glances from some of our best research carried out by our students would be demonstrated to showcase our research through this prestigious forum of 5th Pak-Truk International Conference on Chemical Sciences. These investigations will display the facts where the small size speeds up the time duration from days - hours – minutes and finally to seconds. Through this presentation, I aim to inspire, encourage and attract the new researchers, scientists, engineers and industrialists of our participation countries compete with global institutes and grow newer, safer and easily constructible nano-products for marketable utilization to restrain and discourage the foreign reliance through massive imports. These steps will enormously support the nation in economizing the expenses particularly for deprived people of our nation along with availability of cherished stuffs at our entrance.

**KN-3**

# Ionic Liquids from Plant Derived Components

**Firdous Imran Ali* & Imran Ali Hashmi**
*Department of Chemistry, University of Karachi-75270, Sindh-Pakistan*
*Corresponding author E-mail: firdous@uok.edu.pk*

**Abstract:**

Ionic liquids (ILs) are organic salts with melting points below 100°C, distinguishing them from high-melting-point classical salts. Their structure, featuring bulky, asymmetric cations and weakly coordinating anions, confers unique properties such as negligible vapor pressure, high ionic conductivity, and thermal stability. These features initially positioned ILs as promisinggreen solvents. Early (second-generation) ILs often contained hydrolysable anions (e.g., $PF_6^-$, $BF_4^-$), which can release toxic hydrogen fluoride (HF) and fluorides, creating significant environmental and economic disposal issues.To overcome these drawbacks, we pursued a sustainable approach using plant-derived components. We report the design and successful synthesis of a new series of ILs incorporating anions from benzoic and phenolic acids.

Additionally, the plant derived anions have been combined with cations derived from diterpenes and carbohydrates. The applications of these bio-based ionic liquids were subsequently investigated.

***Keywords:*** Ionic Liquids, Benzoates, Organic catalysis, metal extraction

**References:**

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KN-4

# Health Benefits of Pomegranate Fruit and its Seed Oil

**Syed Tufail Hussain Sherazi*, Sarfaraz Ahmed Mahesar & Abdul Hameed Kori**
*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
*Corresponding author E-mail: tufail.sherazi@gmail.com*

## Abstract:

Pomegranate (*Punica granatum L.*) is known as one of the ancient plant that contains numerous biologically active compounds. The extracted juice of Pomegranate fruit and pomegranate seed oil contain several bioactive compounds which lead to the great antioxidant, anti-inflammatory, cardiovascular, metabolic, reproductive and potential anticancer advantages. Therefore, several researcher are now focusing more attention on pomegranate juice and seed oil. Pomegranate seed oil is unique oil due to the presence of especial conjugated fatty acid, punicic acid. But, key challenge is to control the stability and bioavailability of very valuable pomegranate seed oil. To preserve the valuable compounds of pomegranate from heat, oxygen, moisture and light, encapsulation techniques are widely employed. Encapsulation is a process of building functional barrier between the core and wall material to avoid chemical and physical reactions and maintains the biological and functional properties. The choice of an appropriate microencapsulation technique and wall material depends upon the end use of the product and the processing conditions. Present research work demonstrates health benefits of pomegranate fruit and its seed oil as well as the encapsulation of its valuable oil using different wall materials.

***Keywords:*** Pomegranate juice, Pomegranate oil, health benefits, encapsulation.

KN-5

# Climate Change: Risks & Impacts on Life in Pakistan

**Jamil Anwar**
*University of Management and Technology, Lahore, Pakistan*
*Corresponding author E-mail: jamilanwarch51@gmail.com*

**Abstract:**

Pakistan ranks among the most climate-vulnerable nations, facing rising risks to food, water, health, and livelihoods. Shifting monsoon cycles, prolonged droughts, glacial melt, and catastrophic floods—such as those of 2010 and 2022—have displaced millions and damaged critical infrastructure. Agriculture, the country's economic backbone, is under threat from increasing temperatures and water stress, raising urgent concerns for food security. Climate change also aggravates public health risks, including heat stress, malnutrition, and vector-borne diseases, while disproportionately affecting marginalized groups such as women, children, and rural communities. Weak infrastructure, resource limitations, and governance challenges constrain Pakistan's adaptive capacity, yet opportunities lie in climate-smart agriculture, renewable energy, and integrated water management. This talk emphasizes the urgent need for science-driven policies, regional cooperation, and community-led resilience strategies to safeguard lives and ensure sustainable development in a rapidly changing climate.

KN-6

# Science Education in Pakistan; Challenges and Opportunities

**Muhammad Iqbal Bhanger**
*International Center for Chemical and Biological Sciences, University of Karach, Pakistan*
*Corresponding author E-mail:* dbhanger2000@gmail.com

## Abstract:

The education of a nation plays an essential role in its future development and any amount of emphasis laid in this regard is not enough. The prospects of the entire country and its success in various fields rely on how well-informed, literate, skilled and educated human resource it has got. Education in the field of science, however, occupies a central place in sustainable human development, technological advancements, eradication of poverty and removing unequal distribution of resources etc. Hence, as a nation we must be adequately equipped with an understanding and ability to implement science education for our survival in this era of global modernization.

In this regard continuity of traditional teaching methods including rote memorization may not be sufficient for conceptual understanding of the subject. Need to spread new and innovative methods of teaching such as enquiry-based learning in our institutions is indispensable to move forward. Thereby robust teacher's education training must be equally emphasized in successfully implementing new pedagogies.

This presentation provides an overview of education system especially science education in Pakistan, and examines how the gaps in science education were addressed with the help of its successive educational policies. Due to numerous reasons including financial constraints, proper management etc. these have not borne fruit. Consequently, Pakistan is yet to achieve the milestone of socio-economic development for which several efforts and political will are needed to improve the situation. Lastly, some ways in which science education may be enhanced and improved in Pakistan are proposed.

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**KN-7**

# Women in Stem in Pakistan: Breaking Barriers and Building Pathways to Leadership

**Arfana Mallah**
*M.A. Kazi Institute of Chemistry, University of Sindh, Jamshoro, Pakistan*
*Corresponding author E-mail: arfana.mallah@usindh.edu.pk*

## Abstract:

Women in Pakistan's science and technology sectors have made remarkable progress; however, their representation in leadership and decision-making roles remains disproportionately low. Deep-rooted socio-cultural norms continue to associate scientific and managerial authority with men, creating invisible barriers for women aspiring to reach positions of influence. Persistent gender stereotypes, safety concerns, restricted mobility, and expectations surrounding caregiving responsibilities further limit women's opportunities for leadership development.

Institutional challenges—including inadequate mentorship, implicit bias in promotion practices, and the absence of childcare facilities and harassment-free workplaces—have resulted in the attrition of talented women during mid-career stages, reinforcing the "leaky pipeline" in STEM professions. Transforming this landscape requires both systemic and cultural reform across academia, research organizations, and industry. Policies ensuring flexible work arrangements, transparent promotion mechanisms, and robust anti-harassment frameworks are essential. Equally critical are initiatives that foster male allyship, institutionalize women's leadership training, and amplify the visibility of women role models who challenge stereotypes and inspire others.

Despite structural limitations, several Pakistani women have achieved global recognition for their contributions to science and technology. Figures such as Dr. Nergis Mavalvala, Dr. Tasneem Zehra Husain, Dr. Shahida Hasnain, Jehan Ara, and Dr. Sarah Qureshi exemplify excellence in their respective fields. Yet, the dominant narrative often reflects urban and class privilege, while the experiences of women from rural and under-resourced backgrounds remain underrepresented. The real transformation will occur when these women—educated in public schools and local universities—receive equal institutional support and recognition. The resilience and achievements of many such women, including those organizing this conference, stand as evidence that meaningful change is possible within Pakistan's own academic and scientific environment.

***Keywords:*** Gender Equity in STEM, Leadership Representation, Socio-cultural Barriers, Institutional Reform, Inclusive Recognition

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KN-8

# From Recognition to Relevance: How Research Creates Real-World Impact

**Zeeshan Khatri**
*Department of Textile Engineering, Mehran University of Engineering and Technology,*
*Jamshoro, Pakistan*
*Corresponding author E-mail:* Zeeshan.khatri@faculty.muet.edu.pk

**Abstract:**

For decades, research excellence has been measured by publications, citations, impact factors and h-Index, yet many groundbreaking ideas never reach the people they are meant to serve. This talk challenges that narrative by exploring how research can evolve from academic output into tangible innovations that shape industries, solve societal problems, and create meaningful impact. Drawing on real examples of technologies developed and commercialized from our own laboratories, the session demonstrates the full journey from concept to consumer, highlighting the lessons learned, the barriers faced, and the transformations achieved along the way. It will reflect on the cultural shift required in academia from publishing for recognition to innovating for relevance and emphasize how universities can become powerful engines of economic and social change when research is aligned with market and community needs.

***Keywords:*** research impact, innovation, commercialization, product development, socio-economic transformation

**KN-9**

# Green Extraction for Optimal Recovery of Phenolics from Selected Food Plants and Agro-Wastes

**Farooq Anwar* & Sami Ullah**
*Institute of Chemistry, University of Sargodha, Sargodha- Pakistan.*
**Corresponding author E-mail: farooq.anwar@uos.edu.pk*

## Abstract:

Plant phenolics are valuable components due to their functional food and nutraceutical uses. Conventional extraction of such high-value components, which typically involves tedious process and a larger volume of toxic organic solvents, raises serious concerns regarding process safety and products quality. Green extraction is an emerging eco-friendly approach and yields healthier natural extracts, which are in high demand in the nutra-pharmaceutical and food industries. This lecture focuses on the basic principles of green extraction and highlights the application of different related techniques such as ultrasound-assisted-extraction (UAE), enzyme-assisted extraction (EAE) and enzyme-assisted supercritical fluid extraction (EA-SFE) for efficient phenolics recovery from selected food plants and agro-wastes, as applicable. Overall, we noticed that response surface methodological (RSM) based optimized UAE and EAE are viable green approaches for efficient recovery of phenolics from olives, jujube fruit, balsam apple, mulberry leaves and *Capparis* fruits while EA-SFE effectively recovered hydrolysable and non-hydrolysable phenolics from black tea residue and pomegranate peel. Moreover, the bioactive extracts showed a significant improvement in the antioxidant potential compared to the control. The extracted phenolic components were characterized for metabolites using GC-MS and LC-MS. Field-emission scanning electron microscopy (FE-SEM) revealed significant changes in the ultrastructure of the residual materials, supporting that the given pre-treatments effectively cleaved cell wall glycosidic connections, facilitating the liberation of bound form phenolics. The devised green extraction methods can be effectively used to recover phenolics from a variety of fruits and agro-wastes with value-added perspectives.

***Keywords:*** Functional components, Green extraction technologies, Enzymatic pretratment, Supercritical fluid extraction, GC-MS/LC-MS profiling

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**KN-10**

# Chemical Studies on Humic Substances from Pakistani Shilajit

**Tajnees Pirzada* & Humera Solangi**
*Institute of Chemistry, Shah Abdul Latif University Khairpur, Sind, Pakistan*
*Corresponding author E-mail: tajnees@salu.edu.pk*

## Abstract:

Shilajit is a blackish-brown exudation and rich in minerals and complex organic compound. It can be obtained from mountainous ranges of the world, whereas in Pakistan it is found in Himalayan region from Gilgit to Skardu in Pakistan. This study is focused on the chemicalstudies humic substances present in shilajit used in Pakistan's traditional medicine. The major physiological action of shilajit has been attributed to the presence of bioactive dibenzo-α-pyrones (DBPs) along with fulvic acids (FA) and humic acid (HA), which act as carrier molecules for the active ingredients and minerals like (iron, magnesium and zinc). For many years, shilajit is extensively used as a part of ayurvedic drug for the treatment of various ailments such as anemia, viral infection, diabetes, wound healing, liver disability and allergic disorders. Also, shilajit can settle the body's immune system because it has antibacterial, and anti-inflammatory properties. Considering the benefits of these bioactive compounds on human health present in shilajit, this study will be enlightening for researchers.

KN-11

# Green Hydrogen Production Using Semiconductor Heterojunctions Technology

**Shiba Adhikari[1], Zach Hood[1] & Abdou Lachgar[2,3,4]**
[1]*Applied Materials Division, Argonne National Laboratory, Illinois, USA*
[2]*Department of Chemistry, Wake Forest University, Winston-Salem, North Carolina, USA.*
[3]*Sabin Center for Environment and Sustainability, Wake Forest University, Winston-Salem, North Carolina, USA*
[4]*Center for Functional Materials, Wake Forest University, Winston-Salem, North Carolina, USA.*
*Corresponding author E-mail:* lachgar@wfu.edu

## Abstract:

A clean and sustainable energy source is required to address the increase of global energy demand and the carbon-related environmental issues. Semiconductor-based photocatalysis has received tremendous attention because of its potential for solving current energy and environmental problems. In a semiconductor photocatalytic system, photo–induced electron-hole pairs are produced when a photocatalyst is illuminated by light with energies larger than that of its band gap. These photo-excited charge carriers can either recombine or migrate to the surface of the semiconductor, where they can be involved in redox processes. The photocatalytic efficiency depends on the number of charge carriers and the lifetime of the electron hole pairs generated by the photoexcitation. High recombination rate of photo-excited charge carriers and limited efficiency under visible light irradiation are the two limiting factors in the development of efficient semiconductor-based photocatalysts. We present the design, preparation, characterization, and photocatalytic performance of several semiconductor heterojunctions used to enhance green hydrogen production using visible light. The study of these systems demonstrates that the design and preparation of heterojunctions with proper band gaps and relative band positions can facilitate charge separation/migration and decrease the charge recombination rate, thus enhancing the photocatalytic efficiency in visible light. On the basis of observed activity, band positions calculations, and photoluminescence data, a mechanism for the enhanced photocatalytic activity is proposed and discussed.

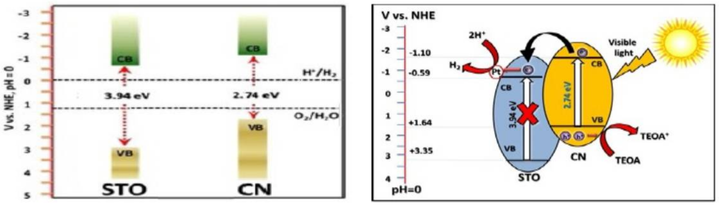

**Figure.** Schematic diagram showing a semiconductor heterojunction made of one visible light active and UV light only active component.

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Shiba P. Adhikari, Zachary D. Hood, Vincent W. Chen, Karren L. More, and Abdou Lachgar, "g-C3N4 / nitridized Sr2Nb2O7 nanocomposite as an efficient photocatalyst for hydrogen evolution under visible light irradiation" *Sustainable Energy Fuels* (2018), *2*, 2507–2515.

# Association of Ambient Fine Particulate Air Pollution ($PM_{2.5}$) with Cardiovascular Morbidity in a Megacity Karachi, Pakistan

**Haider A. Khwaja**
*Department of Environmental Health Sciences, College of Integrated Health Sciences, University at Albany, Albany, New York, United States*
*Corresponding author E-mail: hkhwaja@albany.edu*

## Abstract:

Air Pollution impacts on mortality and health are a significant public health issue worldwide. Population-based studies have documented health risks resulting from short-term exposure to air pollutants. Southeast Asia is now the most polluted region in the world, with 2.6 million deaths related to outdoor air pollution. We have investigated the short-term effects of $PM_{2.5}$ and black carbon (BC) in ambient air on hospital admissions and emergency room (ER) visits among residents living in one of the largest cities of Southeast Asia, Karachi, Pakistan. Daily records of hospitalizations and ER visits for cardiovascular diseases (CVD) at three major hospitals serving the city were collected.. Concentrations of $PM_{2.5}$ were collected at two commercial/residential and industrial/ residential sites. Single- and multi-pollutant lagged generalized linear time-series models were utilized to analyze daily counts of hospital, meteorological, and pollutant data. Analysis showed the evidence of positive associations of fine particle air pollution, meteorological factors, and seasonal parameters with ER visits and hospital admissions due to CVD in Karachi. This study provides scientific evidence on the magnitude of health effects associated with air pollution in urban centers of large developing nations, evaluate BC as an additional indicator for evaluating health impacts associated with ambient air pollution, and finally, to provide scientists and policy makers with vital information for policy planning.

***Keywords:*** Air pollution, Fine particulate matter, Cardiovascular diseases, Pakistan

KN-13

# Hydrocarbon from Waste Cooking Oil By Electro-Assisted Reaction Process

**Renata Adami**[a, c]*, Faraz Kahn[b, c], Christian Catapano[a], Nicole D'Avanzo[a, c], Mariagrazia Iuliano[a, c], Claudia Cirillo[a, c], Maria Sarno[a, c]
[a] Department of Physics "E.R. Caianiello", University of Salerno
[b] IUSS Pavia
[c] Interdepartmental Centre NANO_MATES (Research Centre for NANOMAterials and nanoTEchnology)
**Corresponding author E-mail: radami@unisa.it*

## Abstract:

Hydrocarbons are the basis of organic chemistry. They are a major source of chemical energy, used as fuels like gasoline and natural gas, and are essential raw materials for producing plastics, fibers, and solvents. Waste cooking oil (WCO) is an abundant and renewable resource to produce hydrocarbons, yet its direct use is limited by its high viscosity and unstable nature. To address this, we developed a low-temperature pathway for converting WCO into long-chain hydrocarbons using a two-step process combined with Kolbe electrolysis. First, triglycerides were converted into free fatty acids (FFA) using ethanol and 1.5 M KOH at 60°C. Then, the FFA were upgraded into kerosene-range long-chain hydrocarbons through Kolbe electrolysis, using sustainable electrodes.

For the Kolbe electrolysis, pencil-graphite electrodes coated with Ni nanoparticles were employed and a comparison study of preparation with electrochemical deposition and electroless deposition was performed. Surface of electrodes was thoroughly characterized by FTIR (Fourier Transform Infrared Spectroscopy), XRD (X-ray Diffraction), TGA (thermogravimetric analysis), and SEM (Scanning Electron Microscope) to confirm successful Ni loading and structural stability.

Electrolysis was carried out at 10 V and 50°C for 1 hour in a solution containing 25 mL methanol, 0.5 M NaOAc, and 2.3 g FFA. FTIR and TGA analyses of the product confirmed the formation of long-chain hydrocarbons, with a dominant $C_{34}$ carbon fraction.

Overall, this study presents an accessible, energy-efficient method for producing long chain hydrocarbons from WCO, offering a promising alternative solution to shortages of biofuels, like bio-kerosene for aviation, while supporting sustainable fuel development.

***Keywords:*** Waste cooking oil (WCO); Biokerosene; Kolbe electrolysis; Free fatty acids (FFA); Nickel-coated pencil graphite electrode; Electroless deposition; Sustainable fuel production

**KN-14**

# Fluorinated MOF Materials for Gas Separation

**Karim Adil**
UM6P, Morocco
*Corresponding author E-mail: karim.adil@um6p.ma*

**Abstract:**

Fluorinated metal–organic frameworks (MOFs) represent a promising class of porous materials for selective carbon dioxide capture and challenging gas separations. Their unique combination of tunable pore chemistry and the strong affinity of fluorinated functionalities toward $CO_2$ provides unprecedented selectivity and stability, even under humid and harsh operating conditions. In this talk, I will highlight recent advances in the design, synthesis, and structural engineering of fluorinated MOFs, discuss their performance in $CO_2$ capture and gas separation, and outline future opportunities for translating these materials into scalable separation technologies.

**Bio:** Karim Adil is Full Professor of Chemistry specializing in porous materials and separation science. His research focuses on the development of advanced metal–organic frameworks for energy and environmental applications, with a particular emphasis on $CO_2$ capture, gas separation, and sustainable chemical processes. He has published extensively in the field of functional porous materials and leads collaborative projects bridging fundamental chemistry and industrial innovation.

KN-15

# Molecular Recognition-Based Biosensors

**Ayşe Müge Andaç**
*Department of Environmental Engineering, Hacettepe University, Ankara, Turkey*
*TÜBİTAK Fellow, Department of Chemistry, Imperial College London, UK*
*Corresponding author E-mail: andac@hacettepe.edu.tr, a.andac@imperial.ac.uk*

## Abstract:

Molecular recognition-based polymers represent a versatile class of synthetic materials designed to mimic the specific binding capabilities of natural receptors such as enzymes and antibodies. Through the rational design of functional monomers, crosslinkers, and template molecules, these polymers exhibit high selectivity and affinity towards target analytes. My research focuses on the synthesis and application of molecularly imprinted polymers (MIPs) and affinity-based cryogels for the selective recognition and separation of biologically and environmentally significant species. Imprinted polymeric systems have been developed for the depletion of plasma proteins (albumin, haemoglobin, transferrin), the removal of toxic metal ions ($Ni^{2+}$, $Cd^{2+}$, $Fe^{3+}$, $Pb^{2+}$), As species and the recognition of small biomolecules, endocrine disruptors and drugs. These materials demonstrate rapid mass transfer, mechanical stability, and reusability under dynamic conditions. Integration of recognition-based polymers with nanostructured supports and biosensing platforms, including graphene-based field-effect transistors and QCM sensors, enables real-time detection and quantification of analytes with high sensitivity. In review, these studies highlight the potential of molecular recognition-based polymers as sustainable, tunable, and cost-effective alternatives to biological receptors in separation, detoxification, and biosensing technologies.

***Keywords:*** Molecularly imprinted polymers; Affinity cryogels; Molecular recognition; Biosensing; Sustainable materials.

KN-16

# High-throughput and Sensitive Detection of Plant and Human-based Metabolome: Few interesting Mass Spectrometry-based Pipelines

**Syed Ghulam Musharraf**
*H.E.J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences, University of Karachi, Karachi-75270, Pakistan.*
*Dr. Panjwani Center for Molecular Medicine and Drug Research, International Center for Chemical and Biological Sciences, University of Karachi, Karachi-75270, Pakistan*
*Corresponding author E-mail:* musharraf1977@yahoo.com

## Abstract:

Use of herbal plants are an integral part of various indigenous medicinal systems such as Traditional Chinese Medicine (TCM) and Ayurveda. The presence of a very large number of compounds makes them complicated and pose a challenge to physiochemist. Similarly, products which contains herbs are often difficult to standardized. Many studies on the standardization of herbal medicines focus only on either HPLC-based fingerprinting or on the quantification of a few major peaks. However, environmental factors such as temperature, humidity, and soil can affect the amounts of secondary metabolites in a plant, which in-turn can lead to variations in the batch-to-batch quality of herbal medicines. It is therefore important to focus on the complete picture rather than a few specific compounds. Such knowledge can only be generated through a comprehensive metabolomics analysis that can convert analytical data into useful biological knowledge. Metabolomics data obtained through comprehensive and reliable methods for fingerprinting, profiling and quantification of active natural products can be used to study global metabolite composition, taxonomy, stress response, interaction of plant with the environment, drug lead discovery and for the study of mode of action of an herbal drug

We have developed several strategies for the dereplication of natural products in single and polyherbal formulations by advanced mass spectrometry tools . The strategy is based on five major steps: the collection of plant samples from different locations to observe the effects of environmental variables; LC-ESI-MS/MS-based untargeted metabolite profiling of the plant samples to identify marker compounds using extensive chemometric analysis of the obtained data; the identification of marker compounds in polyherbal products; the isolation, purification and characterization of the marker compounds; and MRM-based quantitative analysis of the isolated marker compounds using LC-ESI-MS/MS. Using this strategy, we identified a large number of compounds in plant extracts. Chemical fingerprinting of the plant led to the identification of characteristic peaks that are used to confirm the presence in complex polyherbal formulations. Moreover, marker compounds were isolated, purified and quantified in various herbal formulations containing respective plants. These methods demonstrate a comprehensive strategy based on untargeted and targeted metabolite analysis that can be used for the standardization of complex polyherbal formulations. Similarly, our research group has also developed mass spectrometric strategies for the sensitive detection of human metabolome. Details will be discussed in the presentation.

KN-17

# Genotoxic Impurities in Drug Subtances

**Duri Sehvar Ozer Unal**
*Istanbul University, Faculty of Pharmacy, Department of Analytical Chemistry, İstanbul, Türkiye*
*Istanbul University, Drug Research Center, İstanbul, Türkiye*
*Corresponding author E-mail: durisehvar@gmail.com; durisehvar@istanbul.edu.tr*

## Abstract:

Genotoxic impurities are compounds that induce genetic mutation, chromosomal breaks and/or chromosomal rearrangements, and have the potential to cause cancer. Genotoxic impurities can enter drug compounds from a variety of sources, the most common of which is the starting material utilized in drug substance manufacturing and its impurities. Regulatory agencies, including EMA, FDA, and ICH, require stringent detection and control of these impurities inactive pharmaceutical ingredients and finished products. Given their simplicity, reliability, and full compliance with international regulatory guidelines, the validated GC-MS and LC-MS/MS methods are highly suitable for routine implementation in pharmaceutical quality control laboratories. Their application not only enhances the ability to monitor impurity profiles effectively but also plays a critical role in safeguarding product quality and patient health, in line with current global regulatory standards.

In this study, a gas chromatography-mass spectrometry (GC-MS) method was optimized for the determination of methyl methanesulfonate (MMS), ethyl methanesulphonate (EMS), and isopropyl methanesulfonate (IMS) in imatinib mesylate. Additionally, impurities such as epichlorohydrin, benzaldehyde, and 2,6-dimethylaniline, which may be present in pharmaceutical products, were investigated by Gas Chromatography-Mass Spectrometry in pharmaceutical products containing the active ingredients Sitagliptin and Linagliptin-Metformin. In parallel, a liquid chromatography-tandem mass spectrometry (LC-MS/MS) method was established to determine the amount of nitrosamine impurities in drug substances. The results were evaluated and genotoxic impurity limits were calculated.

***Keywords:*** Genotoxic impurite, GC-MS, HPLC-MSMS, nitrosamines, sulfonates

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**KN-18**

# Deep Eutectic Solvents in Catalysis and Material Development

**Saima Q. Memon [a]*, Sassi Siddiqui[a] & Amber Rehana Solangi[b]**
*[a]Dr. M.A.Kazi Institute of Chemistry, University of Sindh, Jamshoro, Pakistan.*
*[b]National center of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
**Corresponding author E-mail: saimaqmemon@usindh.edu.pk*

## Abstract:

Deep eutectic solvents (DES) have emerged as promising alternatives to conventional solvents and catalysts, combining the advantages of low toxicity, biodegradability, and tuneable physicochemical properties. In this work, a novel DES was synthesized and characterized to explore its multifunctional applications in green chemistry and materials science. The DES exhibited favourable electrochemical and physicochemical behaviour, while cytotoxicity and microbial studies confirmed its non-toxic, biocompatible nature. As a catalyst, the DES efficiently replaced conventional acids in esterification of used oil, achieving over 96% conversion under optimized conditions, with an improved greenness profile compared to classical methods. In addition, the DES was employed as a structure-directing agent in the synthesis of mixed metal oxides (MMOs). Characterization revealed distinct morphological and crystallographic differences in materials synthesized with and without DES, demonstrating its role in tailoring crystallization pathways. The DES-modified MMO electrode showed excellent electrochemical performance for phenol detection, achieving a detection limit of 0.48 nM and reliable recovery in real cosmetic samples. Collectively, these findings highlight the dual role of DES as green catalysts and sustainable platforms for functional material synthesis, with potential applications spanning catalysis, environmental monitoring, and industrial processes.

***Keywords**:* Deep Eutectic solvent, electrochemical analysis, DES based metal oxides, catalysis

**KN-19**

# The Graphene Oxide Derivative Liquid Chromatography Stationary Phases and Application of Carotenoids Separation

**Mustafa Topkafa[a]*, Nadide Songül Gümüş Şentürk[b] & Nihat Telli[c]**
[a]*Konya Technical University, Vocational School of Technical Sciences, Chemistry and Chemical Processing Technologies, Konya/TÜRKİYE*
[b]*Konya Technical University, Institute of Graduate Education, Konya/TÜRKİYE*
[c]*Konya Technical University, Vocational School of Technical Sciences, Food Processing, Konya/TÜRKİYE*
**Corresponding author E-mail:* m.topkafa@gmail.com

## Abstract:

Nanomaterials have been gaining increasing importance in various fields such as food, the environment, and healthcare over the past 20 years due to their size and functional surface properties and they have attracted more attention in analytical applications than conventional materials. Stationary phases prepared using graphene oxide and graphene oxide derivatives, which have an important place among these materials, have begun to be used in the separation and purification of different species. In this regard, we synthesized and characterized graphene oxide, Si-GO and Si-GO-C18 materials for use as stationary phases in liquid chromatography of graphene oxide derivatives, which have applications in different areas such as food, environment and health, and developed methods for the separation of β-carotene and lutein molecules and validated this method. The synthesized graphene oxide (GO) was first chemically bonded to aminopropyl silica, resulting in a Si-GO. C18 was then bonded to this stationary phase, resulting in a Si-GO-C18 stationary phase. The synthesized GO, Si-GO, and Si-GO-C18 materials were characterized by UV-vis, FTIR, TEM, and SEM analyses. Si-GO-C18 stationary phases obtained were loaded into different columns at high pressure. Both isocritical and gradient separations were performed in method determination studies using the Si-GO-C18 column. The desired results were not obtained from the isocritical studies, and it was determined that gradient separations were suitable for the separation of β-carotene and lutein by calculating the calculating the resolution and teoretical plates. For the validation studies of the optimum method, %RSD, % recovery, LOD, LOQ and $R^2$ values were calculated. Considering the obtained results from the studies, it was seen that the synthesized stationary phase could be used in the separation of β-carotene and lutein.

***Keywords:*** β-carotene, graphene oxide, lutein, liquid chromatography, silica-graphene oxide-C18.

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**KN-20**

# Voltammetric Strategies for Quantitative Determination of Some Anti-Diabetic Drugs

**Aysegul GOLCU**
*Department of Chemistry, Faculty of Arts and Sciences, Istanbul Technical University, Maslak, Istanbul 34469, Turkey.*
*Corresponding author E-mail:* aysegulgolcu@gmail.com

## Abstract:

Currently, sensors and biosensors that utilize various chemical and biological materials as recognition surfaces enable rapid diagnosis of genetic and infectious diseases[1]. A timely and reliable evaluation of "sensor"-based interactions involving drug molecules, especially those with anti-diabetic properties, is essential for drug development research. Diabetes is a chronic condition characterized by high blood glucose levels. It is one of the most common diseases today and plays a crucial role in the development of many serious illnesses. In healthy individuals, insulin, a hormone produced by the pancreas, helps regulate blood sugar levels. However, in diabetics, insulin is either not produced sufficiently or the body cannot use it effectively. Based on insulin needs, diabetes is classified as Type 1 and Type 2. In Type 1, the body produces no insulin at all, while in Type 2, insulin production may be inadequate or the body develops insulin resistance and cannot use it properly. This complexity leads to longer treatment times, the development of chronic diseases, and socio-economic impacts. Over the past five years, our laboratory has investigated the release of drugs from synthetic polymers and developed methods to extract certain drugs from pharmaceutical forms and synthetic serum using molecularly imprinted polymers[3]. Our methods apply the "key-lock" model proposed by Emil Fischer in 1894[2] to explain enzyme-substrate interactions. Molecularly imprinted polymers are created by forming polymers around the molecule to be imprinted (the target or template molecule, i.e., drugs). After removing the template molecule, specific, shape- and size-selective binding sites are formed for the template. This technique creates cavities that are complementary in size, shape, and binding interactions to the template molecule, with an appropriate spatial arrangement. The resulting polymers should exhibit high selectivity for re-binding the template molecules. These binding sites allow the polymer to selectively rebind the template from a mixture of closely related compounds. In this presentation, I will share experimental and theoretical information on molecularly imprinted polymer (MIP) methods aimed at developing more sensitive, selective, and faster electrochemical sensors that outperform existing techniques for anti-diabetic drugs used in the treatment of diabetic patients. These sensors can help control blood sugar levels and reduce the risk of diabetic complications.

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KN-21

# Development and Validation of an RP-HPLC Method for the Determination of Organic α-Keto Acids in Serum of Diabetic Patients

**Khalida Parveen[1] & Sumera Mahar[2]**
[1] *Institute of Chemistry, Shah Abdul Latif University Khairpur (Sindh) Pakistan*
[2] *Pakistan Institute of Health and Medical Science Islamabad*
*Corresponding author E-mail: E-mail: khalidamahar@yahoo.com*

## Abstract:

A new reversed-phase high-performance liquid chromatographic (RP-HPLC) method was developed and validated for the determination of seven α-keto acids pyruvic acid (PYR), oxo butyric acid (OBA), 3-methyl-2-oxobutyric acid (3MOBA), 2-oxoglutaric acid (GA), 4-methyl-2-oxovaleric acid (4MOBA) and phenyl pyruvic acid (PPA) in serum samples of diabetic patients. The Spectrophotometric calibration curves were observed within 1.0 to 35.0 $\mu g ml^{-1}$ at λ-max 420 to 428nm. The derivatives were easily eluted and separated from HPLC column Zorbax C–18, and the UV detection was carried out by photodiode array at 255 nm. The isocratic elution was with methanol-water-acetonitrile (42:56:2V/V/V) with flow rate 1.0 ml/min and a column temperature of 25°C. Detection was performed using a photodiode array (PDA) detector. Complete separation of the six organic α-keto acids was completely separated within 14 minutes.

The method utilized 1,2-propylenediamine (PDA) as a derivatizing reagent. Chromatographic separation was achieved on a Zorbax 300 SB-C18 (4.6 × 150 mm) column using a mobile phase consisting of methanol, water, and acetonitrile (40:58:2, v/v/v) at a flow rate of 1.0 mL/min and a column temperature of 25°C. Detection was performed using a photodiode array (PDA) detector. Complete separation of the six organic α-keto acids was accomplished within 14 minutes.

The method exhibited good linearity over the concentration range of 0.1–60 µg/mL ($r^2 > 0.99$) for each compound. The relative standard deviation (RSD) values for precision were ≤ 3%, while recovery values ranged from 95.5% to 97.8%. The limits of detection (LOD) and quantitation (LOQ) were in the ranges of 0.04–0.13 µg/mL and 0.12–0.39 µg/mL, respectively.

***Keywords:*** RP-HPLC, α-keto acids, serum analysis, derivatization, diabetes.

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KN-22

# Hypoxia and pH Responsive Polyamino Acid-Based Polymers: Synthesis, Characterization and Drug Delivery Applications

**Zaheer Ahmad**
*Department of Chemistry GPGC Timergara Higher Education, Archives and Libraries Department Government of Khyber Pakhtunkhwa.*
*Corresponding author E-mail:* saubanzaheer@gmail.com

## Abstract:

The effectiveness of anticancer drugs such as cisplatin (CDDP) and doxorubicin (DOX) is often limited by nonspecific toxicity, poor bioavailability, and systemic side effects. Stimuli-responsive polymeric nanoparticles offer a promising strategy for controlled and targeted drug delivery, particularly under the unique physiological conditions of the tumor microenvironment such as acidic pH and hypoxia.

This study aimed to develop and evaluate pH- and hypoxia-responsive polymeric nanocarriers for the controlled delivery of CDDP and DOX, with enhanced selectivity toward tumor tissues and reduced adverse effects on healthy cells.

pH-responsive polymers methoxy poly(ethylene glycol)-*block*-poly(glutamic acid) (mPEG-*b*-PLG) and methoxy poly(ethylene glycol)-*block*-poly(glutamic acid-*co*-phenylalanine) [mPEG-*b*-P(LG-*co*- Phe)]—and a hypoxia-responsive polymer, methoxy poly(ethylene glycol)-*block*-poly(glutamic acid)- graft-6-(2-nitroimidazole)hexyl amine (mPEG-*b*-PLG-*g*-NID), were synthesized. Structural and physicochemical characterization was performed using 1H NMR, FT-IR, GPC, UV–Vis spectroscopy, DLS, TEM, and zeta potential analysis. Drug loading, *in vitro* release, cytotoxicity (MCF-7, ZR-75- 30), hemolysis, pharmacokinetics, and cellular uptake studies were conducted.

All formulations yielded uniform nanoparticles with optimal size, morphology, and surface charge. CDDP and DOX exhibited sustained and controlled release, with significantly higher release at lysosomal pH (5.5) and under hypoxic conditions compared to physiological and normoxic environments. CDDP-loaded systems followed zero-order kinetics, whereas DOX-loaded systems showed diffusion-controlled release. Cytotoxicity assays confirmed dose and time-dependent inhibition of cancer cell proliferation. Confocal microscopy and flow cytometry demonstrated receptor-mediated endocytosis for polymer-loaded DOX nanoparticles. Pharmacokinetic studies revealed prolonged circulation and improved biocompatibility compared to free CDDP.

The synthesized pH and hypoxia-responsive polymeric nanoparticles exhibited excellent biocompatibility, controlled release, and enhanced tumor selectivity, establishing them as promising nanocarriers for targeted cancer chemotherapy.

***Keywords:*** pH, Hypoxia, Cisplatin, Doxorubicin, polymeric nanoparticles

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KN-23

# Morphological Properties of Laser Irradiated Bio Materials

**Imtiazullah Khawaja[1] & Mohammad Farooq[2]**
[1]*Department of Physics Hazara University Manasehra, KPK Pakistan.*
[2]*Department of Physics Hazara University Mansehra, KPK Pakistan.*
**Corresponding author E-mail: Imtiaz Ullah Khawaja, kimtiaz11@yahoo.com*

**Abstract:**

On heating di-calcium phosphate dehydrate $CaHPO_4.2H_2O$ to 750℃, the $\beta$-$Ca_2P_2O_7$ is obtained. The materials were then pressed at 4 tons for 5minutes for preparation of pallets. The pallets were then driedat 120oC in a vacuum Chamber for 4 hours. The materials was sintered in a muffle furnace at $450^{o}$C for 24 hours, this resulted to grey colour $\gamma$-$Ca_2P_2O_7$ phase. Further sintering at $750^{o}$C for 24 hours resulted in tetragonal beta $Ca_2P_2O_7$ phase with lattice constants to btain a=b=6.684A and c=24.144A. The pallets were prepared from Di-Calcium Phosphate Di-Hydrate triclinic $2CaHPO_4.2H_2O$ powder was used to obtain three different phases Gamma, Beta, Alpha. These three different phases were obtained at $450^{o}$C,$750^{o}$C and $1050^{o}$C respectively.

The pallets having mean thickness of 0.12 cm were characterized by monochromated x-Ray Diffraction technique, high resolution optical microscopy. Before sintering micro-cracks were frequently seen on the palleted surfaces but then cracks disappeared after sintering at 750C.Grey coloured gamma phase was found to be harder than the white coloured Beta Phase. SEM were also recorded for $450^{o}$C and $75^{o}$C pallets sintered for different periods and laser irradiation with Nd:YAG laser with some special specifications.

***Keywords*: sintering, morphological, grey, calcium phospoate, $CaHPO_4$**

**KN-24**

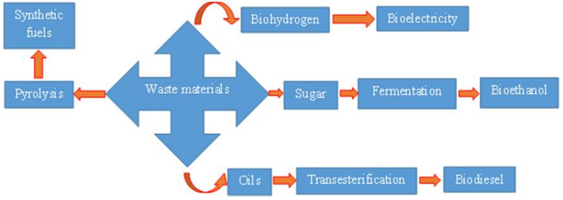
# Development of Green Energy Technologies: An Alternative Approach to Promote Green Energy and Waste Management

**Abdul Majeed Khan**
*Research Laboratory of Bioenergy (RLB), Department of Chemistry, Federal Urdu University of Arts, Science and Technology, Gulshan-e-Iqbal Campus, University Road, Karachi, Pakistan*
*Corresponding author E-mail: dr.abdulmajeedkhan@fuuast.edu.pk*

## Abstract:

Currently, a number of global challenges are associated with the extensive use of non-renewable fossil fuels. The main challenges are global warming, energy crisis, environmental pollution, instability of economy, biodiversity, dependence on other countries and many others. These challenges stimulated us to develop an alternative and green energy technologies. Therefore, a number of approaches have been developed to mitigate these challenges. Biohydrogen was produced from wastewater and converted to electrical energy by the development of microbial fuel cells (MFCs). Bioethanol have been produced from bagasse and waste fruits that was used to power the gasoline engine. A detailed study of the emission of gases was conducted during the combustion of bioethanol-gasoline blends and compare with the combustion of gasoline. In addition, biodiesel was produced by the transesterification of oils obtained from different feedstocks including castor oil, waste fish oil, seaweeds oil and waste cooking oil. Various heterogeneous catalysts were produced from waste materials like waste marble, egg shell, mollusca shell and waste catalysts from metallurgical industries and used for the conversion of oil to biodiesel. These reactions were conducted by renewable and green concentrated solar thermal (CST) energy. Furthermore, different waste materials like human hairs, animal hairs, waste fish, coconut shell, waste diapers and e-wastes were converted to synthetic fuels by pyrolysis. These renewable and green approaches will be helpful to overcome the current demerits of fossil fuels.

***Keywords:*** Bioelectricity, bioethanol, biodiesel, synthetic fuels, solar energy



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KN-25

# From Waste Leather to Electrochemical Sensors: Green Approach For Sustainable Electroanalytical Chemistry

**Wael Bosnali[a], Şeyma Korkmaz[a], Ayşen Demir Mülazımoğlu[b], İbrahim Ender Mülazımoğlu[b]***
*[a]Necmettin Erbakan University, Institute of Science, Chemistry Department, Konya, Türkiye*
*[b]Necmettin Erbakan University, Ahmet Keleşoğlu Education Faculty, Chemistry Department, Konya, Türkiye*
**Corresponding author: iemulazimoglu@erbakan.edu.tr*

## Abstract

The rising demand for environmentally friendly, low-cost, and highly sensitive analytical methods has stimulated the exploration of industrial by-products as functional materials in electrochemistry. Among these, leather shaving waste (LSW) -a hazardous residue of the tanning industry- offers a unique chemical composition that enables its valorization into electrode modifiers with exceptional electrochemical activity. By employing waste leather extract to modify pencil graphite electrodes (LSWE/PGE), we established a versatile sensing platform successfully validated across pharmaceutical, food, and biomedical matrices.

In pharmaceutical analysis, the LSWE/PGE achieved highly linear quantification of paracetamol with recoveries exceeding 99%, providing a sustainable alternative to chromatographic techniques. In nutraceutical applications, catechin determination in green and black tea was realized with nanomolar detection limits, wide linear ranges (2.5–100 µM), and robust resistance to interferents. In biomedical monitoring, dopamine detection in synthetic urine achieved ultralow limits of detection (0.06 µM) with excellent reproducibility and quantitative recovery. Mechanistic studies consistently revealed hybrid electron transfer governed by both diffusion and adsorption processes, accompanied by enhanced charge-transfer kinetics and enlarged electroactive surface area derived from LSWE functional groups. This approach not only validates the analytical robustness of LSWE-based electrodes but also exemplifies how hazardous waste streams can be transformed into value-added electrochemical platforms, simultaneously advancing environmental remediation and next-generation sensing. Collectively, these findings establish waste leather–modified electrodes as a paradigm-shifting innovation at the interface of green chemistry, sustainable materials science, and high-precision electroanalysis.

***Keywords:*** Leather shaving waste, sensor electrode, voltammetry, green technology, environmental sustainability.

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**KN-26**

# Green Synthesis of Nanoparticles from Plant-Based Wastes: Characterization and Evaluation of Biological Activities

**İsmail Murat Palabıyık**
Ankara University, Ankara, Türkiye
*Corresponding author E-mail:* mpala@pharmacy.ankara.edu.tr

## Abstract:

The increasing demand for sustainable and eco-friendly nanomaterials has led to a growing interest in green synthesis approaches, particularly those utilizing plant-based wastes. This review summarizes recent advancements in the green synthesis of metal oxide nanoparticles using agricultural - derived plant residues, such as apple, sugar beet, citrus fruits and hazelnuts. These waste materials, rich in phytochemicals like phenolics, flavonoids, and tannins, act as natural reducing and stabilizing agents during nanoparticle formation. This presentation highlights common synthesis protocols, the physicochemical characterization techniques employed (e.g., UV-Vis, XRD, FTIR, SEM, AFM), and discusses the influence of synthesis parameters on nanoparticle properties. Furthermore, the biological activities of the synthesized nanoparticles, including antimicrobial and anticancer effects, are critically evaluated. Emphasis is placed on the advantages of plant waste-based green synthesis in terms of cost-effectiveness, environmental compatibility, and potential for biomedical, environmental, and agricultural applications. This also addresses current challenges and future perspectives for scaling up and standardizing these green technologies.

***Keywords:*** Nanotechnology, plant waste, green synthesis, nanoparticles, biological activity, sustainable chemistry

KN-27

# The Use of Pencil Graphite Electrodes as Sensor Electrodes in Electroanalytical Chemistry

**Şeyma Korkmaz[a], İbrahim Ender Mülazımoğlu[b] & Ayşen Demir Mülazımoğlu[b]***
*[a]Necmettin Erbakan University, Institute of Science, Chemistry Department, Konya, Türkiye*
*[b]Necmettin Erbakan University, Ahmet Keleşoğlu Education Faculty, Chemistry Department, Konya, Türkiye*
** Corresponding author E-mail: admulazimoglu@erbakan.edu.tr*

## Abstract:

Coating the PGE surface with graphene (GR), coal tar pitch (CTP), and multi-walled carbon nanotubes (MWCNTs) increases the sensitivity and selectivity of electrochemical sensors. GR accelerates electron transfer due to its high surface area and conductivity, enabling low detection limits and strong signals (1). CTP derivatives enhance analyte selectivity by forming thin polymeric films on the surface, thereby reducing interference, and contributing to more reliable measurements (2). MWCNTs increase the active surface area of the electrode, enhance the current response, and provide wider linear ranges and lower detection limits, particularly in the determination of biomolecules (3). Additionally, after coating the PGE surface with GR, CTP, and MWCNTs, modification with compounds containing amino and hydroxyl functional groups (4) using the cyclic voltammetry technique increases the electrochemical surface area of the electrode, thereby providing improved sensor performance (5-9).

PGEs are widely used in food, pharmaceutical, and biological analyses due to their low cost and easy modification features. PGEs offer high sensitivity for the rapid determination of phenolic compounds, food additives, and antioxidants in the food sector, as well as for the quantitative analysis of active pharmaceutical ingredients in pharmaceutical applications. Furthermore, PGEs are selectively and reliably used in the detection of low concentrations of neurotransmitters such as dopamine, serotonin, and histamine. With these properties, PGEs represent a powerful alternative in food safety, pharmaceutical quality control, and clinical biosensor applications.

***Keywords:*** Pencil graphite electrodes, sensor electrodes, electroanalytical chemistry, microelectrodes, electrode modification.

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KN-28

# Process Development for Recovering and Purifying Vanadium Pentoxide ($V_2O_5$) from Spent Sulphuric acid Catalysts

**Husnain Ali Khan[1], Naseer Ahmed Khan*[1], Naveed ul Hasan Syed[1] & Liaqat Mehmood[2]**
*[1]Department of Chemical Engineering, University of Engineering and Technology Peshawar,*
*Postal code 25120*
*[2]Shift Engineer, Hazara Phosphate Fertilizers (Pvt.) Limited (HPFL), Postal code 43394*
**Corresponding author E-mail: naseerahmedkhan@uetpeshawar.edu.pk*

## Abstract:

The sulphuric acid production is a major chemical process industry globally and in Pakistan. The Vanadium Oxide ($V_2O_5$) catalyst undergoes deactivation after a period of operation and is subsequently replaced with a new catalyst. In Pakistan the deactivated vanadium catalyst is dumped underground, which poses a significant risk to the underground water reservoirs. These spent sulfuric acid catalysts are an important secondary source of vanadium, which can be recovered and reused for the production of high-purity vanadium pentoxide. In this study, a hydrometallurgical process was developed to extract and purify vanadium from spent catalysts collected from an indigenous sulfuric acid production plant. The catalyst was first powdered and then roasted in presence of air at 450°C for an hour to remove sulfur-bearing compounds and to convert vanadium into more soluble forms. The roasted sample was then leached with 1.0 M sulfuric acid at 80 °C using a liquid-to-solid ratio of 10 mL $g^{-1}$. Commercial grade sodium hypochlorite (liquid bleach) was added during leaching to oxidize vanadium to its pentavalent state, improving its dissolution in the acidic medium. This resulting leachate was refined by lowering the pH to 2 to selectively precipitate iron and other impurities, followed by kerosene diluted with Di-2-ethylhexyl phosphoric acid solvent extraction to improve vanadium purity. Vanadium was then precipitated as ammonium metavanadate ($NH_4VO_3$) by introducing ammonium chloride (commonly called as white solid) into the purified solution. The precipitate was filtered, washed, and calcined at 500 °C to yield bright orange $V_2O_5$ powder. The final product showed a purity exceeding 98 wt% with a recovery efficiency of 50–60%. Analytical characterization using XRD confirmed the presence of crystalline orthorhombic $V_2O_5$, while SEM-EDS analysis verified a uniform surface morphology and minimal residual contamination. The process developed in this study provides a simple, scalable, and environmentally sound approach to recover vanadium pentoxide from industrial waste catalysts, reducing environmental hazards and contributing to resource circularity in the chemical industry.

***Keywords:*** Vanadium Oxide catalyst ($V_2O_5$), Environmental risk, and Solvent extraction.

**KN-29**

# Role of Artificial Intelligence (AI) in Research: A Human AI Collaboration

***Rafia Azmat, Tehseen Ahmed & Ailiyan Saleem**
*Department of Chemistry, University of Karachi, Karachi, Pakistan*
** Corresponding author E-mail: rafiasaeed200@yahoo.com*

## Abstract:

Artificial Intelligence (AI) is a modern tool, and machine learning now plays an increasingly vital role in contemporary research by enhancing data analysis, automating repetitive tasks, and improving accuracy in prediction and decision-making. AI tools can process large datasets quickly, identify hidden patterns, and generate insights that human researchers might overlook, thereby accelerating the pace of discovery in fields such as Chemistry, Biology, Medicine, and the Social Sciences. Moreover, AI assists in literature review, plagiarism detection, and manuscript editing, thereby improving research quality. However, there are also disadvantages. AI systems depend heavily on the quality of input data; biased or incomplete data can lead to misleading conclusions.

Additionally, over-reliance on AI may reduce critical thinking and creativity among researchers. Ethical concerns, such as data privacy and transparency of algorithms, also pose challenges. Therefore, while AI offers tremendous potential to advance research, its use must be balanced with human oversight and ethical responsibility. AI is not a replacement for human intelligence (HI), but rather a tool to enhance it and provide relief in literature searches.

The ideal path for research advancement is human-AI collaboration, combining human creativity and ethical sense with AI's data-processing power.

***Keywords:*** AI, HI, Collaboration, literature search

KN-30

# Ensuring Casting Integrity: The Critical Role of Silica Sand for the Automobile Industry

**Tahir Rafique**
*Applied Chemistry Research Center, PCSIR Laboratories Complex Karachi, Pakistan*
*Corresponding author E-mail:* tahirrafique92@yahoo.com

**Abstract:**

Silica sand represents a critically important industrial mineral for Pakistan, with key applications in the glass, ceramics, foundry, soap, and construction sectors. In foundry applications, its role is fundamental; prized for its thermal stability, it forms the essential base material for fabricating molds and cores used in casting both ferrous and non-ferrous metals.

The performance of silica sand in casting is critically dependent on its specific physical and chemical characteristics, which must be carefully matched to the casting metal, the component's design, and the binder employed. The industry has shifted from historically used naturally-bonded sands to contemporary requirements for refined, high-purity, washed sands that are free of clay. To perform effectively with modern resin systems, these sands must exhibit high silica purity, consistent grain size, and spherical grain shape. These attributes are indispensable for manufacturing cores and molds that guarantee dimensional accuracy, superior surface finish, and castings free from defects.

Despite the general abundance of silica sand across Pakistan, very few deposits naturally possess the strict quality parameters mandated by advanced foundry operations. This presentation will outline the necessary processing, washing techniques, and grading standards, as well as the essential physical and chemical properties, needed to convert native silica sand into a high-grade foundry product that satisfies the rigorous demands of the automotive and general metal casting industries and also offers a significant opportunity for import substitution and supply chain strengthening within Pakistan's automotive and metal casting sectors.

***Keywords:*** Silica Sand, Foundry Industry, Automobile, Mold and Cores, Sand Processing

**OP-1**

# Fabrication of Metal Oxide-Doped with Nano-Graphite Humidity Sensor

**Mirza M Farrukh Waheed Baig*, Amtul Qayoom & Muhammad Faizan Shirazi**
[a] *Department of Computer Science, UIT University, Karachi, Pakistan.*
[b] *Department of Chemistry, NED University of Engineering and Technology, Karachi, Pakistan.*
[c] *Department of Electrical Engineering, NED University of Engineering and Technology, Karachi, Pakistan.*
**Corresponding author E-mail: fwbaig@uiu.edu.pk*

## Abstract:

In the quest for high-performance humidity sensors, nanocomposite materials have been seen as potential contenders owing to their potential for electrical and surface property tuning. This work reports the synthesis and comprehensive characterization of NGM-doped ZnO nanocomposites intended for effective humidity sensing. The main focus was on understanding the effects of NGM concentration on the structural, morphological, and electrical properties of ZnO to determine the most effective doping ratio for the highest sensing efficiency [1].

NGM–ZnO composites were prepared through the controlled sol–gel process to provide uniform NGM distribution in the ZnO matrix. Systematic characterization tools such as XRD, SEM, and FTIR ensured effective development of nanocomposites with enhanced crystallinity and surface area. Humidity sensing was analyzed by monitoring capacitance changes under varying relative humidity conditions (10–90% RH) over various frequencies (10 kHz–1 MHz).

The 4% NGM–ZnO sample showed better performance, with the maximum capacitance sensitivity, fast response (4.0 s), and recovery time (7.2 s). The improved sensing property was due to the synergistic contribution of expanded surface adsorption sites, facilitated charge transfer, and conductive channels created by NGM doping [2].

These findings demonstrate the promising potential of NGM–ZnO nanocomposites as low-cost, stable, and highly responsive materials for future-generation humidity sensors for industrial, environmental, and biomedical monitoring. In addition to advancing knowledge on nanographite semiconductor interactions, this research also offers a platform for developing environmentally friendly sensing devices with scalable fabrication potential.

***Keywords:*** Nanographite, ZnO nanocomposite, Humidity sensor, Capacitance, Sensitivity

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OP-2

# Polymer-Modified Nanofiber Membranes for Efficient Removal of Atrazine Pesticide from Aqueous Environments

**Syeda Sara Hassan[1*], Saira Sidhu[1] & Zeeshan Khatri[2]**
[1]USPCASW Mehran University of Engineering and Technology, Jamshoro 76062, Pakistan
[2]Department of Textile Engineering Mehran University of Engineering and Technology, Jamshoro 76062, Pakistan
*Corresponding author E-mail: sshassan.uspcasw@faculty.muet.edu.pk*

**Abstract:**

Atrazine is a synthetic herbicide widely used to control broadleaf weeds in crops such as sugarcane, corn, and sorghum. Due to its toxic and persistent nature, its removal from water sources remains a significant challenge. This study focuses on removing atrazine from synthetic aqueous solutions using titanium dioxide ($TiO_2$) nanoparticles synthesized via the sol-gel method and incorporated into polyamide-6 (PA6) nanofiber membranes through electrospinning. The $TiO_2$-embedded PA6 nanofiber membrane (PA6/$TiO_2$-NFM) was characterized using X-ray diffraction (XRD), and Fourier transform infrared spectroscopy (FTIR) to confirm successful in-situ polymerization. Scanning electron microscopy (SEM) was employed to analyze the microstructure and surface morphology, revealing uniform nanofibers with a rough surface and an average diameter of approximately 110 nm. The $TiO_2$ nanoparticles were spherical, smooth, and homogeneous, with an average diameter of 120–140 nm. The electrospun nanofiber membrane demonstrated excellent removal efficiency, achieving 85% atrazine removal at an initial concentration of 1 ppm with different fiber mass after 30 minutes of contact time at room temperature and neutral pH. The removal efficiency was assessed using a UV-Vis spectrophotometer at a wavelength of 470 nm. These findings highlight the potential of PA6/$TiO_2$ nanofiber membranes as an effective and rapid method for atrazine removal from contaminated water.

***Keywords:*** Water treatment, Nanofibers membrane, Electrospinning, PA6/$TiO_2$ Embedded Nanofibers, Atrazine removal, Adsorption.

OP-3

# Emerging Trends in Coordination Bonding of Newer Bi-Pyridine Ligands with Metal Ions: Synthesis, Characterizations and Applications

**Ambreen Shah[a]* & Fayaz Keerio[a]**
*[a]M. A. Kazi Institute of Chemistry, University of Sindh, Jamshoro.*
*Corresponding author E-mail: ambreen.shah@usindh.edu.pk*

**Abstract:**

Newly developed M-L coordination complexes were synthesized by various methods for research and commercial uses, which saw significant improvement over time. Mixed-ligands complexes of Cu(II), Zn(II), and Pb(II) were synthesized using (2, 2’-bipyridine 4,4’-dicarboxylic acid) (BPDA) and 4-nitro (phenylenediamine) (PA). The structure of the new M-L complexes was analyzed using various spectroscopic techniques, including FT-IR, UV/Vis, SEM, XRD and EDS. The newly synthesized compounds M-L showed weak to medium-intensity bands in the 1730 $cm^{-1}$ range, attributed to aromatic carboxylate stretching vibrations. These mixed ligand metal complexes were employed as photocatalysts for the photodegradation of methylene blue in an aqueous solution. The photocatalytic efficiency of single and mixed-metal complexes was assessed for the photodegradation of methylene blue. The Cu(II) complexes, both single and mixed-ligand, established higher decolorization efficiency compared to Zn(II) and Pb(II) complexes. The photocatalytic experiments revealed that the Cu(II) complex exhibited the best photocatalytic performance, degrading 88% of MB at 26°C. The kinetics of the photodegradation of methylene blue were investigated with optimized parameters in the presence of nanocatalysts

***Keywords:*** Metal complexes, synthesis, FT-IR, UV-Vis, SEM, photodegradation reaction.

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OP-4

# Biocatalytic Oxidation Remediation of 5-Amino-2-Naphthalene Sulphonic Acid and Diclofenac Sodium Via Immobilized Horseradish Peroxidase

**Tahira Qureshi[1]* & Rabel Soomro[2], M. Iqbal Bhanger[3] & Adil Denizli[4]**
*[1]Government College University Hyderabad, Sindh, Pakistan*
*[2]Government Girls College Tando Adam, Sanghar, Sindh, Pakistan*
*[3]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
*[4]Haccettepe University, Ankara, Turkey*
*Corresponding author E-mail:* dr.tahira@gcuh.edu.pk

**Abstract:**

In this study, horsereddish peroxidase (HRP) was efficaciously immobilized on a microemulsion-based organogel–silica composite matrix**,** provided that a substantial backing with improved porosity and surface functionality. The materials were characterized using Fourier-transform infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM) to confirm the successful incorporation of the enzyme and structural integrity of the composite. We have selected 5-amino-2-naphthalene sulphonic acid (ANSA) and diclofenac sodium (DCF-Na) as primacy contaminants due to their resistance to biodegradation and adverse ecological effects, including endocrine disruption and oxidative stress in aquatic organisms. Catalytic degradation optimization experiments were performed to determine the impact of parameters such as pH, temperature, contact time, oxidant concentration, analyte concentration, gel dose**,** and stirring rate on the enzymatic degradation of ANSA and DCF-Na.

The results revealed that HRP retained high catalytic activity across a broad pH (5–9) and temperature (20–50°C) range, indicating strong operational stability under environmental conditions. The immobilized HRP system achieved significant removal efficiencies for both selected pollutants, aligning with recent findings that immobilized peroxidases on silica, alginate, or chitosan supports exhibit enhanced degradation efficiency and reusability over multiple cycles**.** Moreover, the incorporation of HRP into hybrid gel matrices mitigated enzyme leaching and preserved its conformational stability during successive oxidation reactions.

***Keywords:*** Green degradation, catalytic remediation, Enzyme, gel, *horseradish peroxidase* (HRP), dye, drug

**OP-5**

# Application of Central Composite Design for Adsorption of Paracetamol on Novel Fulvic Acid Fabricated Calcium Oxide Nanoparticles

**Fakhar N. Memon*, Areesha Ashraf, Parvez Ali Mahesar, Humera Moosa, Alveena Khan, Sana Imam, Kashan**
*Department of Chemistry, University of Karachi-Pakistan*
*Department of Chemistry, University of Karachi-Pakistan*
*Institute of Chemistry, Shah Abdul Lateef University of Khairpur*
**Corresponding author E-mail: fakhar.nisa@uok.edu.pk*

## Abstract:

Nanotechnology, as a cutting-edge field of modern science, focuses on synthesizing, preparing, and utilizing nanoparticles (NPs) ranging from 1 to 100 nanometers in size.

**Objective:** Nano technological application is significantly important in the field of drug delivery because of its high specificity towards the target site, so it is able to reduce toxic side effects of drugs to normal cells. Nanoparticles plays a vital role and it can conjugate with various drugs by different method to deliver drugs to the target site.

Calcium oxide nanoparticles (CaO-NPs) are prepared in different ways. In this study, we have prepared calcium oxide nanoparticles using Fulvic acid as coating agent. Fulvic acid is humic substance fraction. It has lower molecular weight through which it can easily absorbed by plants. This makes the cell membrane more permeable to carry nutrients into the cell. Fulvic acid consists of small hydrophilic molecules, which contain abundant functional groups. The most important functional groups are the carboxylic, phenolic, alcoholic, carbonyl, amino and sulfhydryl groups.

The presence of these functionalities in fulvic acid also enhances the adsorption capability. In current study, Calcium oxide nanoparticles (CaO-NPs) are synthesized and characterized by different Analytical techniques (IR, SEM, and XRD). Moreover, for optimization of various parameters related to drug delivery Central Composite Design (CCD) have been used. Three effective parameters (pH, adsorbent dosage and concentration of drug) were optimized by assessment with CCD.

***Keywords:*** Fulvic Acid, Nanoparticles, Analytical techniques (IR, SEM, XRD), Adsorption, Central Composite Design (CCD)

OP-6

# Synthesis of Graphene Oxide/Titinium Oxide Based Catalyst and Exploring its Degradation Ability towards Methylene Blue

**Imdadullah Qureshi*[1], Hazrat Usman[1], Muhammad Shazad Shifa[2], Sharafat ullah[1]**
*[1]Department of Chemistry, University of Science & Technology, Bannu- 28100-Pakistan*
*[2]Department of Physics Islamia University Bahawalpur Punjab Pakistan.*
**Corresponding author E-mail: dr.imdadullah@ustb.edu.pk*

## Abstract:

Rapid industrialization and excessive use of different chemicals causes serious pollution to the general public. Among these chemicals dyes are the most consumable chemicals, which are extensively used in many processe. Methylene blue is one of the dye which is used in very large amount in many industries. It causes many adverse effect to human health. Therefore to get rid of this menace there is need of certain catalysts to degrade the dye and convert it into environmentally benign product. Here in a grapheme/titanium based catalyst is reported to be synthesized and explored its degradation ability towards methylene blue. The material has been characterized through UV-Vis, FTIR, SEM EDX, TEM, and XRD. All these techniques confirmed the product. The material ability and capacity for the degradation of Methylene blue and Eriochrome black T has been investigated. From the result it has been observed that the material has high efficiency to degrade Methylene blue, while its interaction with the Eriochrome black T is not appreciable. Methylene blue has been degraded 95 % in 45 minutes.

***Keywords:*** Graphene Oxide, Methylen blue, Catalytic degradation, Eriochrome Black T

OP-7

# Modeling and Simulation of Biocompatible Composite Material for Wastewater Treatment

**Sadaf Iqbal**[a,*] **& Fouzia Perveen Malik**[b,*]
[a] *Department of Chemistry, University of Karachi, Karachi-75720, Pakistan.*
[b] *Materials Modeling Lab, Department of Sciences, School of Interdisciplinary Engineering & Sciences (SINES), NUST, H-12 Campus, Islamabad, Pakistan.*
[*] *Corresponding author E-mail: sadaf.iqbal@uok.edu.pk*

## Abstract:

Urgent growth of economical and biocompatible materials that are able to assimilate with state-of-the-art water treatment technologies is anticipated to address water purification and recycling owing to the discharge of untreated textile effluents. The textiles contamination to the water bodies causes severe environmental, health, and aquatic life problems. In this study, we employed density functional theory (DFT) and molecular dynamics (md) simulations to investigate the binding of hazardous anionic, cationic and neutral dye pollutants of different classes with a biocompatible biopolymer (Chi) and its eco-friendly composite (ChiLig) material. The obtained binding energy was found in the order of anions > cations > neutral dyes and the magnitude of binding is much larger against the composite (ChiLig) material. The detailed analysis of the thermodynamic parameters obtained through md simulations indicated a spontaneous adsorption process with electrostatic and van der Waals interactions between dye pollutants and composite material. Our research highlighted the importance of biocompatible composite material (ChiLig) whose individual components have already been shown excellent potential in various waste water treatment research studies. Our encouraging results also emphasized the potential role of biocompatible composite material (ChiLig) in promoting sustainable water treatment practices. Further, materials modeling and simulations are found to be extremely constructive methodology to screen and design potential materials prior to their synthesis and fabrication.

***Keywords:*** Adsorption, Biocompatible, DFT, Materials simulations, Waste water treatment.

## References:

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OP-8

# Ultrasonic-assisted synthesis of ($Fe_3O_4$@$SiO_2$@$NH_2$-BPA-MIP) and Their Analytical Practicality as a Selective Magnetic Adsorbent for the Removal of Bisphenol A from Water systems

**Abdullah[a,b,c], Aamna Balouch[b] & Mustafa Tuzen[c]**
*[a]Department of Chemistry, Faculty of Sciences, Engineering and Technology, University of Gwadar, Gwadar 91200, Balochistan, Pakistan*
*[b]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro 76080, Pakistan*
*[c]Tokat Gaziosmanpaşa Üniversitesi, Fen-Edebiyat Fakültesi, Kimya Bölümü, 60250 Tokat, Türkiye*
*Corresponding author E-mail: anachemist31@gmail.com*

## Abstract:

In this study, we report the synthesis of magnetic molecular imprinted polymer ($Fe_3O_4$@$SIO_2$@$NH_2$@BPA-MIP) by a simple ultrasonic-assisted coprecipitation polymerization method for the first time and applied as a magnetic selective adsorbent for efficient removal of Bisphenol A from real water samples. The application of ultrasonic waves reduces the synthesis reaction time by 5 times as compared to conventional heating. After successful synthesis magnetic selective adsorbent was characterized by different techniques such as SEM and FT-IR, for its surface morphology and functionality. During this study, other parameters were optimized, such as pH, adsorbent dose, effect of time, temperature, and concentration of target analyte to get maximum adsorption. The adsorption pattern and kinetics were best described by Langmuir and pseudo-second order kinetics. An excellent linear concentration range of (10-150 µg/L), with a satisfactory low limit of detection (0.71 µg/L) was achieved. The design method was validated by the standard addition method. The synthesized magnetic selective adsorbent was applied successfully for the selective removal of BPA from real water samples.

***Keywords:*** Molecular Imprinted polymer, Bisphenol A, Magnetic selective adsorbent

**OP-9**

# Fabrication of Barium Titanium Oxide Nanoflowers as an efficient adsorbent material for the selective solid-phase Microextraction of Copper from real environmental and food samples

**Abdul Hameed Kari**
*National Centre of Excellence in analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
*Corresponding author E-mail: hameedchemistry97@gmail.com*

## Abstract:

This work extracted a trace level of copper (11) from water and food samples using the solid-phase microextraction (SPME) technique with nano-adsorbent $BaTiO_3$ material. SEM-EDX, FTIR, BET and XRD, were used to characterize $BaTiO_3$. For the selective and sensitive elimination extraction of Cu (II) from the environmental samples, many analytical parameters, including pH, adsorbent amount, adsorption time, desorption time, eluent type, eluent volume, model solution amount, and matrix ions effects, were optimized. The limit of detection and quantification for the Cu(11) were determined to be 3 and 10 $\mu gL^{-1}$, respectively. $BaTiO_3$ nano adsorbent successfully extracted Cu (II) from water and food samples. According to the results, the fabricated $BaTiO_3$ nanoflowers are highly selective and sensitive compared to reported methods.

***Keywords:*** Barium Titanium oxide, Solid Phase microextraction, sample preparation, pre-concentration, water, and food samples.

**OP-10**

# Synthesis and Characterization of Ferrite-Polymer Nanocomposites

**Gulfam Nasar**
*BUITEMS, Quetta Pakistan*
*Corresponding author E-mail:* gulfam.nasar@buitms.edu.pk

**Abstract:**

This study focuses on synthesizing and analyzing PVA-Nickel spinel ferrite nanocomposites. Ferrite nanoparticles are iron oxide compounds (Fe2O3 or Fe3O4) combined with other metals, with one or more dimensions on the nanoscale (1-100 nm). These materials are smaller, have a larger surface area, and exhibit exceptional magnetic and electrical properties. Because ferrites are highly magnetic, tend to aggregate, and are relatively unstable, coating them with polymer is necessary for chemical stabilization. Therefore, composites of these ferrites are created to stabilize them, as composite materials are formed by combining two substances with different properties to achieve specific characteristics in the final product. Accordingly, Ni0.4Co0.6NdxFe2-xO4 ferrite coated with PVA nanocomposites was successfully prepared. Since PVA is a synthetic, water-soluble polymer with excellent emulsifying and film-forming properties, it is well-suited for this application. Ni0.4Co0.6NdxFe2-xO4 nanoparticles were prepared via microemulsion technique. These nanoparticles were then incorporated into the PVA matrix to form Ni0.4Co0.6NdxFe2-xO4/PVA nanocomposite thin films through the solvent evaporation method. The nanocomposite thin films were characterized using X-ray diffraction (XRD), Fourier Transform Infrared (FTIR) spectroscopy and Scanning Electron Microscopy (SEM). XRD analysis indicated that the Ni0.4Co0.6NdxFe2-xO4 nanoparticles are well-dispersed within the composites, exhibiting a cubic spinel structure. The XRD results also confirm the presence of semicrystalline PVA and the crystalline nature of the ferrites, as identified by JCPDS card numbers (01-089-4927) and (53-1847). FTIR spectra display various peaks in the functional group and fingerprint regions, such as OH stretching vibration, bending vibration of the -CH3 group, stretching of the CH2 group, vibration of CH2, C-O-C of acetyl groups, C-O stretching, and C-C stretching. SEM results demonstrated the uniform distribution of nanoparticles within the PVA polymer matrix. As ferrite concentration increased, dispersion of particles in the PVA matrix also improved. These properties suggest that polymer nanocomposites have enhanced structural and surface properties compared to traditional materials.

***Keywords:*** Nanotechnology, Ferrites, Nanocomposites, Solvent evaporation technique, Microemulsion method, Thin films.

**OP-11**

# Synthesis and Characterization of Advanced Magnetic Max Phase ($Fe_3O_4$- $Ti_3AlC_2$) and It's Application in Microextraction of Heavy Metals

**Mansoor Khan[a]*, Mustafa Soylak[b]**
*[a]Kohat University of Science and Technology, Koha, Kp, Pakistan.*
*[b]Erciyes University, Faculty of Sciences, Department of Chemistry, 38039 Kayseri-TURKEY*
**Corresponding author E-mail: mansooroo9988@gmail.com*

## Abstract:

Due to their non-biodegradable and toxic nature, heavy metals are the primary source of water contamination. The heavy metals slowly deposit in the human beings to lead health problem through food products and water. Therefore, it is crucial to identify harmful heavy metals precisely in a variety of samples. Direct quantification of heavy metals form real samples cannot be employed with analytical techniques due to a lack of selectivity and sensitivity. Therefore, proper preconcentration step required prior to its quantification. Max phases, also known as titanium aluminum carbide ($Ti_3AlC_2$), are non-oxide and with high melting point compounds have a layered structure of hexagon. They have the chemical formula Mn+1AXn, where M is a transition metal, A is a group IIIA or IVA element, and X is either C or N. The ternary carbide titanium aluminum carbide ($Ti_3$AlC2) was initially created by Benchakar in 2020 Owing unique characteristics, like as nontoxic, cheap, easy preparation, high heat resistance and electrical conductivity, resistance to damage, titanium aluminum carbide ($Ti_3AlC_2$) has received great attention of the scientists recent past. The aims of the work were to apply max phases and their derivatives as solid phase extracting material for the heavy metals in different samples.

***Keywords:*** Heavy metals, solid phase extraction, preconcentration, max phases.

OP-12

# Synthesis and Characterization of Nano-Biochar from Waste Plant Biomass

**Fatih ERCİ[a]*, Hala BOUBAKEUR[a], Vildan ERCİ[b] & Ahmet Burçin BATIBAY[c]**
*[a]Department of Biotechnology, Faculty of Science, Necmettin Erbakan University, Konya, Türkiye.*
*[b]Department of Soil Science and Nutrition, Faculty of Agriculture, Selcuk University, Konya, Türkiye.*
*[c]Necmettin Erbakan University, Faculty of Engineering, Department of Metallurgical & Materials Engineering, Konya, Türkiye.*
**Corresponding author E-mail: ferci@erbakan.edu.tr*

**Abstract:**

The conversion of plant biomass into biochar has received a great deal of attention because of its potential applications in various green strategies. Biochar can be upgraded from suboptimal to high-quality nanomaterials by reducing its particle size to the nano scale. This is an efficient way to improve properties like porosity and specific surface area. This study focuses on the synthesis and detailed characterization of nano-biochar produced from waste plant biomass. A slow pyrolysis process at 450 °C was used to produce biochar from readily available agricultural waste, in particular olive waste, which was then converted to nano-biochar (NBC) by means of a ball-milling process, a top-down mechanical process. The physicochemical properties of both the biochar and the nano-biochar were comprehensively characterized. Analytical techniques including Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDX), and Brunauer-Emmett-Teller (BET) surface area analysis were employed to determine the morphological, elemental, and surface characteristics. In comparison to its bulk counterpart, the results demonstrated a notable decrease in particle size to the nanoscale and a corresponding increase in specific surface area in the nano-biochar. With potential uses in environmental remediation, composite materials, and sustainable agriculture, the successful synthesis of nano-biochar from waste plant biomass shows a promising path for turning low-value agricultural residues into a high-value nanomaterials.

***Keywords:*** Green synthesis, nano-biochar, pyrolysis, waste biomass

OP-13

# Mind Under Machine Influence: When AI Starts Rewiring Executive Decision-Making

**Ammara Aftab**
*Founder & President, Pro AI Global AI Strategy Consultant | Author, Falling in Love with AI*
*Karachi, Pakistan*
*Corresponding author E-mail:* ammara.aftab63@gmail.com

**Abstract:**

This research tracks cognitive shifts in 200+ professionals averaging four hours daily of AI-assisted work. What emerged were three patterns that should alarm any board member, though they rarely show up in quarterly reports.

First, analytical degradation. As leaders offload synthesis to AI, their own pattern recognition capacity declines measurably. In our six-month tracking, 68 percent showed reduced ability to identify anomalies in data without algorithmic prompting. They could still read spreadsheets, but the instinct to question what felt off had atrophied.

Second, emotional transference. Thirty-four percent developed trust-based relationships with AI systems, including expressions of loyalty and betrayal when outputs disappointed them. These were not figures of speech. Participants described genuine frustration when the AI "let them down" and relief when it "came through." They knew it was code. Their nervous system responded anyway.

Third, decision dependency. Dopamine loops formed around AI validation, creating a cohort of leaders who could not initiate strategic moves without machine confidence scores. One finance director described this as "thinking in autopilot"—a phrase that captures the core danger. The brain, given a perfect cognitive crutch, stops walking on its own.

The ProAI Global community serves as both laboratory and warning system. Members report altered risk thresholds and a growing intolerance for ambiguity, preferring false machine certainty over human uncertainty. This has direct implications for strategic planning and innovation capacity.

What we built from these observations is practical, not academic. A simple framework that tracks biometric markers like decision latency and cognitive load, runs team audits to spot collective analytical decay early, and builds in mandatory offline thinking time. The point is not to reject AI. It is to stop treating executive neural health as an afterthought while we chase productivity gains.

Companies scaling AI without these safeguards are not optimizing. They are trading their leadership's independent judgment for speed. That is a bad deal.

***Keywords***: executive AI dependency, cognitive risk management, human-machine interaction, neural adaptation, Pro AI Global, leadership cognition

**OP-14**

# Eco-friendly Synthesis of ZnO-TiO2 Nanocomposites for the Efficient Removal of Toxic Metal Ions from Aqueous Solutions

**Mohammad Younis Talpur[1*], Qadeer Khan Panhwar, Syeda Sara Hassan[2] & Ambreen Shah[1]**
*[1]Dr. M. A Kazi Institute of Chemistry, University of Sindh, Jamshoro, 76080, Sindh, Pakistan*
*[2]USPCAS-W, Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan*
*Corresponding author E-mail: younis.talpur@usindh.edu.pk*

## Abstract:

In the present study, we synthesized zinc oxide (ZnO), titanium oxide ($TiO_2$) nanoparticles, and their nano-composites of ZnO/$TiO_2$ using citrus x senusis (orange peels) extract by the co-precipitation method. This greener synthesis of nanomaterials (NMs) refers to the simple, cost-effective, efficient, and organic-free solvent. These synthesized NMs were characterized by ultraviolet-visible (UV-Vis) spectrophotometer, Fourier transform infrared (FTIR) spectroscopy, scanning electron microscope (SEM), energy dispersive spectroscopy (EDS), and X-ray diffraction (XRD) spectroscopy, respectively. UV-Vis and FTIR monitored the surface interaction of green synthesized NMs, while SEM and XRD confirmed the shape and size of the as-synthesized green NMs. For the application study, the lead concentration was reduced by ZnO NPs, $TiO_2$ NPs, and their ZnO/$TiO_2$ NCs using inductively coupled plasma-mass spectroscopy (ICP-MS). The results obtained from ICP-MS show a 92% reduction in lead levels, with ZnO/$TiO_2$ NCs acting as an excellent adsorbent. The Isothermal and kinetic models were applied, and the best-fitted method was Langmuir (adsorption capacity 33.33 mg/g; r 0.99) and Freundlich (91 mg/g; 0.99). The developed method followed the pseudo 2nd order with r value of 0.99. The method was validated on the wastewater and real water samples collected from industrial effluents, Kotri, and the Institute of Chemistry, University of Sindh, Jamshoro, and the highest reduction of lead obtained from those samples when tested on ICP-MS was 98.8%.

***Keywords:*** Eco-friendly, ZnO, $TiO_2$, ZnO-$TiO_2$ NCs, ICP-MS, Heavy metal ions (Lead), Aqueous solution.

**OP-15**

# Visualizing Ultrafast Spectral and Spatial Heterogeneity in Photoexcited Nanomaterials via Broadband Transient Absorption Microscopy

**Maha Sharif*, Xiao Ma, Melody Moossavi, Dany Doughan & Elham Ghadiri***
[a]*Department of Chemistry, Wake Forest University, Winston-Salem, 27109, North Carolina,*
[b]*Center for Functional Materials, Wake Forest University, Winston-Salem, 27109, North Carolina, USA*
*Corresponding author E-mail: sharm22@wfu.edu*

## Abstract:

Kesterite-based thin films have rapidly gained popularity for photovoltaic energy conversion applications due to their high absorption coefficient (> 10^4), cost-effectiveness, non-toxicity,earth-abundance, and tunable bandgap, which enables absorption in the visible region. In this paper, we synthesized Cu2BaSnS4 using the molecular ink method (on a Molybdenum substrate) and colloidal synthesis (prepared on a glass substrate via drop casting). Structural characterization was determined using SEM. The optical bandgap is approximately 600nm, and XRD and XPS results indicate the absence of a secondary phase in CBTS film, which is a common feature in these materials.

Despite their potential, kesterite-based thin films have limitations in terms of open-circuit voltage (Voc) and low quantum yield. Various factors, including non-radiative recombination, surface defects, and both shallow and deep defects, influence these limitations. To understand the photophysical behavior of photoexcited carriers and heterogeneity within the grain, we are using ultrafast spectroscopy and microscopy in both diffuse and reflectance modes. These techniques allow us to visualize the distribution of sub-band electronic states and free charge carriers over a broad range of 500-900nm, as well as at a single wavelength. Our results show that these films demonstrate spectral dependency and spatial-temporal heterogeneity within the grains. We also reported carrier lifetime at different wavelengths. We used Pearson correlation analysis, comprised of 400 dataset points, to examine the photophysics of various regions, showing a similar pattern, and then sorted them into three groups: Group 1 (ESA), Group 2 (GSB/ESA), and Group 3, with a slightly blue-shifted GSB compared to Group 2. We also found evidence that the compositional method is a key factor in determining the distribution of band-edge states, band tailing effects, and absorption by minority charge carriers, which vary across different spectral regions in both films.

## References:

Maha Sharif, Xiao Ma, Melody Moossavi, Dany Doughan, and Elham Ghadiri, ACS Photonics 2025 12 (8), 4130-4142, DOI: 10.1021/acsphotonics 4c02400

OP-16

# A Green Ultrasonic-Assisted Liquid–Liquid Microextraction Technique Based on Deep Eutectic Solvents for Flame Atomic Absorption Spectrometer Determination of Trace Level of Lead in Tobacco and Food Samples

**Zainab Manzoor Memon[1], Erkan Yilmaz[3], Afsheen Mushtaque Shah[2], Tasneem Gul Kazi[2], Bikha Ram Devrajani[1], Mustafa Soylak[3]**
*[1]Liaquat University of Medical & Health Sciences Jamshoro,*
*[2]University of Sindh, Jamshoro,*
*[3]Erciyes University, Kayseri, Turkey*
*Corresponding author E-mail: zainab.manzoor@lumhs.edu.pk*

**Abstract:**

A novel and green ultrasonic-assisted liquid phase microextraction method (LPME) based on deep eutectic solvents (DESs) has been developed for the pre-concentration and extraction of lead from cigarette tobacco and food samples prior to flame atomic absorption spectrometer (FAAS) determination. Multivariate Plackett–Burman design has been employed which make the proposed method more easy and fast as compare to routine practices and eliminated the step by step optimization process. Further, accuracy of the developed UA-DES-LPME has been checked with analysis of certified reference material and addition-recovery experiments for tobacco and food samples. The developed method showed a 4.4 µg L−1 of limit of detection (LOD) and 14.6 µg L−1 of limit of quantification (LOQ) with the 4.0% of relative standard deviation (RSD). Moreover, the developed method is more user-friendly, faster, and easier as compared to reported methods.

***Keywords:*** Tobacco Cigarette, Food, Lead, Deep eutectic solvent, Liquid phase microextraction, Multivariate Plackett–Burman design, Factorial design, FAAS

OP-17

# Copper Oxide-Based Anodes for Highly Sensitive Electrochemical Detection of Amlodipine

**Naeem Ullah Khan[a], Hira Iaza Sahito[b], Nazar Hussain Kalwar[b]* Muhammad Yousuf[c,d], Jun Lu[a] & Selcan Karakuş[e*]**
*[a]State Key Laboratory of Chemical Resource Engineering and College of Chemistry, Beijing University of Chemical Technology, Beijing 100029, PR China*
*[b]Institute of Chemistry, Shah Abdul Latif University, Khairpur Mirs 66111, Sindh, Pakistan*
*[a]Department of Environmental Engineering, Beijing Normal University, 100875, Beijing, China.*
*[c]Institute of Engineering Thermophysics, Chinese Academy of Sciences, Beijing 100029, PR China*
*[d]University of Chinese Academy of Sciences, Beijing 100029, PR China*
*[e]Faculty of Engineering, Department of Chemistry, Istanbul University-Cerrahpaşa, Istanbul 34320, Turkey*
* *Corresponding author E-mail: selcan@iuc.edu.tr, nazar.kalwar@salu.edu.pk*

## Abstract:

Sensitive and reliable detection of the Amlodipine (AML) drug in biological and environmental samples poses a significant challenge, necessitating the development of innovative electrode platforms. Herein, efficient anodes (CuO@ITO) were constructed for the direct electrochemical detection of AML in phosphate buffer saline (PBS) by growing CuO nanostructures onto the ITO electrode. Controlled nucleation of Cu ions facilitated consistent structural growth over the ITO surface, resulting in close interfacial contact between the nanostructures and the current collector. The fabricated CuO@ITO anode exhibited remarkable electrochemical oxidation response towards AML, enabling sensitive detection within a dynamic concentration range of 0.1-1.6 µM using differential pulse voltammetry, with a detection limit of 0.014 µM. Additionally, the sensor demonstrated robust anti-interference capabilities against various biomolecules and pharmaceutical drugs, ensuring accurate and reliable AML detection even in complex biological samples. Satisfactory recoveries of spiked AML drug from human urine samples affirmed the sensor's suitability for real-world applications. The overall findings of this work emphasize the significance of the developed sensor in enabling the sensitive and selective detection of AML, making it a valuable tool for clinical and environmental monitoring.

***Keywords:*** Amlodipine, *electrochemical sensors, CuO nanostructures, flexible anodes*

**OP-18**

# Unveiling Sustainable Methodology for the Synthesis of Dihydropyrimidinones Utilizing Biginelli Reaction

**Naved Iqbal[a] & Maria A. Khan[a*]**
*[a]Third World Center for Science and Technology, International Center for Chemical and Biological Sciences, University of Karachi-75270, Pakistan.*
*Corresponding author E-mail: navediqbal004@gmail.com*

## Abstract:

Dihydropyrimidinones (DHPMs) represent a vital class of heterocyclic compounds with diverse pharmacological activities, including anticancer, antimicrobial, antiviral, and enzyme inhibitory properties. They also constitute the structural framework of nucleobases such as cytosine, thymine, and uracil, essential components of DNA and RNA. In this work, previously developed by our group, was employed as a green catalyst for the synthesis of DHPM analogues via the Biginelli reaction. Two libraries comprising thirty-eight analogues were synthesized and compared with the conventional $Cu(NO_3)_2{\cdot}3H_2O$-catalyzed approach. The ionic liquid catalyst provided an efficient and sustainable alternative to metal catalysts under mild conditions. The synthesized compounds were evaluated for biological potential and demonstrated promising activity against Leishmaniasis and Malaria.

***Keywords:*** Heterocyclic compounds, Ionic liquid, Bioactive molecules, Biginelli Reactions, Multicomponent reactions.

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OP-19

# Molecular Docking Insights of Schiff Base–Copper(II) Complexes: Exploring Lipoxygenase Enzyme Inhibition

**Maira Naz, Uzma Ashiq* & Rifat Ara Jamal**
[a]*Department of Chemistry, University of Karachi, Karachi, Pakistan*
** Corresponding author E-mail: uzma.ashiq@uok.edu.pk*

## Abstract:

A series of copper(II) complexes consisting of tetradentate ligands (**1, 4,** and **6**) with general formula [$Cu_2L_2$] and pentadentate ligands (**2, 3,** and **5**) with general formula [$Cu_3(L)_3$] were synthesized by the reaction of salicylaldehyde with various amino acids. The complexes were characterized using various physicochemical and spectroscopic techniques, including elemental analysis, ESI-MS, UV-Visible spectroscopy, FTIR spectra, conductivity measurements, and thermal analysis. Single-crystal X-ray analysis has confirmed the binuclear structure of compound **1** and the trinuclear structure of compound **2,** which exhibit novel polymeric coordination with the Leucine-Schiff base. Complex **1** has crystallized with the tetradentate mode of chelation. In contrast, complex **2** shows a completely novel geometry featuring pentadentate ligand binding and trinuclear polymeric assemblies in a square pyramidal motif. Based on the structural investigation, it has been elucidated that the metal center was bonded through nitrogen and oxygen moieties and identified to have distorted square planner and square pyramidal geometries. Low values of molar conductance reveal the possible neutral structure of all complexes. All synthesized compounds have been screened for lipoxygenase enzyme inhibition. Compound **5** demonstrated potential lipoxygenase (LOX) inhibition properties ($IC_{50}$ = 21.4 μM) comparable to the standard compound, baicalein. Compounds **1**, **2**, **5**, and **6** exhibited significant inhibition as compared to their free ligands with lower $IC_{50}$ values. The docking properties of all the synthesized Cu(II) complexes and their free ligands were studied for lipoxygenase enzyme to obtain information on binding affinity and their binding orientation at the active site. The molecular docking studies for all compounds were in good agreement with the experimental values, making them promising candidates for the treatment of inflammation, tissue degradation, and cancer.

***Keywords:*** Copper(II), Complexes, Schiff bases, Lipoxygenase, Molecular docking

OP-20

# Investigation of the Effects of High Intensity Ultrasound on the Secondary Structures of Proteins Using Ftir Spectroscopy

**İsmail Tarhan**[a,b]* & **Ashraf A. Ismail**[a]
*[a]McGill IR Group, McGill University, Faculty of Agricultural and Environmental Sciences,*
*Department of Food Science and Agricultural Chemistry, Montréal, QC, Canada*
*[b]Selçuk University, Faculty of Science, Department of Biochemistry, Konya, Turkey.*
**Corresponding author E-mail: ismtarhan@gmail.com*

## Abstract:

To meet the protein demand of the world's increasing population and to provide easy access to protein, many applications on nutritional proteins are carried out by the food industry. High-intensity ultra sound (HIUS) is the subject of many studies in this field with its superior quality and applicability, especially in the field of protein modifications in foods[1]. FTIR spectroscopy is widely used in examining the effects of HIUS on protein structures in foods, but the vibrational properties of proteins at the full molecular level have not been examined. For this reason, this study aims to provide an in-depth examination of FTIR spectroscopy, especially with its superior features in determining the effects of HIUS on protein structures in foods. For this purpose, protein samples from different brands were provided and changes in their secondary structures were examined with FTIR by applying HIUS. Examining the results reveals that raising the applied HIUSP to 4 hours might have affected secondary structures, particularly turns and β-sheets.  A decline in the band's average ratio at 1693 $cm^{-1}$ is noted.  All secondary structures were found to have changed significantly, with the exception of side chains and structures at 1693 $cm^{-1}$. It may be concluded from this finding that the impact of the 250W HIUSP treatment on secondary structures increased with its duration. It should be remembered that instantaneous heating up to 40 $^{o}$C within a 4-hour period may have caused changes in these secondary structures, even though the distilled water in the cell was changed every seven minutes during the HIUSP application to prevent the cell and the protein sample from heating up.  The ratio of the band at 1693 $cm^{-1}$ did not significantly alter, suggesting that 250W HIUSP power could not have an impact on the protein's folded structure for at least four hours.

***Keywords:*** FTIR; protein; secondary structure; ultrasound

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OP-21

# Investigation of Some Chemical Removals in Domestic Wastewater Treatment Plants

**Fatih Durmaz[a]* & Cihat Uçar[b]**
*[a]Selçuk University, Faculty of Science, Department of Chemistry, Konya, Türkiye*
*[b]Konya Wastewater Treatment plant, Konya, Türkiye*
**Corresponding author E-mail: fdurmaz@selcuk.edu.tr*

**Abstract:**

Domestic wastewater is wastewater generated as a result of various activities performed by people in their daily lives (e.g., kitchen, toilet, bathroom, laundry, etc.). Domestic wastewater contains organic substances, such as proteins and carbohydrates, as well as inorganic substances, including nitrogen and phosphorus. While aquatic plants in natural waters require nutrients such as carbon (C), nitrogen (N), and phosphorus (P) for growth and development, high concentrations of nitrogen and phosphorus in surface waters have a negative impact on the ecosystem. Therefore, wastewater must be treated before being discharged into rivers, lakes, and the receiving environment. Today, many methods are used to remove nitrogen, phosphorus, and various parameters from wastewater.

This study examines and evaluates the removal properties of some chemical treatment processes, such as total nitrogen and total phosphorus, removed in treatment units in domestic wastewater treatment plants.

***Keywords:*** Domestic Wastewater Treatment, Chemical Wastewater Treatment, Total Nitrogen Removal, Total Phosphorus Removal.

**OP-22**

# g-$C_3N_4$@LDH Nanocomposite for Efficient Trace and Toxic Metal Extraction from Environmental and Food Samples

**Muhammad Balal Arain[a,b]* & Mustafa Soylak[b]**
[a]*Department of Chemistry, Faculty of Sciences, Erciyes University, 38039 Kayseri, Türkiye*
[d]*Department of Chemistry, University of Karachi, 75270 Karachi, Pakistan.*
* *Corresponding author E-mail: drbalal@uok.edu.pk*

## Abstract:

The increasing levels of trace and hazardous elements in environmental water systems and food matrices pose a significant threat to human health, necessitating the development of selective, sustainable, and reusable adsorbent materials[1] [2]. In this study, a novel graphitic carbon nitride layered double hydroxide composite (g-$C_3N_4$@LDH) was synthesized using thiourea as the precursor through a facile hydrothermal route. The incorporation of sulfur functional sites enhanced electron density and increased active adsorption centers on the composite surface. Key operational variables affecting adsorption efficiency, including pH, contact time, adsorbent dosage, and ionic strength, were systematically optimized. The developed adsorbent exhibited a high adsorption capacity, rapid equilibrium behavior, and excellent reusability over multiple cycles. Analytical evaluation demonstrated a low limit of detection (LOD) and strong selectivity in the presence of competing ions. The method was successfully applied for Pb(II) extraction and quantification in real environmental waters and food samples with satisfactory recoveries.

***Keywords:*** g-$C_3N_4$, LDH, Thiourea, Pb(II), Adsorption, Food Samples, Environmental Analysis.

**Acknowledgment:** Dr. Muhammad Balal Arain gratefully acknowledge the financial support from Project No. 121C104, Sponsored by TUBITAK 2232-A Program, Turkey.

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OP-23

# AI Models for Basic Sciences: Where the Journey Begins

**Faraz Hussain Buriro**
*Founder, PakGPT Co-Chairman, ProAI Global Karachi, Pakistan*
*Corresponding author E-mail:* farazhussain95@gmail.com

**Abstract:**

Most conversations about AI in basic sciences start with breakthroughs. This one starts with a dead laptop in a Karachi classroom.

For five years, I have trained students who lack GPU clusters or cloud credits. They have old computers, patchy internet, and labs that close at 5 PM. That is where their journey begins. Not with a grant, but with a problem that needs solving anyway.

Take Sana. She spent her chemistry thesis manually counting soil particles under a microscope for eight hours a day, cross-eyed with fatigue. I handed her YOLOv5 and a setup guide written for CPUs, not data centers. Three days later, it counted its first sample automatically. She did not cheer. She just sat back and said "I can breathe now." That is the real metric. Not accuracy scores, but whether a tool actually changes a student's life.

The mistake I kept making was teaching code first. I would lose half the class before we got to the science. Now I do the opposite. I give biology students DistilBERT pre-loaded on Google Colab. Thirty minutes later, they are mining research papers for relevant studies. No installation hell. No dependency nightmares. They learn Python as a side effect, not a prerequisite. The science stays front and center.

Assessment changed everything. I stopped grading code quality. Instead I ask: "Why did the model flag this compound? What would you change about the training data?" My worst programmer last semester had the best scientific intuition. She spotted a data leakage issue the rest missed because she understood the chemistry, not the algorithm. That is the student you want building AI models for science.

Institutional change does not come from strategic plans. It comes from one team seeing results. A research lead at a ProAI training session resisted ML integration for months. Then their analysts started processing data ten times faster. Now they are the ones advocating AI adoption across their organization. No executive mandates. No budget approvals. Just proof that works.

The PakGPT chemistry bot happened because COVID shut down campus. Students needed reaction data but could not access lab computers. So we built a WhatsApp interface. They already had the app. No new logins. No learning curve. Engagement tripled. The university's official learning platform remains unused at $50,000. Our solution cost $150 in API credits.

Ethics was not a philosophical debate. It was survival. Pakistan does not have strict data privacy laws, so we made our own: no student data leaves campus servers. Every AI result gets manually verified the first fifty times. Students complain it is slow. Then they watch a model hallucinate a chemical structure and they understand. Experience teaches what lectures cannot.

**OP-24**

# Silk Fibroin-Graphene Oxide Composite Membranes for Selective Separation of Ions and Molecules from Water

**Qurat-ul-ain Shaikh[a], Khalid Hussain Thebo[b, c], Akbar Ali[d], Muzaffar Iqbal[e] & Ahmed Nadeem[f]**
[a]*Institute of Chemistry, Shah Abdul Latif University, Khairpur Mir's, Sindh 66020, Pakistan*
[b]*Institute of Metal Research, Chinese Academy of Sciences, 72 Wenhua Road, Shenyang, China*
[c]*Functional Nano Materials Lab, Department of Chemistry, Mirpur University of Science and Technology (MUST), Mirpur, AJK 10250, Pakistan*
[d]*State Key Laboratory of Multi-phase Complex Systems, Institute of Process Engineering (IPE), Chinese Academy of Sciences, Beijing 100F190, China*
[e]*Department of Chemistry, Faculty of Physical and Applied Sciences, The University of Haripur, KPK 22620, Pakistan*
[f]*Department of Pharmacology and Toxicology, College of Pharmacy, King Saud University, Riyadh 11451, Saudi Arabia*
[*] *Corresponding author E-mail:* khalidthebo@yahoo.com

## Abstract:

Nanofiltration membranes with controlled pores are useful in many fields, such as pharmaceuticals, desalination, petroleum, and food processing. Recently, graphene oxide has emerged as a promising candidate for the fabrication of highly efficient and pressure-resistant nano filtration membranes with excellent water permeability and solute rejection. However, it remains difficult to achieve increased permeability while maintaining excellent separation ability. Herein, we report a novel silk fibroin-graphene oxide (FGO) composite membrane prepared by using fibroin as a cross-link reagent, which is extracted from natural Bombyx mori silkworm cocoons. Such a FGO membrane shows a pure water permeance of ~280 L m- 2 h- 1 bar- 1, which is five times greater than previously reported GO-based membranes. Further, such a membrane also exhibits excellent separation efficiency (> 99 %) for different feed molecules. Additionally, these membranes exhibit high chemical stability in water, acidic and basic solutions for several days compared to pristine GO membranes.

***Keywords:*** Graphene oxide, Bombyx mori silkworm cocoons, Fibroin, Separation membrane, Dye

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**OP-25**

# Fabrication of a Calcium Alginate–Based Immobilization System for Novel Alkaline β-Amylase Derived from *Bacillus Subtilis*

**Ayisha Aman Ullah[a*], Ayesha Sharif[a], Rashida Rahmat Zohra[a], Mahnaz Ahmad[b] & Raheela Rahmat Zohra[b]**
[a]*Department of Biotechnology, Jinnah University for Women, Karachi.*
[b]*Department of Biotechnology, University of Karachi, Karachi..*
[*] *Corresponding author E-mail: ayisha.aman@juw.edu.pk*

## Abstract:

**Introduction:** Enzymes are broadly utilized in various commercial processes due to their specificity and efficacy, but their practical application is often limited because of their instability under extreme conditions. Immobilization of bio-catalyst on appropriate carriers can improve enzyme stability, reusability, and operational efficiency. Calcium alginate is a biocompatible and cost-effective scaffold commonly used for enzyme entrapment. This research focuses on the development of calcium alginate-based immobilization system for novel alkaline β-amylase purified from *Bacillus subtilis* isolated from hot spring. **Objectives:** The primary goal of this study is to establish calcium alginate-based immobilization system for novel alkaline microbial β-amylase; to compare kinetic and biochemical characteristics of free and immobilized enzyme and to assess the operational stability of immobilized enzyme. **Methods:** Partially purified enzyme was subjected to enzyme immobilization. For maximum immobilization yield, concentrations of sodium alginate and calcium chloride were optimized. After wards, the kinetics and biochemical attributes of free and entrapped β-amylase were compared using OFAT approach. Studies on operational stability and structural topologies of immobilized enzyme were also done. **Results:** 1% concentration of sodium alginate and 0.1M concentration of calcium chloride gave maximum immobilization yield. The catalytic reaction time remained 5 minutes for both free and immobilized enzymes. After immobilization, the enzyme exhibited a shift in optimal temperature from 40 °C to 50 °C and a decrease in optimal pH from 10.0 to 8.0. Kinetic analysis showed that substrate affinity slightly decreased upon immobilization, with Km increasing from 5.0 $\mathrm{mg{\cdot}mL^{-1}}$ (soluble enzyme) to 5.2 $\mathrm{mg{\cdot}mL^{-1}}$ (entrapped enzyme), while Vmax decreased from 5000 $\mu\mathrm{mol{\cdot}min^{-1}}$ (free enzyme) to 2000 $\mu\mathrm{mol{\cdot}min^{-1}}$ (immobilized enzyme). The immobilized β-amylase preserved activity for up to ten continuous starch hydrolysis cycles, elucidating its recycling potential. SEM analysis confirmed enzyme entrapment, showing the matrix pores occupied by enzyme molecules. **Conclusions**: These consequences elaborate the efficacy of calcium alginate–immobilized β-amylase for effective and sustainable hydrolysis of starch in various commercial applications.

***Keywords:*** β-amylase, Enzyme, Immobilization, Sodium alginate, operational stability

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# Appraising Wintertime Gaseous Air Pollution Episodes in Karachi: Diurnal Variability, Meteorological Effects, and Health Risk Assessment

**Arshad Fazal[a]*, Shaikh Mohiuddina & Haider Abbas Khwajab**
*[a]Department of Chemistry, University of Karachi, Karachi 75270,Pakistan*
*[b]Department of Environmental Health Sciences, School of Public Health, University at Albany, State University of New York,1 University Place, Rensselaer, NY 12144,USA*
** Corresponding author E-mail: arshad_fazal@yahoo.com*

**Abstract:**

This study presents a high resolution diurnal analysis of reactive gaseous pollutants NO, $NO_2$, HONO, $O_3$, $HNO_3$, $SO_2$, HCl, and HF in Karachi, Pakistan, during the winter season, addressing critical gaps in South Asian air quality research. Employing meteorological and chemical analysis through different analytical techniques , investigated the relation among anthropogenic emissions, photochemical processes, and meteorological conditions. Results revealed distinct diurnal patterns, with elevated NOx and $SO_2$ concentrations during evenings linked to vehicular aand industrial activities, while $O_3$ peaks in the afternoon were driven by VOC-NOx photochemistry. Nocturnal HONO accumulation and morning photolysis underscored its role as a key OH radical precursor, influencing oxidative capacity. Heterogeneous reactions, such as $N_2O5$ hydrolysis for $HNO_3$ formation, and acid displacement mechanisms for halides (HCl/HF) highlighted the complexity of wintertime pollutant pathways. Strong correlations between pollutants and meteorological variables (temperature, humidity, wind speed) emphasized the role of local conditions in pollutant dynamics. Weekday-weekend variations further confirmed anthropogenic dominance in emission sources. Assessment for health risk due to said pollutants carried out in details lead to further comparison with other metropolitan cities South Asia region. These findings provide vital insights for air quality management in rapidly urbanizing coastal megacities, advocating for targeted emission controls and integrated modeling frameworks to mitigate health and environmental impacts. The study underscores the urgency of multi pollutant monitoring and region specific strategies to address wintertime air pollution in South Asia.

***Keywords:*** Gaseous pollutants; Diurnal variation; Meteorological effects; Health risk assessment; Karachi winter air pollution

OP-27

# Mitigation of Thermal Fatigue Cracking in Automotive Brake Discs (GCI, FC250-A): A Case Study on Material Optimization Using Alloyed Grey Cast Iron

**Abdul Rauf Jamali[1]*, Muhammad Sohail Hanif[1], Shahid Ali[1] & Shazad Ahmed[2]**
*[1]Department of Materials Engineering, NEDUET, Karachi.*
*[2]Hussein Engineering Work (PVT) Limited, Karachi.*
*Corresponding Author: engrabdulrauf@neduet.edu.pk*

## Abstract:

Disc brake rotors manufactured from standard, unalloyed Gray Cast Iron (GCI, FC250-A) frequently exhibit thermal fatigue cracking when subjected to severe durability and thermal shock tests on inertia dynamometers at higher temperatures. These cracks may arise from high thermal gradients generated during service such as braking which leading to localized plastic deformation and stress concentration. The current research presents a material development strategy where the base GCI, FC250-A composition was modified with alloying elements to significantly enhance thermal conductivity ($\kappa$). In present work, two samples were selected one is the baseline unalloyed disc (Material A) failed a standard Rapid Cooling Rotor Test (RCRT) due to severe cracking while other is modified alloyed GCI, FC250-A disc (Material B), featuring a 15% increase in thermal conductivity, was subjected to the identical RCRT and successfully completed the qualification, demonstrating a robust solution for highperformance thermal applications. Moreover, both unmodified baseline unalloyed disc (Material A) and the modified alloyed GCI, FC250-A disc (Material B) were subjected to different mechanical and chemical testing and observed that modified disc has enhanced properties for the application of automotive brake disc.

***Keywords:*** Brake disc, thermal fatigue, grey cast iron, dynamometer testing, thermal conductivity, corrosion, mechanical properties, failure analysis.

**OP-28**

# Exploring Textile Dyes and Effluent-Treating Bacteria: Isolation, Characterization, and Phytotoxic Impact of Treated Effluent

**Shagufta Noreen**
*Department of Biotechnology, Jinnah University for Women, Karachi, Pakistan.*
** Corresponding author E-mail: shaguftanoreen506@gmail.com*

## Abstract:

Textile untreated effluents release into the environment contain different dyes, metallic pollutants and salt. The hazardous composition of the untreated discarded effluents from the industries is associated with the severe environmental pollution. The current research is mainly focused on the microbial decolorization and detoxification of textile dye effluent. **Objectives:** The main objective of this study is to exploit bacterial diversity capable of dye degradation; to optimize fermentation conditions for enhanced decolorization of textile dye effluent by bacteria and to assess phytotoxicity analysis of treated dye effluent.

In the present work, indigenous bacterial strains were isolated from textile effluents and soil collected from textile industries in Karachi. Two potent strains were subjected to ribotyping for characterization. Studies on cultural conditions for improved dye degradation by bacteria were also conducted. Treated effluent from these bacteria was used for phytotoxicity evaluation.

Total six isolated bacterial strains were found to decolorize different azo reactive dyes like reactive black-5 (RB-5) and reactive blue-19 (RB-19). The optimum dye decolorization was observed in 50mg/L conc., 40°C temperature, pH ranges from 6-8 and 24 hours of incubation by halo and metal tolerant bacterial isolates. Additionally, the strains MS-5 and MS-8 also found to anchorage a dye decolorizing efficiency in CFF. Further these MS5 and MS8 strains screened for the degradation of red green and black effluents collected from Karachi local dyeing industry. However, the phytotoxic effect of treated effluents showed considerable effect on plant germination, and their rooting and shooting growth. The MS5 and MS8 strains characterized by Bergey's manual and 16S rRNA sequence study and identified as *Alcaligenes sp. strain* AMS-8 and *Paenibacillus sp.* strain PdMS5.

It might be concluded that these strains showed considerable potential for bioremediation of textile industrial waste. Furthermore, the simultaneous plant growth in presence of treated effluent offers a great opportunity to increase and sustained crop productivity even under stressed water scarcity. Hence, these strains could be used to develop the bio-treatment systems (bioreactors) for treating azo dyes present in industries effluents.

***Keywords:*** Bioremediation, decolorization, effluent, germination, phytotoxicity

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OP-29

# Photocatalytic Degradation of Sudan Black B Dye by Using Synthesized Sno2 Nanoparticles as a Catalyst: Factorial Design Model

**Muhammad Farooque Lanjwani**[a,c], **Muhammad Yar Khuhawar**[b] & **Mustafa Tuzen**[c]
[a]*Department of Human & Rehabilitation Sciences, The Begum Nusrat Bhutto Women University Sukkur, Sindh, Pakistan*
[b]*Dr. M. A. Kazi Institute of Chemistry, University of Sindh, Jamshoro*
[c]*Department of Chemistry, Tokat Gaziosmanpasa University Tokat Turkiye*
*Corresponding author email: muhammad.farooque@bnbwu.edu.pk*

## Abstract:

The $SnO_2$ is a semiconductor and is employed in several fields because of broad energy-gap (3.6 eV). The $SnO_2$ has good selectivity, greater sensitivity and short response–recovery time and good degradation capability versus many dyes. The $SnO_2$ was synthesized by precipitation method via tin chloride pentahydrate complexation with diethyldithiocarbamate then, calcined at temperatures 450, 600 and 750 °C and utilized for degradation of Sudan black B (SBB) dye. The calcination temperature 600 °C exhibited better degradation capability. Three light sources like visible, mercury and fluorescent were applied and fluorescent light exposed highest degradation of SBB dye. Degradation of SBB reached 90% with dosage of catalyst 15 mg at neutral pH 7 in 100 min. The 20 mg $L^{-1}$ concentration of SBB dye was optimized for degradation but the degradation decreased at increased concentration of the dye. Synthesized $SnO_2$ nanoparticles was characterized by SEM, XRD, DLS, EDX, zeta potential and FTIR to know their particles size, surface charge, morphology, structure and elemental composition of prepared nanoparticles. The SBB dye degradation followed pseudo second order kinetic model and Langmuir isotherm model. The impacts of factors were studied through factorial design using 18 experiments run, and interactions among different parameters were noted. The present study was planned to synthesize $SnO_2$ nanoparticles and used for degradation of SBB dye by different light sources.

***Keywords***: Photocatalytic degradation, Sudan black B, $SnO_2$ nanoparticles, Factorial design.

**OP-29**

# Dispersive Solid Phase Microextraction Method for the Determination of Arsenic in Food Samples Using a Gadolinium Oxide-Based Block Copolymer as a composite adsorbent

***Jamshed Ali*, Mustafa Tuzen, Wahid Bux Jatoi & Baki Hazer***
*Tokat Gaziosmanpaşa University, Faculty of Science and Arts, Chemistry Department, 60250 Tokat, Turkiye*
*Institute of Chemistry, Shah Abdul Latif University, Khairpur Mir's-66020. Sindh, Pakistan*
**Corresponding Author: jamshed.raeesi@salu.edu.pk*

## Abstract:

A novel amphiphilic block copolymer, poly(3-hydroxybutyrate)-b-poly(dimethylaminoethyl methacrylate) (PHB-b-PDMAEMA), embedded with gadolinium oxide nanoparticles ($Gd_2O_3$ NPs), was synthesized and utilized as a composite adsorbent for the extraction of total inorganic arsenic. The nanocomposite material (PHB-b-PDMAEMA-$Gd_2O_3$) was characterized using spectroscopic techniques. Experimental parameters influencing the extraction efficiency were screened and optimized using Plackett-Burman and central composite designs. The optimized adsorbent was applied in ultrasound-assisted dispersive solid phase microextraction (UA-dSPμE) coupled with hydride generation atomic absorption spectrometry (HG-AAS) for arsenic determination in foodstuffs. The method demonstrated a linear range of 0.1–1.5 μg $L^{-1}$, a correlation coefficient ($R^2$) of 0.996, an enrichment factor of 128, and a limit of detection of 0.02 μg $L^{-1}$. Validation using certified reference materials yielded recoveries of 96.0-98.5%, confirming the method's accuracy and applicability for reliable quantification of arsenic in diverse food matrices.

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PP-1

# Phytochemical Analysis and Bioactive Components Investigation of Traditional Unani Herbal Formulations Used for Diabetic Mellitus

**Shazia Komal Junejo[1], Farah Naz Talpur[1] & S. A. Junejo[2]**
[1]*National Center of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
[2]*Department of Geography, University of Sindh, Jamshoro, Pakistan 76080*
*Corresponding author E-mail: dr.skjunejo@gmail.com*

## Abstract:

Herbal formulations are used generally for the treatment of several diseases worldwide due to their acceptability globally as safe medicines. Diabetes Mellitus (DM) is the one of the major disease in Pakistan; majority of the peoples in the country uses Unani herbal formulations for its treatment. Nevertheless, Unani herbal formulations are widely used yet their active ingredients are not defined or listed well. Therefore, it is imparetive to analyze chemically the local Unani herbal formulations. Hence the aim of present study was to investigate chemical ingredients in herbal formulations manufactured locally and are used for the treatment of DM. For this, seven different samples of herbal formulation used for DM treatment were purchased from local market and Dawakhanas based on common use among local population and wre analyzed in triplicate. Acquired samples were prepared and analysed according to the recommended methods. Initially screening of photo-chemicals (Protein, Alkaloids, tannins, saponins, steroid, terpenoid, etc.) was performed on FTIR UV-Visible spectroscopic and LC-MS-MS analysis was done. The obtained results indicate that alkaloid and saponin were present in all samples, the steroids were found in only one herbal formulation. Flavonoids, terpenoids and tannins were also confirmed accounting 57.14 to 85.71% of all positive test samples. Presence of alkaloid was ascertained by UV-Visible spectroscopic analysis. FT-IR analysis revealed different functionalities such as OH, C=O, C-H, C=H, C-C stretching vibrations in all herbal formulations. LC-MS-MS analysis confirmed the presence of bioactive compounds such as Gymnemic Acid III (Beta-D-Glucopyranosiduronic acid), Thymoquinone (2-Isopropyl-5-methylbenzo-1,4-quinone), Stigmast-5-en-3β-ol (β-Sitosterol), 3-O-Feruloylquinic acid, Secoisolariciresinol diglucoside, Amentoflavone, Palmatine, were found as antidiabetic active constituents. These compounds structure was elicited based on mass fragmentation pattern available in reported literature. The results of the present study reveals that herbal formulation has active ingredients originated from natural resources, indicating save source of DM treatment, however, impact of multiple active ingredient consumption needs to be further evaluated.

***Keyword:*** Phytochemical Analysis, Herbal Formulations, Diabetes Mellitus

**PP-2**

# Enhanced Electro Active Properties of $NiCo_2O_4$ Nanostructures Using Garlic Extract for the Sensitive and Selective Enzyme-Free Detection of Ascorbic Acid

**Abdul Ghafar Solangi*, Tajnees Pirzada , Zafar Hussain Ibupoto**
*Institute of Chemistry, Shah Abdul Latif University Khairpur, Sind, Pakistan*
*Corresponding author E-mail:* ghaffarchemistry786@gmail.com

**Abstract:**

Electroactive materials with low costs, simplicity, eco-friendliness, and efficiency are highly desirable for a variety of applications, including energy conversion, energy storage, and nonenzymatic sensing, by the use of garlic green leaf biomass, active molecules are extracted to enhance $NiCo_2O_4$ nanostructure electroactive properties via reducing, stabilizing, and capping agents. A $NiCo_2O_4$ nanostructure electroactive material was formed using 5 mL, 10 mL, and 15 mL of garlic leaf extract heated hydrothermally. An evaluation of the material's morphology, crystallinity, and surface chemical composition, as well as the application of electrochemical tests aimed at detecting ascorbic acid (AA) without the use of enzymes in phosphate buffer solution with pH of 7.4. Pure $NiCo_2O_4$ has the morphology of nanorods which was transformed into thinner nanowires consisting of nanoparticles with the addition of garlic leaves extract. Biosensors without enzymes have the advantages of being easy to make, reproducible, and stable over those with enzymes. $NiCo_2O_4$ nanostructures fabricated with garlic leaf extract in a 10 mL volume are being developed as non-enzymatic AA sensors. The AA sensor presented here operates linearly from 0.5 to 8.5 mM with a detection limit of 0.01 mM. It was found that an AA sensor is highly selective, stable, repeatable, and capable of quantifying AA concentrations in various real-life samples.

**PP-3**

# In-vitro Study of Hybrid Silver Nanoparticles With Humic Acid Extracted from Cow Dung Against Pathogens

**Shabir Ahmed Dharejo*, Tajnees Pirzada & Muhammad Raza Shah**
*Institute of Chemistry, Shah Abdul Latif University Khairpur, Sind, Pakistan*
**Corresponding author E-mail: shabirdharejo@gmail.com*

**Abstract:**

Recently researchers have used silver nano particles (AgNPs) coupled with humic acid (HA) as antimicrobial agents. Herein, AgNPs were prepared and coupled with humic acid for their antimicrobial activities. The as-prepared AgNPs with HA were characterized by an atomic force microscope (AFM), X-ray powder diffraction (XRD), zeta potential, zeta sizer, Fouriertransform infrared (FT-IR) spectroscopy, and UV–VIS spectrophotometer. Moreover, human plasma, varied salt concentrations, and pH levels were used for stability confirmation using a UV–VIS spectrophotometer. The antibacterial activities and minimal bactericidal concentration (MBC) of coupled AgNPs were determined by disk diffusion and broth dilution methods, respectively, against identified *Staphylococcus aureus, Streptococcus pyogene, Pseudomonas aeruginosa,* and *Escherichia coli*, which are extracted from cow dung. The result indicated that the as-synthesized AgNPs/HA are more effective in inhibiting all the studied microorganisms, which can be attributed to the therapeutic use of nanoparticles coated with humic acids.

PP-4

# Synthesis and Characterization of Zinc Oxide Nanoparticles Hybrid with Humic Acid and its Applications in Agriculture

**Weenghar Ali Chandio*, Tajnees Pirzada & Mir Munsif Ali Talpur**
*Institute of Chemistry, Shah Abdul Latif University Khairpur, Sind, Pakistan*
**Corresponding author E-mail:* weenjharali5@yahoo.com

**Abstract:**

Utilization of nanoscale materials in agribusiness are as yet in earliest stages contrasted with clinical and mechanical areas. The effect of, zinc oxide nanoparticles and humic acid (HA) coated nanoparticles were evaluated for *Brassica campestris* seed germination. A simple one-pot method was used to synthesize HA/ZnO NPs involving zinc oxide nanoparticles (ZnO) core (2035 nm in diameter) and humic acid shell. HA/ZnO NPs were used to investigate the effect on the germination profile of *Brassica campestris.* Germination profile parameters were measured as root-shoot length, germination index, fresh and dry weight for 15 days. HA/ZnO NPs were confirmed with various physicochemical techniques such as X-ray diffraction, Fourier transform infrared (FTIR), UV-Vis spectroscopy, and scanning electron microscopy (SEM).The data confirmed the adsorption of humic acid on the surface of ZnO nanoparticles. The HA/ZnO NPs exposure significantly increased germination by 83 %, root length (60 %), shoot length (78 %), fresh weight (71.4 %) and dry weight (45.9 %).. The HA/ZnO NPs were applied as co-fertilizer to upgrade the *Brassica campestris* seed germination. Seeds may have assimilated NPs, which thus might prompt the union of specific catalysts, working with the food activation. This investigation exhibited that HA/ZnO NPs can be a capable co-compost, giving zinc and HA to seed.

**PP-5**

# Fabrication and Performance Evaluation of Graphene Oxide-Loaded Nanofiber Composites for Indoor Air Filtration

**Amna Abbas[a] & Huma Shaikh[b]**
*[a]National Centre of Excellence in Analytical Chemistry,University of Sindh, jamshoro, Pakistan*
*[b]H.E.J. Research Institute of Chemistry, International Centre for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi, Pakistan*
**Corresponding author E-mail: huma.hashu@gmail.com*

## Abstract:

With rapid urbanization and industrialization, air pollution has become a global concern due to its harmful effects on public health and the environment. Among various pollutants, airborne particulate matter (PM) poses significant health risks. This study aims to develop sustainable filtration materials using cellulose acetate propionate (CAP) nanofibers modified with an Ag-rGO/[BMIM]$BF_4$ composite to effectively capture fine particulates. Electrospun particulate matter PM10, PM2.5, and PM1.0 increased from 65.24%, 68.61% and 68.42% to 99.05%, 96.07%, 97.30% for CAP nanofibers loaded with 0.4 mg of Ag-rGO/[BMIM]$BF_4$, attributed to the high surface area, oxygen-functionalized surface, and nano-platelet morphology of graphene oxide. The modified membranes exhibited a quality factor of 0.229 $Pa^{-1}$. These findings demonstrated that the CAP-loaded Ag-rGO/[BMIM]$BF_4$ nanofibers based nano-mats offer a sustainable, high-efficiency solution for reducing air contamination and protecting human health.

***Keywords**:* Graphene Oxide, Nanofibers, Air Filtration, Particulate Matter

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**PP-6**

# Development of Electrochemical Sensors for Point-of-care Ciagnostic of Disease Biomarkers

**Asifa Batool[a], Sanya Khursheed[a], Huma Ishaque[b] & Muhammad Imran Malik[a,c]**
*[a]Third World Center for Science and Technology, International Center for Chemical and BiologicalSciences (ICCBS), University of Karachi, Karachi 75270, Pakistan*
*[b]National Centre of Excellenec in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
*[c]H.E.J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi 75270, Pakistan*
*Corresponding author E-mail: asifabatool150@gmail.com*

## Abstract:

A new electrochemical sensor has been developed to detect glutathione (GSH), a crucial biomarker for liver cirrhosis, with high sensitivity, using layer by layer deposition of copper metal-organic frameworks and polyethyleneimine-capped silver nanoparticles onto an electrode surface to create the sensor. By offering a high surface area and porous structure, the Cu-MOFs made it easier to immobilize PEI-capped AgNPs and PEI capping on AgNPs reduced interference from other chemicals and promoted electron transport, which improved the electrochemical signal and selectivity. The Ag/Cu-MOF nanocomposite was characterized by SEM, AFM, XRD, DLS, zeta potential, FT-IR spectroscopy, and UV-visible spectrophotometry.

Cyclic voltammetry (CV), square wave voltammetry (SWV), and electrochemical impedance spectroscopy (EIS), were used to analyze the sensor's electrochemical activity. For GSH, the sensor showed excellent sensitivity, selectivity, and stability along with a broad linear detection range (LDR) from 1aM (SWV) to 10µM (CV) based on different voltammetric techniques and is crucial for detecting diverse GSH level in blood serum. The LOD and LOQ of developed glutathione detection method were found to be 4.21aM AND 12.7aM respectively. The electrochemical sensor exhibited an exceptionally high sensitivity of 83.10µAaM-1cm-2. The blood serum sample from healthy volunteers were spiked with known amount of glutathione to examine sensor efficiency in the context of recovery. Finally, blood serum samples were analyzed for glutathione levels.

**PP-7**

# Low Cost Thermally Activated Hydrocar for Adsorption of Metal Ions and Their Applications in Customized Water Filtration

***Imran Khan Rind[1], Najma Memon[1], Muhammad Yar Khuhawar[2], Muhammad Farooque Lanjwani[2] & Waheed Ali Soomro[2]**
*[1]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro,*
*[b]Dr. M.A. Kazi Institute of Chemistry, University of Sindh, Jamshoro, Sindh, Pakistan*
** Corresponding author E-mail: irind87@gmail.com*

**Abstract:**

The trace metal ions concentration found in aquatic bodies and contaminated water before consumption should be treated. The customized point-of-use filtration is foreseeable and efficient to remove trace metal ions and water possible for human consumptions. Traditionally, activated carbon have been utilized for such type water treatment. The study is designed to prepare a new generation of thermally activated hydrochar (ACH) derived from waste biomass e.g fruit mango peels and to tune their functionality for removal of contaminants, specifically metal ions. Activated hydrochar was employed instead of activated carbon in customized point-of-use water filtration. The prepared material highly porous with high surface area and active surface functionalities. The large scale water treatment applications were considered by applying fixed-bed column kinetic models Adams - Bohart, Thomas and Yoon - Nelson. The performance of the ACH for a candle water filtering system was examined using model study parameters. The material was found highly efficient at 1643 L/min/ Filter and 31670.6 L/min/Filter can be treated for removing lead and cadmium ions, if exhaustion point are considered as candle replacement time. These findings indicate that ACH considered as promising sorbent for removing trace metal ions from contaminated water for their use for dinking.

***Keywords:*** Activated hydrochar, fixed-bed column, filtration, trace metals.

PP-8

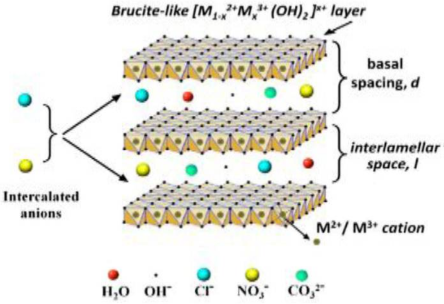
# Synthesis and Characterization of FeCuAl LDH and Photocatalytic Application

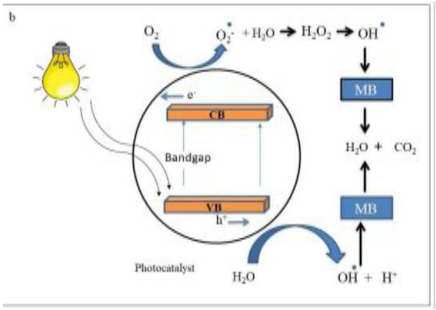
**Lala Faheem Memon & Jameel-ur-Rehman Memon**
*Dr. M.A Kazi Institute of Chemistry, University of Sindh, Jamshoro.*
*Corresponding author E-mail: lalafaheem@scholars.usindh.edu.pk*

## Abstract:

In this study, nanostructured FeCuAl-SO4 layered double hydroxides (LDH) was developed followed by a co-precipitation approach using precursors such as FeSo4-7H2O, CuSo4.5H2O, Al2 (So4)3.18H2O and well characterized by Fourier-transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), UV/Visible spectrophotometer, scanning electron microscopy (SEM) coupled with energy dispersive X-ray (EDX) analysis. Using absorbance data, Tauc plot was plotted and band gap energy of FeCuAl-SO4 LDH was calculated and found to be 1.73 eV. The material was applied as an efficient photocatalyst for degradation of methylene blue (MB) under visible light of a 100 W Tungsten lamp at optimum factors such as concentration of MB 4 mg L–1, pH 8.0, catalyst dosage 5 mg, and shaking time of 30 min at room temperature. The degradation efficiency of the material was calculated and found to be ≥95.5% with RSD ≤4%. The method worked well on the synthetic solutions of MB, prepared in tap water, wastewater, and seawater of different concentrations.

***Keywords:*** Layered double hydroxides; Photocatalysis; Methylene blue; Wastewater; Degradation.





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# The Radish Leaf Mediated Selenium Nanoparticles for Colorimetric Sensing of $Hg^{2+}$ Ions from Water

**Noshad Razzaque, Hassan Imran Afridi, Farah Naz Talpur*, Jameel Ahmed Baig, Sobia Kunbhar, Shagufta Qambrani, Sanam Rahujo & Shoaib Ahmed Hab**
*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro 76080, Sindh, Pakistan.*
** Corresponding author E-mail: farahtalpur@hotmail.com*

## Abstract:

In this study, a microwave-assisted method, known for being environmentally friendly, efficient, and cost-effective, was utilized to synthesize selenium nanoparticles (SeNPs). Radish leaf extract was used for the first time as both a capping and reducing agent for synthesizing SeNPs from its precursor selenium salt. The time duration was optimized (10 to 50 sec) for the formation of RL@SeNPs and then characterized using different techniques. Ultra-violet visible (UV–visible) spectroscopy revealed an absorption band at 264 nm, indicating the successful formation of RL@SeNPs. Fourier transform infrared (FTIR) spectroscopy was used to investigate the interaction between radish leaf extract and SeNPs. Scanning electron microscopy (SEM) was utilized to analyze the morphology of RL@SeNPs, while energy dispersive X-ray spectroscopy (EDX) was employed to determine the elemental composition of RL@SeNPs. X-ray diffraction (XRD) was utilized to determine both particle size and crystallinity of synthesized RL@SeNPs. The synthesized RL@SeNPs were confirmed to be a highly sensitive, exceptionally selective, cost-effective, environmentally friendly, and swiftly responsive colorimetric sensor for Hg2+ detection, indicated by a change in the color of the solution from red to transparent. The developed sensor exhibited a linear dynamic range with an $R^2$ value of 0.9985, operating in the 0.25–60 µM range. The limit of detection (LOD) and limit of quantitation (LOQ) were determined to be 0.03 µM and 0.11 µM, respectively. Metal cations such as $Be^{2+}$, $Ca^{2+}$, $Cr^{3+}$, $Co^{2+}$, $As^{3+}$, $Mg^{2+}$, and $Ni^{2+}$ showed very little interaction with the sensor. The sensor that was built was effectively utilized to identify low concentrations of $Hg^{2+}$ in actual water samples.

***Keywords:*** Selenium Nanoparticles, Radish leaf extract, Mercuric ions, Colorimetric sensor, Water samples

PP-10

# Fabrication of Poly (Quinine-co-itaconic Acid) Incorporated Reduced Graphene Oxide Nanocomposite and its Application for Electrochemical Sensing and Photocatalysis of Hydroquinone

**Sehrish Khadim Hussain**
*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
*Corresponding author E-mail: sehrish.khadim98@gmail.com*

## Abstract:

In this work, we report the synthesis of poly (quinine-co-itaconic acid) incorporated graphene oxide composite that is electro-active and photo-active simultaneously. The poly (quinine-co-itaconic acid) @rGO composite was successfully utilized for electrochemical detection and photocatalytic degradation of hydroquinone (HQ). HQ is recognized as an environmental pollutant because of its high toxicity to human health even at low concentrations. The synthesized composite was characterized using different characterization techniques i.e. Fourier Transform Infrared Spectroscopy (FTIR), Energy Dispersive X-ray Spectroscopy (EDX), Scanning Electron Microscopy (SEM), X-ray Diffractometry (XRD), Brunauer–Emmett–Teller (BET) and zeta potential. The characterization studies revealed the net negative surface charge of −17.6 mV for poly (quinine-co-itaconic acid)@rGO composite that confirms its stability. Moreover, the XRD and FTIR studies confirmed the fabrication of poly (quinine-co-itaconic acid)@rGO composite. The electrochemical properties of synthesized composite were determined via cyclic voltammetry and electrochemical impedance spectroscopy which showed high conductivity and charge transfer kinetics. Under optimized condition, the sensor showed excellent response for hydroquinone i.e. potential window from −0.6 to 0.6 V at scan rate 50 mV $s^{-1}$ and borate buffer of pH 8 as supporting electrolyte. The developed method was comprehensively validated and found linear between 0.1 to 40 µM of HQ, with limit of detection 0.03 µM and limit of quantification 0.1 µM, respectively. The real water and personal care products samples were used to check the applicability of developed sensor and good percent recovery was achieved. The synthesized poly (quinine-co-itaconic acid)@rGO composite was also utilized for photocatalytic degradation of HQ and the degradation efficiency was obtained as 99% with dosage of 0.5 g $L^{-1}$ under optimized conditions such as solution pH 7, initial concentration of HQ 10 mg $L^{-1}$, catalyst dosage of 5 mg and irradiation time of 40 min, respectively. The degradation efficiency of poly (quinine-co-itaconic acid)@rGO composite was also evaluated in real water samples from industry and river.

***Keywords:*** Poly (quinine-co-itaconic acid)@rGO composite, Hydroquinone, Electrochemical sensor, Cyclic voltammetry, Differential plus voltammetry and photocatalytic degradation

**PP-11**

# Electrochemical Dye Recovery as a Sustainable Route to Zero Liquid Discharge Dyeing Systems

**Pirh Muqaddisa[a]* & Najma Memon[b]**
*[ab]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Sindh, Pakistan*
* *Corresponding author E-mail: muqaddisa@scholars.usindh.edu.pk*

## Abstract:

The transition toward sustainable textile manufacturing calls for innovative water management strategies that align with circular economy principles, zero liquid discharge (ZLD) frameworks, and the Sustainable Development Goals (SDGs). Conventional wastewater treatments often fall short of ensuring resource recovery and reuse, whereas electrosorptive systems offer an energy-efficient route for direct dye reclamation. This study focuses on electrochemical dye recovery using sericin-derived carbon electrodes as a sustainable route to achieve ZLD dyeing systems by recovering excess dyes from textile dye baths. Sericin, a silk industry by-product, was valorized as a carbon precursor and combined with polyvinyl alcohol (binder) and glutaraldehyde (crosslinker) to fabricate stable and conductive electrodes. The material was characterized using SEM, EDS, FTIR, and BET analyses, confirming a porous carbon framework, homogeneous elemental distribution, and favorable surface properties for charge-assisted dye adsorption. Electrochemical analyses through cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) revealed favorable specific capacitance (562.27 F/g) and low charge-transfer resistance (1226.46 Ω), validating its suitability for electrosorptive applications. Electrosorption experiments were conducted in a two-electrode configuration at 1.0 V DC using 5 mg/L dye solutions (50 mL, pH 9, 0.1% NaCl), and adsorption was monitored through UV–Visible spectroscopy over 24 hours. The sericin-derived carbon electrodes exhibited enhanced electrosorptive performance and operational stability, achieving significant dye removal (88% in 24 hours, with rapid removal ~30% within 25 minutes) under optimized conditions. These findings establish electrochemical dye recovery as a practical and sustainable approach for achieving circular water use and ZLD in textile processing.

***Keywords:*** Electrochemical Dye Recovery, Sericin-Derived Carbon Electrodes, Zero Liquid Discharge (ZLD), Circular Water Management, Sustainable Textile Industry

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PP-12

# Graphene-based Hybrid Nanocomposites for High-Performance Supercapacitors via Electrophoretic Deposition

**Kissa E Zehra[a]* & Huma Shaikh[b]**
*[ab]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro-76080, Pakistan*
**Corresponding author E-mail: kissataqvi10@gmail.com*

## Abstract:

Graphene consists of 2D sheets of sp2 hybridized carbon atoms forming a honeycomb crystal lattice. There are two main derivatives: GO and rGO. These derivatives are widely used in different applications. Supercapacitors offer high power capability, long lifespan, and environmental benefits over secondary batteries, making them attractive for energy storage. This study uses an efficient and cost-effective electrophoretic deposition (EPD) approach to fabricate graphene-based hybrid supercapacitor electrodes. NiO@rGO, CeO2@rGO, and NiO/CeO2@rGO nanocomposites were synthesized via the microwave-reduction method and deposited as uniform thin layers on indium tin oxide (ITO) substrates. The electrode materials were comprehensively characterized using FTIR, EDX, SEM, XRD, Zeta Potential, DLS, cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and galvanostatic charge/discharge (GCD). The electrodes were tested in a three-electrode setup with 1 M KOH as the electrolyte. NiO@rGO exhibited a specific capacitance of 570.5 F/g, while CeO2@rGO showed 114.2 F/g at a scan rate of 1 mV/s. Remarkably, the NiO/CeO2@rGO nanocomposite achieved an enhanced specific capacitance of 1536.1 F/g at the same scan rate. An improved specific capacitance of 476 F g-1 at a current density of 1 was calculated through GCD. The discharge time of the NiO/CeO2@rGO electrode is longer than the charging time, suggesting robust performance and efficient energy release. Whereas the internal resistance (1.752 Ω) of the NiO/CeO2@rGO is lower than that of the other materials, signifying improved electrode material conductivity. The findings suggest that NiO/CeO2@rGO hybrid electrodes, fabricated via EPD, hold significant potential for high-performance supercapacitors, providing a promising solution for global energy storage challenges.

***Keywords:*** Metal oxide nanoparticles, reduced graphene oxide, energy materials, supercapacitor, synergistic effect

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**PP-13**

# Removal of Environmental Contaminants from Water Samples Using Magnetic Sorbent Coupled with Liquid Chromatography

**Muhammad Ahmed Chang[a], Najma Memon[a] & Saima Q. Memon[b]**
*[a]National Center of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Sindh, Pakistan*
*[b]Dr. M. A. Kazi Institute of Chemistry, University of Sindh, Jamshoro, Sindh, Pakistan*
*Corresponding author E-mail: ahmedchang123@gmail.com*

## Abstract:

The overuse of pesticides is a growing concern among the scientific community as it may lead to harmful effects being observed in living beings due to exposure. Different sorbents for removal of environmental pollutants have been proven as an effective way of removal from various matrices. $Fe_3O_4$ has been considered a prime choice for magnetic removal as it can be functionalized with appropriate groups in order to achieve maximum results. This study aims towards the use of $Fe_3O_4$ that has been functionalized with 3-aminopropyltriethoxysilane (APTES) along with sericin, a biopolymer obtained from silk cocoons, in order to make a magnetic biocomposite. The synthesized material was characterized using FTIR, SEM, BET, XRD and VSM. FTIR confirmed successful coating of sericin, SEM revealed porous rough surface, BET showed the porosity along with overall surface area, XRD showed peaks corresponding to spinel cubic geometry and VSM revealed the magnetic nature of biocomposite. The current study was based on removal of Cypermethrin, a pesticide belonging to the class of Pyrethroids. An experimental design was made by using Response Surface Methodology with experimental parameters of pH, amount of adsorbent, contact time and concentration. The percentage removal of pesticide was calculated by determining residual percentages by High Performance Liquid Chromatography paired with Diode Array Detector. The mobile phase for each sample was selected as 85% Acetonitrile and 15% water with a runtime of 10 minutes with ultraviolet radiation selected at 235 nm. The removal of Cypermethrin from water samples ranged from 68 % to 93.84%. The optimum parameters obtained from experimental design were pH of 11, amount of adsorbent to be 51.7 mg, concentration of 2.34 mg/L and contact time of 10 minutes. This biocomposite was employed for the use of magnetic removal of Cypermethrin from real water samples and its efficacy was investigated.

***Keywords:*** $Fe_3O_4$, Pyrethroid, Cypermethrin, Sericin, Liquid Chromatography

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**PP-14**

# Development of Efficient Photothermal Materials for Solar Interfacial Desalination

**Shakeela Abbas* & Najma Memon**
*National Centre of Excellence in Analytical Chemistry, University of Sindh,Jamshoro.*
**Corresponding author E-mail:* shakeelaabbasmahar@gmail.com

## Abstract:

Water scarcity is a serious challenge and causes problems for two billion people worldwide. Current technologies use expensive energy resources and paves the way towards fresh water and energy dilemma. Tapping into solar energy seems to be a viable and sustainable solution for the ongoing global challenges of water scarcity and clean energy shortage. However, the natural mechanism of solar energy driven water evaporation is often compromised by low evaporation rate and water and solar absorption spectrum mismatch. Therefore, the current study presents use of interfacial solar evaporator in order to achieve localized heating on the water vapor-liquid interface by photothermal materials. Here, different types of photothermal materials have been used for application in interfacial solar evaporator. It includes CuO Nanoparticles imprinted plasmonic Janus membrane, Self Suspended Microreactor Material, activated carbon and graphitic carbon nitride. These photothermal materials show high light absorption, contain functional groups with hydoxyl groups, have porous structure and large surface area. Interfacial solar evaporator developed during experimental work which contain photothermal material floating on the surface of water and experimental work was done by utilizing normal sunlight with 1 sun illumination intensity. Mass change of water was calculated by using electronic balance and Thermometer is used to check temperature changes after each hour. Evaporation rate was calculated by using above different photothermal materials which shows highest evaporation rate for Self Suspended Microreactor material as 1.7 Kg /m2/h as compared to others while CuO Nanoparticles imprinted Plasmonic Janus membrane shows evaporation rate of 1.51 Kg /m2/h. It is compared with evaporation rate of water without photothermal material which has less evapoation rate of 1.36 Kg /m2/h. Therefore, the highest evaporation rate of Self Suspended Microreactor material is due to its porous structure and highest Phothermal efficiency. Hence, interfacial solar evaporation provides cost-effective solution to water Scarcity.

**Keywords:** Phothermal materials, biochar, Plasmonic, Janus membrane, desalination.

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**PP-15**

# Conjugated Polymer Sensor Based Visual Detection of Hydrogen Peroxides Through Fluorescence Technique

**Tilok Chand**
*Department of Chemistry, Shah Abdul Latif University Khairpur, Sindh, Pakistan*
*Corresponding author E-mail: tilkchand628@gmail.com*

**Abstract:**

The oxidation of omega-3-rich seafood and fish oils leads to peroxide formation, compromising both quality and safety. This study reports the synthesis and evaluation of an azobenzene-based conjugated polymer (PPA-AB) as a fluorescent sensor for the rapid detection of hydrogen peroxide ($H_2O_2$). The polymer exhibited strong fluorescence that was selectively quenched by $Cu^+$ ions and subsequently restored upon oxidation of $Cu^+$ to $Cu^{2+}$ by $H_2O_2$. This fluorescence recovery formed the basis for sensitive peroxide quantification. Experimental results demonstrated 98% fluorescence quenching efficiency with a strong linear correlation ($R^2 > 0.98$) between fluorescence intensity and $H_2O_2$ concentration. The sensor showed high selectivity toward $H_2O_2$ over other metal ions and effectively detected peroxide levels in extracted fish oil samples. The developed conjugated polymer thus offers a simple, cost-effective, and highly responsive fluorescence-based approach for peroxide detection in marine food and supplement analysis.

PP-16

# Fabrication of Urea Imprinted Nano-Mats for Electrochemical Detection of Urea

**Asbah Kabeer[b]*, Huma Shaikh[b] & Najma Memon[c]**
[a]*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Sindh, Pakistan.*
* *Corresponding author E-mail:* asbahkhanzada12@gmail.com

## Abstract:

In this study an attempt is made to develop a cost-effective and portable electrochemical sensor for the detection of urea form biological samples. The Urea imprinted Polymer was fabricated into the layers of Graphene Oxide and resulting nanocomposite was embedded into the electrospun nanofibers of polyvinylidene fluoride (PVDF). The resulting nanofibers mats were highly specific for electrochemical sensing of urea; therefore, the screen printed electrodes were modified with nanofibers mats and an electrochemical method was developed and validated for the detection of urea in milk samples. The porous structure of nanofibers mats provided a high surface area, enhancing analyte interaction. The functional properties of fabricated materials were confirmed via FTIR and EDS studies. The Dynamic light scattering analysis and Zeta Potential studies were performed for the estimation of hydrodynamic size and net surface charge of prepared materials. The morphology of the fabricated materials was analyzed using scanning electron microscopy (SEM), and their electrochemical performance was evaluated using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The sensing behavior was studied by analyzing the correlation between peak currents and both urea concentration and scan rate. Selectivity, reproducibility, and stability tests confirmed the reliability of the developed sensor. Additional experiments were conducted on spiked real samples of milk, confirming nanofibers mats applicability in complex matrices. These findings highlight the potential of molecularly imprinted PVDF nanofibers as a promising platform for on-site, low-cost electrochemical sensing in biomedical and food safety applications.

***Keywords:*** Urea Imprinted Polymer, Nanofibers, Electrochemical Sensing, Cyclic Voltammetry, Square Wave Voltammetry

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PP-17

# Drug Delivery Application of Amphiphilic Molecules

**Fatima Iqbal**
*HEJ, ICCBS, University of Karachi, Sindh, Pakistan*
*Corresponding author E-mail: fatimazahrakhan32@yahoo.com*

**Abstract:**

Modern day research is actively involved in the development of new drug delivery systems (DDS) for exploring the maximum therapeutic efficiency of drugs. The researchers lay down great emphasis to minimize the side effects of any drug. Polymeric micelles (PMs) have gained great attention in recent times. Most of the time drugs show decreased bioavailability and reduced solubility when introduced into the tissue systems. Micelles based on block copolymers are able to deliver greatly anticipated benefits against these challenges. The development of an effective drug has lot of challenges, a major being the reduced bioavailability at the target site. This is because of the reduced solubility of the drug in biological systems.

Biodegradable and biocompatible polymers are widely used for the entrapment of the drug moiety. Polymeric micelles in an aqueous medium; are formed by either amphiphilic or oppositely charged block copolymers. For synthesizing PMs, polycarbonate based copolymers such as polyethylene ether carbonate (PEEC) and polyethylene glycol (PEG) are selected. They self-assemble in the system under observation. The core of the micelles is formed by the hydrophobic part where as the corona is formed by the hydrophilic part. In this study, empty micelles and drug-loaded polymeric micelle will be prepared. Co-Solvent Evaporation method will be used. After this, Characterization of the PMs such as Fourier Transform Infrared Spectroscopy (FTIR), Thermogravimetric Analysis (TGA), Scanning Differential Calorimetry (SDC), Atomic Force Microscopy (AFM) and Zeta Potential will be carried out. After this, determination of critical micelle concentration (CMC), encapsulation efficiency, In-vitro drug release and biocompatibility studies will be carried out.

PP-18

# Analysis of Platinum-Based Anticancer Injections Cisplatin and Carboplatin in Blood Serum and Urine of Cancer Patients by Photometry, Fluorometry, Liquid Chromatography Using a Schiff-Base as Derivatizing Reagent

**Faiz Muhammad**
*HITECH, University of Sindh, Sindh, Pakistan*
*Corresponding author E-mail: faizm72fmk@gmail.com*

**Abstract:**

Photometric, fluorometric and liquid chromatographic methods were proposed to analyze Pt(II) from cis-platin and injections after derivatization with reagent 2-oxo-propanoic acid N-phenyl hydrazonecarbothioamide. The reagent reacted with metals Au(III), Ag(I), Mn(II), Pt(II), Mo(VI), V(V/IV) to develop their characteristic colors in the pH range 3–12 and were extracted in organic solvent trichloromethane. The photoluminescent behavior of ligand and its metal complexes was investigated to correlate the emission pattern. Liquid chromatographic method was also proposed to analyze cis-platin and carbo-platin anti-cancer drugs based on the pre-column derivatizing platinum(II) with ligand. The complex of platinum was separated and eluted from HPLC column Microsorb C-18, (150 cm x 4.6 mm i.d, 5 µm) comprising eluents - tetrabutyl ammonium bromide (1 mM)-sodium acetate (1 mM)-acetonitrile-water-methanol (02:02:06:22:68 v/v/v/v/v). Metals Au(III), Ag(I), Mn(II), V(IV/V), Mo(VI) were also separated completely. The linear calibration range 0.5–2.5 µg/mL was observed following Beer's law with detection limit of 150.00 ng/mL Pt(II). The determination of cis-platin and carbo-platin injections by photometric, fluorometric and chromatographic methods showed RSD (n = 3) 1.14–3.12, 0.98–2.84, 0.92–2.72% respectively. The developed methods were employed to analyze cis- platin in samples of serum and urine of cancer patients undergoing chemotherapy and platinum amounts were observed within 45.0—86.0, 49.0—91.0, 42.0—84.0 ng/mL and 82.0—398, 81.0—389, 74.0—391 ng/mL with relative standard deviation (RSD) (n = 4) of 2.28—3.88, 2.40—3.82, 2.52—3.82% and 2.52—3.91, 2.44—3.94, 1.98—3.24% by liquid chromatographic, fluorometric and photometric techniques respectively.

**PP-19**

# Enhanced Electrochemical Detection of Diclofenac Sodium in Pharmaceutical Formulations Using a PVP–SrO-Based Sensor

**Sana-ul-Nisa[1] & Amber R. Solangi[2]***
*[1]Begum Nusrat Bhutto Women University, 65200, Sukkur*
*[2]National Centre of Excellence in Analytical Chemistry, University of Sindh, 76080, Jamshoro*
** Corresponding author E-mail: ambersolangi@gmail.com*

## Abstract:

Diclofenac is a widely used non-steroidal anti-inflammatory drug (NSAID) employed for the treatment of various conditions, including ankylosing spondylitis, acute muscle pain, and osteoarthritis. Although diclofenac is safe when taken at recommended doses, however, excessive consumption can result in serious adverse effects on human health. Furthermore, its presence in the environment, even at trace levels, poses a serious threat to ecosystems, negatively impacting the health of living organisms. Given these concerns, the development of reliable and sensitive analytical tools for the monitoring of diclofenac has become increasingly important.

The current study presents a remarkable, simple, and straightforward protocol for the synthesis of polyvinylpyrrolidone functionalized strontium oxide nanoparticles (PVP-SrO NPs). The synthesized PVP-SrO NPs were applied as a sensor to detect diclofenac sodium (DCF). The electro impedance spectroscopy and cyclic voltammetry studies revealed that the PVP-SrO/GCE is more conductive than bare GCE with an Rct value of 960.4 compared to 2440 Ω. The sensor exhibited a wide linear dynamic range for DCF (0.005 µM to 60.0 µM), a low detection limit (1.25 nM), and limit of quantification (4.17 nM). The proposed sensor can be successfully used for monitoring DCF in pharmaceutical samples with a satisfactory level of recovery from 95% to 104%. The fabricated sensor is better than the reported protocols in terms of processing, simplicity, cost-effectiveness, energy consumption, reproducibility, and enhanced efficacy in a very short time.

***Keywords:*** Environmental monitoring, Diclofenac sodium, electrochemical sensor, SrO, PVP-SrO,

**PP-20**

# Synthesis of Heterogeneous Nano-Catalysts and their Application

**Mehrunnisa* & Huma Shaikh**
*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan.*
*Corresponding author E-mail: mahrunnisa95@gmail.com*

## Abstract:

In the era of nanoscience where all the devices and technologies are attracting researcher's interest due to their smaller size with improved properties; catalysis is an important field of application. Nano-catalysts due to their extremely small dimensions yield a tremendous surface area-to-volume ratio. They have been explored to avoid drawbacks associated with the conventional strategies for the synthesis of heterogeneous catalysts. The nano-catalysts have been effectively utilized for the degradation of highly toxic drugs from the aqueous environment. In this study we report an environmentally friendly, facile and straightforward sonochemical synthetic strategy for a Ce-Salen int. GO nanocomposite using N,N′-bis(salicylidene)ethylenediaminocerium(II) as a precursor and graphene oxide sheets as an immobilization support for Ce-Salen int. GO nanocomposite. The synthesized nanocomposite was thoroughly characterized for its composition and morphology using Fourier transform infrared spectroscopy (FTIR), Energy dispersive X-ray spectroscopy (EDS), Scanning electron microscopy (SEM), Raman and X-ray diffraction spectroscopy (XRD), Charge and size distribution data through Zeta Potential and DLS etc. The results show Ce Salen int. GO nanocomposite was successfully synthesized and was applied for the catalytic degradation of Metformin HCL and Beta-Estradiol in the aqueous media. Different parameters such as pH, degradation time, catalyst dosage and initial concentration of each drug were optimized to accomplish maximum degradation using Ce-Salen Int. GO nanocomposite. Each compound showed degradation at different parameters, as Metformin HCL showed 96% degradation at pH 7, while Beta-Estradiol showed 99% degradation at pH 3 within 45 minutes and 85 minutes of UV light irradiation, respectively, with the catalyst dosage of 0.005 g/L for Metformin HCL and 0.007g/L for Beta-Estradiol, respectively. While synthesis Ce-Salen int. GO composite showed its marvelous efficiency towards the degradation of Metformin HCL and Beta-Estradiol in real aqueous waste water and synthetic laboratory wastes.

***Keywords:*** Heterogeneous Catalyst, Ce-Salen, Graphene Oxide, Metformin HCl, β-Estradiol

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**PP-21**

# Application of Fulvic Acid as a Green Carrier for Drug Delivery of Amoxicillin: Computational Assessment and Optimization Using Central Composite Design

**Kashan[a]*, Fakhar N. Memon[a], Pervez Ali Mahesar[b], Humera Moosa[a] & Areesha Ashraf[a]**
[a]*Department of Chemistry, University of Karachi-Pakistan*
[b]*Institute of Chemistry Shah Abdul Lateef University Khairpur, Pakistan*
**Corresponding author E-mail: Kashanghulamnabi@icloud.com*

## Abstract:

FA is a naturally occurring compound having antioxidant, anti-inflammatory, antitumor and antiviral activities that make it a great green material for drug delivery.[1,2] In this study FA was used to enhance the performance of Amoxicillin. Amoxicillin is a widely used penicillin used extensively for bacterial infections[3,4] even though its extensive used it has limited performance by low bioavailability, solubility and rabid metabolism. This study analyses the potential of FA to improve the performance of amoxicillin by forming complex and studying its release behavior and molecular interaction.

- In this study FA was used to enhance the performance of Amoxicillin.
- Preparation of complex of FA-Amoxicillin and confirm complex formation.
- Model molecular interaction between FA and Amoxicillin using DFT optimization.
- Study and optimize the in vitro drug release profile using experimental design (CCD-RSM).

The FA-Amoxicillin complex was prepared in 1:2 molar ratio by physical mixing. The invitro drug release study carried out using SR6 SRII 6 Flask Dissolution Test Station, and the dissolution experiment following CCD. Drug release profile studied and optimized by Central composite design – Response surface method (CCD-RSM), the drug release profile was analyzed using UV Spectroscopy (PEAK UV-C-7000 Spectrophotometer). The FTIR spectrum of Amoxicillin and FA confirmed presence of functional group typical of their molecular structure. UV spectrum of FA-Amoxicillin confirmed complex formation. To confirm orientation for the most stable interaction between FA and amoxicillin Gaussian software with DFT and 3-21G basis set for optimization is used. Statistical analysis revealed release time and drug dose significantly influence drug release while pH did not have a statistical significant effect.

The FTIR confirmed the presence of functional group of Amoxicillin and FA. UV spectrum of FA-Amoxicillin confirmed complex formation. Statistical analysis revealed release time and drug dose significantly influence drug release while pH did not have a statistical significance. DFT optimization using Gaussian identifies the most stable orientation for interaction between FA and Amoxicillin.

***Keywords:*** Fulvic acid (FA), Amoxicillin, Drug Delivery, Central Composite Design – Response Surface Method (CCD-RSM), FTIR, UV Spectroscopy, DFT optimization.

**Conclusion:** FA shows strong potential as a green and multifunctional drug carrier due to its variety of properties, make it a great choice for drug delivery system.

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PP-22

# Fabrication of Flexible Counter Electrodes Based on Polymer-Modified Nanocarbon Ink and its Application in Wearable Conductive Electronics

**Ali Bux Dahri[b], Aqsa Memon[b], Iftikhar Ali Sahito[b], Anam Ali Memon[b] & Najma Memon[a]***
*[a]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan.*
*[b]Smart Energy Textile Materials Research Lab, Department of Textile Engineering, Mehran University of Engineering and Technology, Jamshoro, Pakistan.*
*Corresponding author Email: najma.memon@usindh.edu.pk*

## Abstract:

Flexible counter electrodes are emerging as a promising alternative to the conventional rigid and expensive platinized FTO-based counter electrodes in wearable electronics. In flexible dye-sensitized solar cells DSSCs, the counter electrode must have a large surface area with high conductivity for efficient electron transfer, strong catalytic activity for redox reactions, and stability in the electrolyte. In this study, a flexible, platinum-free counter electrode was fabricated on cotton fabric using a conductive nano-carbon ink formulated with functionalized multi-walled carbon nanotubes (MWCNTs), a conducting polymer, horseradish peroxidase, and a carboxymethyl cellulose (CMC) binder. The ink was applied via the doctor blade technique, followed by drying and curing to achieve a uniform coating. Surface morphology and surface elemental analysis were conducted using SEM and EDS, which confirm that our sample possesses a uniform coating on the fabric surface and exhibits good porosity for electrolyte penetration. EDS confirms the presence of C, O, Na, S, and Fe, which indicates that our composite is successfully retained on the fabric. Further ATR-FTIR and XRD confirm the functional group analysis and ensure that there is only physical fixation on the substrate, without making any chemical changes to it. XRD confirms phase transformation of MWCNTs from a highly crystalline structure to slightly amorphous at 26.6°. XRD confirms a hexagonal arrangement of sp2 hybridized carbon as well. Electrical characterization revealed a low sheet resistance (0.281 Ω/□), high conductivity (480 S/cm), and stable mechanical performance under bending stress. These findings demonstrate that textile-based electrodes represent a promising, low-cost, and environmentally friendly alternative to platinum for DSSCs.

PP-23

# Tailoring Electronic and Sensing Properties of GCN Using Boron Doping and ZnO Functionalization for Endosulfan Detection

**Bakhtawar Khair Muhammad Pirzada**[a] **& Najma Memon**[a]*
[a*]*National Center of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
**Corresponding author E-mail: hina.pirzada65@gmail.com*

## Abstract:

Pesticides are extensively used in agriculture to control pests and weeds, improving crop productivity. However, their prolonged and excessive use has resulted in environmental contamination and health risks. Continuous monitoring is essential for effective management and requires simpler analytical methods. Recent technological advancements particularly in portable electrochemical sensing have enabled faster, low cost, and user-friendly alternatives for pesticide detection. Consequently, developing efficient sensors having suitable surface activity and conduction for on-site pesticide analysis in water is critical. This study present an electrochemical approach for detection of Endosulfan, a persistent organochlorine pesticide frequently found in agricultural runoff and surface waters using a ZnO/BGCN composite. The composite was synthesized via a sonochemical method and utilized as a sensor material. Structural and surface properties were characterized using FTIR and BET to confirm functional group, surface area, and porosity. The material was drop-cast onto a glassy carbon electrode (GCE), forming a uniform sensing layer. Electrical conductivity of the composite was evaluated through cyclic voltammetry and EIS in 0.1 M KCl and 5 mM Potassium hexa-ferrocyanide and ohmic resistance found to be 1496 Ω as compared to bare GC electrode 16350 Ω. The composting of BGCN with ZnO lead to improved sensing of endosulfan. The modified ZnO/B-GCN/GCE electrode was employed for endosulfan using differential pulse stripping voltammetry mode in phosphate buffer (pH 7). The sensor exhibited a linear response within 12.2 to 73.7 µM (R2 = 0.955) with a limit of detection (LOD) of 4.8 µM and a limit of quantification (LOQ) of 13.4 µM. Selectivity was confirmed through interference studies with a metal ions, showing negligible impact on detection performance. Additionally, the sensor was successfully to real water samples following solid phase extraction, yielding satisfactory results.

***Keywords:*** Endosulfan, solid phase extraction, cyclic voltammetry, sensor, limit of detection.

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PP-24

# An Automated, Machine Learning Integrated Platform for Real-Time Quantification of Serum Creatinine in Clinical Samples

**Izzah Batool[a] & Adeel Afzal[a]***
*[a]Sensors and Diagnostics Lab, School of Chemistry, University of the Punjab, Quaid-i-Azam Campus, Lahore, 54590, Pakistan*
**Corresponding author Email:* adeel.chem@pu.edu.pk

## Abstract:

Early detection and monitoring of chronic kidney disease require tools that can quantify serum creatinine accurately, rapidly, and with minimal infrastructural demands. We present an intelligent electrochemical sensing platform that combines a nanostructured, molecularly imprinted polymer (gCN/cPMAA)-modified electrode with machine-learned signal processing for real-time creatinine quantification in clinical serum samples. The sensing interface achieves a detection limit of 0.05 µM and a sensitivity of 0.28 µA/µM. Voltammetric data were transformed into engineered features and processed using ensemble machine learning models trained on 6,000 measurements, achieving a prediction accuracy ($R^2 = 0.9844$) superior to traditional calibration approaches. The system is deployed in a fully automated desktop application that performs real-time signal acquisition, feature extraction, and clinical-level reporting. In a validation study with 13 unspiked clinical serum samples, the predicted creatinine concentrations closely matched reference laboratory values and outperformed raw electrochemical readouts. This work demonstrates a scalable, data-driven sensing framework for point-of-care renal diagnostics and offers a foundation for intelligent multi-analyte biosensing in decentralized healthcare settings.

***Keywords:*** Automated sensing systems; Clinical diagnostics; Electrochemical sensors; Feature engineering; Machine learning; Point-of-care testing.

PP-25

# Environmental Benign Synthesis of Silver Doped Copper Oxide Nanoparticles for Biomedical Applications

**Darshan[a] & Waqas Jamilb**
[a]*Dr. M.A. Kazi Institute of Chemistry University of Sindh, Jamshoro*
** Corresponding author E-mail: darshan@scholars.usindh.edu.pk*

## Abstract:

The present study focuses on the synthesis of silver-doped copper oxide (Ag–CuO) nanoparticles an emphasis on sustainable green chemistry and nanotechnology.

In the green synthesis route, *Acacia senegal* seed extract was used as natural reducing and stabilizing agent. The phytochemical analysis revealed that *acacia senegal* seed extract rich in flavonoid and poly phenolic compounds and can serve an eco-friendly alternative to conventional chemical methods that often involve toxic reagents.

The synthesized nanoparticles were systematically characterized using UV–Visible spectroscopy (UV–VIS), Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), and Energy Dispersive X-ray (EDX) analysis. The UV–VIS spectrum showing distinct absorption peaks in between 430-490 nm correspond to surface plasmon resonance, confirmed the successful formation of Ag–CuO nanoparticles,. FTIR analysis revealed the presence of functional groups derived from *acacia senegal* biomolecules, indicating their active role in reduction and stabilization processes and synthesis of Ag-CuO NPs. SEM micrographs demonstrated that the green-synthesized nanoparticles possessed relatively uniform morphology with reduced agglomeration. EDX results further validated the incorporation of silver into the copper oxide surface, confirming the successful doping of Ag in CuO nanoparticles.

The results highlight that the green synthesis method not only simplifies the nanoparticle production process but also enhances material stability and environmental safety. The synthesized Ag–CuO nanoparticles exhibit promising potential for biomedical applications.

***Keywords:*** Silver-doped copper oxide, green synthesis, Acacia senegal, UV–VIS, FTIR, SEM, EDX, nanomaterials.

## References:

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PP-26

# The Presence of Lead as a Neurotoxin in Inexpensive Toys Sold in Karachi, Pakistan

**Dur-e-Shahwar Gul[a]*, Anam Gul[a], Shaikh Mohiuddin[a] & Irfan Gul[a]**
[a]*Department of Chemistry, Faculty of Science, University of Karachi, Karachi 75270, Pakistan*
**Corresponding author E-mail:* dureshahwargul@yahoo.com

**Abstract:**

Chemicals may be present in children’s items, particularly in children’s toys. Inexpensive toys that are easily available in local markets may create detrimental health issues in children. Elemental lead (Pb) may pose the highest risk due to its toxicity, abundance, and neurotoxic nature. Children are vulnerable to risk from chemical exposure due to their physiological properties. It is important to monitor lead contamination in toys sold in Karachi, Pakistan. This study aims to determine the Pb Concentration in inexpensive children’s toys present in Karachi Markets. For this purpose, more than 100 inexpensive toys were collected from different markets and analysed by using atomic absorption spectrophotometer. Result shows that more than 85% toys were contaminated with high levels of Pb. Limits exceed toy safety regulation guidelines provided by European Union (EU) and United States Consumer Product Safety Commission (US CPSC). Additionally, all toy samples detected Pb in quantifiable amounts. These toys are made from cheap materials and through unsafe manufacturing process. Due to low price, their demand is extremely high in marketplaces. These types of toys may increase neurotoxicity issues in young children. In young children, the blood-brain barrier is not entirely developed, therefore harmful chemicals may enter the central nervous system. Since rapid growth and development occur during infancy and early childhood, damage to the nervous, endocrine, and reproductive system during this period can have profound life-long impacts.

***Keywords:*** Lead Toxicity, Neurotoxin, Toys, Children, Pakistan

PP-27

# Metal Squarate Complexes:- A Study of Synthesis, Characterization, Computational and Biological Properties

**Fatima Javeed[a], Shazia Nisar[a]* & Nasreen Fatima[a]**
*[a]Department of Chemistry, University of Karachi, Karachi-75270, Pakistan*
**Corresponding author E-mail: shazian@uok.edu.pk*

**Abstract:**

Squaric acid (SQA) is a biologically active ligand and SQA based drugs have long been used in the treatment of warts, Alopecia areata, diabetes mellitus, trauma, asthma, ulcer etc. Moreover, it also forms complexes with metals particularly the transition metals. On the other hand, metal ions also play significant well known roles in biological systems and drug designing. In the present study reaction of SQA with four selected transition metal ions ($Fe^{+3}$, $Co^{+3}$, $Cr^{+3}$ and $Cu^{+2}$) was studied in aqueous solution at ambient temperature. The stoichiometry of complexes, characterization, biological investigation (in terms of antibacterial activity) and computational study of the complexes were done. Characterization was done through spectroscopic methods such as; UV-Vis, NMR and FTIR spectrophotometry, potentiometric and spectrophotometric titration. UV-VIS spectra have revealed the formation of complexes in all different ratio of metal and ligand. Geometry optimization of complexes was done through Gaussian software using semi-empirical. All these transition metals tend to form octahedral complexes except $Cu^{+2}$ which formed a tetrahedral complex. Moreover, the antibacterial action of SQA against four bacteria (*E. coli, S. aureus, P. aeruginosa* and *B. pumilis*) were tested. Interestingly, $Fe^{+3}$-SQA has not shown any activity against any bacteria while other metal complexes such as $Cr^{+3}$-SQA, $Cu^{+2}$-SQA and $Co^{+3}$-SQA have presented better activities. Docking energy of $Cu^{+2}$-SQA and $Co^{+3}$-SQA against Proteasomes protein through MOE and CB-DOCK was calculated which have shown good Binding toward Protein Proteasomes enzyme and hence can be used further for drug designing.

***Keywords:*** Squaric acid, Geometry optimization, Docking energy, Proteasomes, Spectrophotometric methods

PP-28

# Fabrication of Functionalized Graphene Quantum Dot-Based Nanocomposites for Electrochemical Sensing of Hydroquinone

**Hafsa Ali[a]*, Amber R. Solangi[a] & Huma Shaikh[a]**
[a]*National Center of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan.*
**Corresponding author E-mail: hafsashaikh.325@gmail.com*

## Abstract:

The design of advanced nanomaterials for electrochemical sensing has emerged as a promising approach for environmental monitoring. In this study, a novel and efficient strategy was developed for the fabrication of functionalized graphene quantum dots (GQDs)-based nanocomposites for the electrochemical detection of hydroquinone, an environmentally hazardous organic pollutant. Graphene oxide (GO) was first synthesized using a modified Hummer's method and subsequently subjected to microwave-assisted treatment to obtain functionalized GQDs with improved structural and electronic characteristics. The resulting GQDs were then composited with nickel oxide (NiO) nanoparticles to form a stable GQDs/NiO nanocomposite exhibiting enhanced electrochemical activity.

Comprehensive characterization was performed using Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS) to analyze surface morphology and composition, Atomic Force Microscopy (AFM) for topographical analysis, and UV–Visible spectroscopy and spectrofluorometer were used to confirm optical properties. Electrochemical studies were carried out using Cyclic Voltammetry (CV) and Electrochemical Impedance Spectroscopy (EIS). The GQDs/NiO-modified glassy carbon electrode exhibited distinct and well-defined redox peaks, demonstrating an efficient and reversible electron transfer process toward hydroquinone oxidation and reduction. The EIS analysis further confirmed reduced charge transfer resistance, indicating improved conductivity and interfacial electron transport.

The novel microwave-assisted synthesis route offers a rapid, cost-effective, and eco-friendly pathway to produce highly functionalized GQDs-based nanocomposites, paving the way for their use in advanced electrochemical sensing and environmental monitoring applications.

***Keywords:*** Graphene Quantum Dots, NiO nanocomposites, electrochemical sensing, hydroquinone detection, microwave-assisted synthesis**.**

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**PP-29**

# Fabrication of Silver Nanoparticles by Chemical Reduction Method and Their Application to Develop Calorimetric Sensors for Environmental Protection

**Hira Iaza Sahito, Nazar Hussain Kalwar*, Sirajuddin[1], Syed Tufail Hussain Sherazi[1], Faraz Ahmed Kanhar*, Abdul Wasiu[2], Saadat Ali[2], Ambreen Ansari[2], Shaiza Solangi[2] & Suhana Solangi[2]**
[1]*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
[2]*Center for Pure and Applied Geology, University of Sindh, Jamshoro, 76080-Pakistan*
*Corresponding author E-mail: farazkanhar110@gmail.com*

## Abstract:

The fabrication of ranolazine-capped silver nanoparticles (Rano-Ag NPs) in an aqueous medium via a simple chemical reduction method. The preliminary studies for fabrication and capping of Ag NPs were carried out through UV-Vis spectroscopy, surface binding interactions were studied with the help of Fourier transform infrared (FTIR) spectroscopy, size and shapes of Rano-Ag NPs were viewed by using transmission electron microscopy (TEM) and the structural patterns were studied through the X-ray diffraction (XRD) analysis. A prominent LSPR band was observed at 425 nm with clear yellow color under optimized conditions of reaction time, temperature, pH, the concentration of the Ag salt, ranolazine, and reducing agent i.e., NaBH4. The size of Rano-Ag NPs obtained in the range of 5 - 31 nm and an average size was observed 17 ± 3 nm. An efficient colorimetric sensor based on ranolazine drug capped Ag NPs was fabricated for sensitive detection of thiram in aqueous medium. Detailed studies for the application of Rano-Ag NPs as a colorimetric sensor for environmental monitoring of the thiram were carried out. The influence of other functional groups from various pesticides including cypermethrin, carbofuran, endosulfan, and imidacloprid on the performance of colorimetric probes in the detection of thiram was investigated. Among the investigated pesticides, the thiol-functionalized Ag NPs exhibited higher selectivity and sensitivity response in their detection. The highly sensitive and selective determination of thiram can be professed by visual detection as well as via UV-Vis spectroscopy analysis, the Rano-Ag NPs were observed to show a color change from yellow to grey/brown solution by the addition of thiram in a linear range of 1.0-100 uM with an R2 value of 0.992. The Rano-Ag NPs showed a very low detection limit (LDL) of thiram up to 0.72 uM in water samples.

***Keywords:*** Chemical reduction method, silver nanoparticles, ranolazine, colorimetric sensor, thiram.

**PP-30**

# Bioactivity-Guided Identification of Methyl Gallate and Lipophilic Anti-Inflammatory, Antioxidant, and Urease Inhibitory Agents from *Detarium microcarpum* Stem Bark

**Kayode Muritala Salawu[1,2]*, Sammer Yousuf[2,3], Attia-tul-Wahab[3,4], Iqbal Mohammed Choudhary[2,3,4,5] &Yan Wang[2,5]**
[1]*Department of Pharmacognosy and Drug Development, Faculty of Pharmaceutical Sciences, University of Ilorin, P.M.B. 1515, Ilorin, Nigeria*
[2]*H.E.J. Research Institute of Chemistry, International Centre for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi-75270, Pakistan*
[3]*Institute of Molecular Biology and Biotechnology, University of Lahore, Lahore, Pakistan*
[4]*Dr. Panjwani Center for Molecular Medicine and Drug Research, International Centre for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi-75270, Pakistan*
[5]*Key Laboratory for Chemistry and Molecular Engineering of Medicinal Resources, School of Chemistry and Pharmaceutical Sciences, Guangxi Normal University, Guilin 541004, China*
**Corresponding author E-mail:* pharmmks@yahoo.com

## Abstract:

*Detarium microcarpum* stem bark is used in traditional African medicine to treat inflammation and infections, suggesting multi-target bioactivity. This study aimed to identify its specific bioactive principles. To isolate and characterize the chemical constituents responsible for the antioxidant, anti-inflammatory, and urease inhibitory properties of *D. microcarpum* stem bark via a bioassay-guided approach. The 70% aqueous methanol crude extract was sequentially partitioned into *n*-hexane, dichloromethane (DCM), ethyl acetate (EtOAc), and aqueous fractions. Bioassay-guided isolation of the most active fractions was performed using chromatographic techniques. Compound structures were elucidated using NMR and MS spectroscopy. All samples were evaluated in DPPH radical scavenging, ROS-based anti-inflammatory, and urease inhibition assays.

Five compounds were isolated. Methyl gallate was the most potent, showing significant antioxidant ($IC_{50}$ = 10.2 µM), anti-inflammatory ($IC_{50}$ = 10.2 µM, comparable to ibuprofen), and urease inhibitory ($IC_{50}$ = 11.3 µM, superior to acetohydroxamic acid) activities. Catechingallate also exhibited notable multi-target activity. Furthermore, GC-MS analysis of the active *n*-hexane fraction revealed a high abundance of lipophilic compounds (e.g., fatty acid esters, terpenoids), correlating with its substantial urease inhibitory effect ($IC_{50}$ = 24.5 µg/mL).

Methyl gallate is a key multi-target constituent of *D. microcarpum*, providing a mechanistic basis for its traditional use. The discovery of a complementary bioactive lipophilic fraction reveals a sophisticated dual-component chemical defense in the plant, offering diverse chemotypes for anti-inflammatory and anti-infective drug discovery.

***Keywords:*** *Detariummicrocarpum*, Methyl Gallate, Urease Inhibition, Multi-target Bioactivity, Bioassay-guided Isolation

**PP-31**

# Microwave-Assisted Synthesis of Nickel-Oxide/Cobalt-Oxide/Reduced-Graphene-Oxide Nanocomposite for Highly Sensitive Electrochemical Determination of Epicatechin in Food Samples

**Nadir H. Khand*, Amber R. Solangi, Huma Shaikh**
*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
*Corresponding author E-mail:* naddir.kh@gamil.com

## Abstract:

The determination of bioactive compounds in food samples has received significant attention in recent years due to their potential health benefits. Epicatechin (EC) is one of the flavanol compounds that is naturally present in various foods such as tea, cocoa, grapes, and berries. It has been shown to have a range of potential health benefits, including antioxidant, anti-inflammatory, and anti-cancer properties. However, excessive intake of EC can also have negative effects on health. As such, the accurate and reliable detection of EC in food samples is crucial for ensuring consumer safety and maintaining quality control standards in the food industry. The development of a sensitive and reliable sensor for the detection of EC in food samples is therefore of significant importance.

In this research, a novel method for detecting epicatechin (EC) in various food samples is presented. The method involves the use of a nickel-oxide/cobalt-oxide/reduced-graphene-oxide nanocomposite material (NiO/CoO/rGO) synthesized through a microwave-assisted technique which is then applied to a glassy carbon electrode to fabricate NiO/CoO/rGO/GCE sensor for sensitive determination of EC. The structural, morphological, and electrochemical characteristics of the electrode materials were analyzed using Fourier transform infrared spectroscopy (FT-IR), field emission scanning electron microscopy (FE-SEM), cyclic voltammetry (CV), and electrochemical impedance spectroscopy (EIS). The morphological results confirmed the successful modification of rGO sheets by NiO/CoO composite. The electrochemical results indicate that the NiO/CoO/rGO/GCE electrode has exceptional electron transport properties and electrocatalytic activity towards EC, with a Rct value of 90.85 kΩ lower than that of the Bare/GCE and GO/GCE electrodes which was attributed to the synergistic effect of NiO/CoO nanocomposite and rGO sheets. The method was found to have a detection limit of 0.0012 µM for EC concentrations, with a linear range of 0.05 - 65 µM. The sensor was also shown to be reliable, stable, reproducible, selective, and yielded excellent recoveries (near to 100%) with low RSD values for the detection of EC in food samples.

**PP-32**

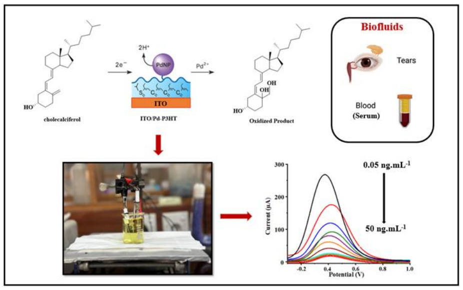
# Development of a P3HT-Assisted Palladium Nanoparticle-Modified ITO Electrode for High-Performance Electrochemical Detection of Cholecalciferol

**Sanya Khursheed**[a] **& Muhammad Imran Malik**[a,b]*
[a]*Third World Center for Science and Technology, International Center for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi 75270, Pakistan*
[b]*H.E.J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi 75270, Pakistan*
*Corresponding author E-mail:* mimran.malik@iccs.edu

## Abstract:

This work presents the development of a poly(3-hexylthiophene) (P3HT)-assisted palladium nanoparticle (PdNP)-modified indium tin oxide (ITO) electrode for the sensitive and cost-effective electrochemical detection of cholecalciferol, a key biomarker for vitamin $D_3$. The PdNPs were synthesized via a simple chemical reduction method using P3HT as a stabilizing and conductive matrix. The resulting nanocomposite was extensively characterized through SEM, AFM, UV-Vis, FTIR, DLS, zeta potential, and TGA analyses, confirming its stability, morphology, and functionalization. The modified ITO electrode was employed for the detection of cholecalciferol, which is critically important due to the widespread prevalence of vitamin $D_3$ deficiency, particularly in Asia. Both deficient and excess levels of this biomarker can lead to serious health issues, highlighting the need for a rapid and reliable sensing method. The fabricated electrode exhibited excellent performance, with a detection limit of 0.2 ng.mL$^{-1}$, a quantification limit of 0.9 ng.mL$^{-1}$, and a wide linear range from 1.3 x10$^{-7}$ – 2.0 µM. Method validation was carried out using high-performance liquid chromatography (HPLC), showing a high recovery of 99.9%, confirming the accuracy of the electrochemical approach. The sensor also demonstrated good stability, reproducibility, and selectivity in the presence of structurally similar biological interferents. Overall, this platform offers a promising tool for the early and affordable detection of cholecalciferol in clinical diagnostics.

***Keywords:*** *Cholecalciferol; Electrochemical sensor; Palladium nanoparticles; P3HT; ITO electrode; Nanocomposite*



PP-33

# Smart Hybrid Nanocomposites for Total Volatile Basic Nitrogen Compound Detection in Food Quality Assessment

**Saba Iqbal[a]*, Shaikh Mohiuddin[a], Syeda Fariya Mehfooz[a], Laiba Khan[a] Saqib Arif[b], Salman Khurshid[b], Qurrat ul Ain Akbar[b] & Hafiza Mehwish Iqbal[b]**
*[a]Department of Chemistry, University of Karachi.*
*[b]Pakistan Agricultural Research Council.*
**Corresponding author E-mail: sabaiqbal190@gmail.com*

## Abstract:

Protein rich foods are globally available, but unsuitable handling and storage conditions generate volatile amines (VAs). During deterioration process the concentration of volatile amines increases implies spoilage due to the buildup of these bioamines. The application of electrochemical devices and image analysis offers accurate and precise results but time consuming, destructive to samples and require professional expertise (He et al., 2022). Therefore, these techniques are not suitable for consumers to assess real-time freshness. Subsequently, it is imperative to develop functional, fast, and efficient approach for the detection of VAs in high protein foods. Therefore, this study aimed to develop biopolymer based smart nanocomposites with mechanical strength, water barrier, antioxidant, and real-time sensing potentials were fabricated using nanoparticles (NPs) and glycosylated flavylium cation derivatives (GFCD). The optimal composition of nanocomposites was developed using central composite design based on two independent variables: the concentration of NPs (10-50 % v/v) and the concentration of GFCD (30-100 % w/w) calculated per mass of biopolymers. The linear thickness (TH, WS), two-factor interaction (TPC) and quadratic (MC, WVP, AC, TS, EAB, and TRS) models were significant ($p < 0.0001$) and matched perfectly with distinctive experimental data ($0.977 < R^2 < 0.998$). The optimum formulation predicted by desirability analysis portions 50% v/v NPs and 30% w/w GFCD provided the nanocomposite films improved characteristics, i.e., WS = 33.01%, WVP = 1.11 $(kg/Pa.s.m^2)10^{-10}$, TS = 23.31 MPa, and EAB = 25.21%. FTIR examination indicated molecular composition and intermolecular interactions in nanocomposite film components, whilst SEM analysis revealed that NPs and GFCD were evenly distributed in polymeric matrix. Furthermore, nanocomposite films were applied to monitor fish and shrimp freshness exhibited visible colour variations from pink to green within 24 hours at 15°C due to volatile amines. As a result, the NPs-GFCD nanocomposite films were considered as smart labels with significant physicochemical, mechanical, and pH-sensing characteristics supporting waste reduction, and sustainable seafood preservation.

***Keywords:*** nanocomposites, smart labels, nanoparticles, seafood, flavylium cation derivatives

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**PP-34**

# Green Synthesis of Nickel Oxide Nanoparticles with Selected Medicinal Plants and their Antimicrobial Activity

**Saima Mooro[1]*, Farah Naz Talpur[1], Nazir Ahmed Brohi[2] & Hassan Imran Afridi[1]**
*[1]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
*2Institute of Microbiology University of Sindh, Jamshoro,76080-Pakistan*
*Corresponding author E-mail: saimamooro@gmail.com*

## Abstract:

The current study aims to synthesize NiO NPs from selected indigenous medicinal plant, which has not been studied previously, in order to potentially evaluate their antibacterial effects as a remedial medication. Among medicinal plants of Sindh, *Datura Inoxia* leaves were used as a bio reductant for the green synthesis of nickel oxide nanoparticles under microwave irradiation. To optimize the synthesis parameters for achieving maximum absorbance of NiO-NPs, a series of 15 experimental runs were designed using the Face-Centered Central Composite Design (FCCCD). The optimized process took 30 seconds at 760 W, with a Ni salt to extract ratio of 2.7 and 1 mL of 0.5 M NaOH as the precipitating agent. The synthesized DI@NiO-NPs were characterized under optimized conditions using a suite of advanced analytical techniques, including XRD, SEM, AFM, UV-Vis, FTIR, and EDS, confirming the formation and elucidating the morphology of the nanoparticles. UV–Vis spectroscopy showed a plasmon resonance band at 267 nm, confirming nanoparticle formation. FTIR analysis revealed characteristic Ni–O stretching vibrations at 529 and 557cm$^{-1}$, along with absorption bands attributed to –OH, C=O, C-O and –CH groups, suggesting effective capping and stabilization by phytochemicals present in the plant extract. AFM and SEM revealed a spongy, porous nanoparticle structure, indicating a high surface area beneficial for catalytic and biological applications. XRD patterns confirmed the formation of crystalline NiO nanoparticles with a cubic phase and an average crystallite size of 25 nm. EDX spectroscopy further validated the elemental purity of the synthesized nanoparticles, showing prominent peaks corresponding to nickel and oxygen. The synthesized nanoparticles showed strong antimicrobial activity against *S. aureus* (14–19 mm) and *E. coli* (8–14 mm), highlighting their eco-friendly synthesis and broad nanotechnological potential.

***Keywords:*** Nickel oxide nanoparticles; Green synthesis; Datura inoxia; Microwave-assisted synthesis; Antibacterial activity

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PP-35

# Fabrication of Luteolin Imprinted Polymer Based Graphene Oxide Composite for the Electrochemical Detection of Luteolin

**Sania Munawar [a]*, Huma Shaikh[b] & Amber R. Solangi[b]**
*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
**Corresponding author E-mail: saniamunawar333@gmail.com*

**Abstract:**

A simple and sensitive electrochemical method was developed for determining luteolin, a compound with anti-inflammatory, anti-bacterial, anti-oxidant, and anti-proliferative properties. This study reports the synthesis of a Luteolin-imprinted polymer-based Graphene Oxide (MIP-GO) composite for selective electrochemical detection. The MIP-GO composite leverages molecular imprinting and graphene oxide advantages, enhancing sensor specificity and sensitivity. MIPs provide tailored recognition sites, while graphene oxide offers exceptional properties like rapid redox kinetics and high surface area. Under optimized conditions, the sensor shows excellent response, demonstrating its potential for detecting Luteolin in various applications. Cyclic voltammetry and electrochemical impedance spectroscopy demonstrated high charge transfer kinetics and conductivity. The developed sensor exhibited a linear range of 72.7-1110 nM with a limit of detection of 24.003 nM and limit of quantification of 72.737 nM. Future work will focus on evaluating the sensor's applicability in fruit and vegetable samples, which is currently pending. The successful development of this sensor could pave the way for monitoring Luteolin in food products, pharmaceuticals, and biological samples, contributing to improved human health and disease prevention.

***Keywords:*** Molecular imprinted polymer (MIP), Graphene oxide composite, Electrochemical sensor, Luteolin detection, Sensor fabrication.

**References:**

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PP-36

# Electrochemical Sensing of Malondialdehyde using Sericin Magnetite Composite (SER-M) for Monitoring Lipid Oxidation in Edible Oils

**Shazia Chohan[a], Ahmed Chang[b], Najma Memon[a]* & Bakhtawar Khair Muhammad Pirzada[c]**
*[abc]National Center of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
** Corresponding author E-mail: shaziachemist03@gmail.com*

## Abstract:

Malondialdehyde (MDA), a reactive three-carbon dialdehyde is a key secondary oxidation product produced from the degradation of ω-3 and ω-6 polyunsaturated fatty acids, mainly linoleic and arachidonic acids. It serves as a major indicator of lipid peroxidation, reflecting the oxidative deterioration of edible oils. MDA levels rise notably in PUFA-rich oils subjected to high temperatures during processing or frying, leading to reduced sensory and nutritional quality. Continuous intake of such oxidized oils increases dietary exposure to MDA, which poses potential health risks due to its ability to react with biomolecules and disrupt normal cellular functions. Therefore, monitoring MDA formation is essential to ensure both the quality and safety of edible oils. In this study, a biocomposite sensor based $Fe_3O_4$ nanoparticles functionalized with 3-aminopropyltriethoxysilane (APTES) and sericin was synthesized for electrochemical detection of malondialdehyde (MDA). The composite was characterized by FTIR, SEM, BET, XRD, and VSM, confirming successful functionalization, porous morphology, high surface area, spinel structure, and magnetic behavior. The sericin based magnetite (SER-M) composite was drop-cast onto a glassy carbon electrode (GCE), showing enhanced electron transfer in 0.1 M KCl with 5 mM of $K4[Fe(CN)_6]$ was verified by cyclic voltammetry and impedance spectroscopy. The ohmic resistance of modified electrode was 192 Ω as compared to bare GC electrode which was 227Ω and its sensitivity was high as compare to bare electrode. Using differential pulse voltammetry, the modified sericin based magnetite (SER-M) electrode was employed for MDA using differential pulse voltammetry mode in phosphate buffer (pH 7). The sensor displayed a linear response from 30 to 268 µM ($R^2 = 0.996$), with LOD of 13.76 µM and LOQ of 45.87 µM. This magnetite based sensor provides a sensitive, stable, and efficient platform for MDA detection as oxidative degradation monitoring in edible oils.

***Keywords:*** Malondialdehyde, Fe3O4, lipid oxidation, electrochemical sensor, differential pulse voltammetry

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PP-37

# Smart Analytical Strategies for Halal Authentication: Dual ATR-FTIR and GC-FID Detection of Lard in Confectionery Products

**Sobia Kunbhar[a], Farah N. Talpur[a]*, Sarfaraz Ahmed Mahesar[a] & Hassan Imran Afridi[a]**
[a] *National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
** Corresponding author E-mail: farah.talpur@usindh.edu.pk*

**Abstract:**

Confectionery products such as chocolates and biscuits are among the most widely consumed foods worldwide; however, adulteration with non-halal fats such as lard has become a critical concern for halal authenticity and consumer protection. This study integrates two complementary analytical approaches for the rapid and reliable detection of lard adulteration in imported confectionery products. In the first approach, attenuated total reflectance–Fourier transform infrared spectroscopy (ATR-FTIR) combined with partial least squares (PLS) regression was optimized for quantitative analysis. A lard calibration model (2–35 %) in the 3035–2984 cm$^{-1}$ spectral region exhibited a strong linear correlation ($R^2 = 0.9994$) with low root mean square errors (RMSEC = 0.320; RMSEP = 0.315) and excellent sensitivity (LOD = 0.10 %; LOQ = 0.35 %). The root mean square error of cross-validation (RMSECV = 1.17) further confirmed model robustness. In the second approach, gas chromatography–flame ionization detection (GC-FID) coupled with principal component analysis (PCA) was applied for fatty acid profiling. The fat content of samples ranged from 11.5 % to 32.5 %. Palm kernel-based chocolates were rich in lauric (42–52 %) and myristic acids (18–20 %), whereas palmitic, stearic, and oleic acids dominated other chocolates. Biscuits contained primarily palmitic and oleic acids (> 75 %). PCA of the full dataset (PC1 = 49.27 %, PC2 = 33.80 %, PC3 = 7 %) effectively discriminated lard-adulterated samples; notably, chocolate samples PM-2 and PMO-2 clustered closely with pure lard, while all biscuit samples formed distinct authentic clusters. These findings confirm the presence of porcine biomarkers in specific chocolate brands and establish ATR-FTIR–PLS and GC-FID–PCA as robust, rapid, and complementary analytical tools for halal verification and food authenticity monitoring in the confectionery industry.

***Keywords:*** Halal authentication, confectionery products, ATR-FTIR, GC-FID, Porcine biomarker

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**PP-38**

# Photocatalytic Degradation of Eriochrome Black T Dye by ZnO Using Multivariate Methods

**Sanjna, Bibi Dua & Sawaira**
*Department of Human & Rehabilitation Sciences, The Begum Nusrat Bhutto Woman University, Sukkur, Pakistan*
*Corresponding author E-mail:* sanjna3.22bschm001@bnbwu.edu.pk

## Abstract:

The zinc oxide (ZnO) nanoparticles are semiconductor materials with a wide bandgap and exceptional optical, chemical, and antimicrobial properties. Their nanoscale size enhances surface reactivity and enables applications in photocatalysis. In current study photocatalyst ZnO was prepared by complexation of zinc acetate with sodium diethyl dithiocarbamate trihydrate, and calcined at 750 °C. The ZnO nanoparticles were characterized by DLS, Zeta potential, SEM, EDX and FTIR. The ZnO nanoparticles (NPs) were applied for photocatalytic degradation of Eriochrome black-T (EBT) dye by UV, visible and mercury light irradiation sources. The experimental conditions were optimized by univariate and multivariate techniques, and it was revealed that degradation of dye by ZnO NPs surface was dependent on source of light and pH of dye solution. The degradation of EBT dye at pH 11 showed highest degradation rate 99.64% with UV light. The ZnO was calcined at 450, 600, 750 and 900 °C, but calcination temperature 750 °C showed better degradation rate for EBT. The highest degradation was found at 15 mg dose and 5 ppm concentration. The degradation obeyed pseudo second order kinetics model as compared to pseudo first and zero order models and Langmuir isotherm model fitted more as compare to other models. The degradation of EBT dye in real samples collected from River Indus, tape water and domestic wastewater and spiked with 20 µg/mL, indicated that dye degraded upto 82–86% with relative standard deviations (RSD) within 2% (n = 3).

***Keywords**:* ZnO, Eriochrome black T, Photocatalytic degradation, UV irradiation, characterization 123456789keV0102030405060708090 cps/eV O Zn Zn

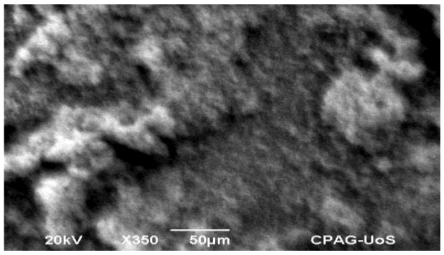


***Figure 1.*** SEM image of ZnO nanoparticles

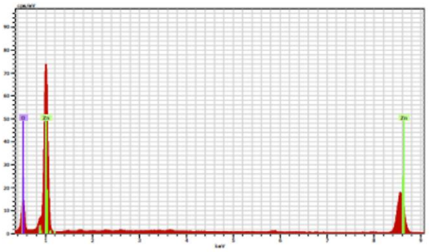


***Figure 2.*** EDX image of ZnO nanoparticles

**PP-39**

# Co-crystallization as a Promising Approach to Overcome the Undesirable Properties of Drugs: A Systematic Study of Amphotericin B

**Yahya Sifan Wahan**[ad*]**, M. Iqbal Choudhary**[abc*] **& Sammer Yousuf**[a*]
[a]*H.E.J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences, University of Karachi, Karachi-75270, Pakistan.*
[b]*Institute of Molecular Biology and Biotechnology, University of Lahore, Lahore, Pakistan.*
[c]*Department of Biochemistry, Faculty of Science, King Abdulaziz University, Jeddah-21412, Saudi Arabia.*
[d]*Chemistry Department, Faculty of Applied Sciences and Humanities, Amran University, Amran, Yemen.*
*Corresponding author E-mail:* yahyawahan@iccs.edu

## Abstract:

Leishmaniasis remains a major public health concern in several endemic regions, particularly in Pakistan and Yemen, where the number of reported cases continues to rise. The current therapeutic options, including antimonials, miltefosine, paromomycin, and amphotericin B (AmB), face limitations *due* to their toxicity, poor solubility, high cost, and drug resistance. Among them, AmB is regarded as the gold-standard drug *due* to its broad-spectrum efficacy; however, its low aqueous solubility, aggregation tendency, and dose-dependent nephrotoxicity severely restrict its therapeutic applications, especially in low-income countries where liposomal formulations are unaffordable. To overcome these drawbacks, we explored co-crystallization as a solid-state modification approach to enhance AmB's physicochemical and biological properties. Four cocrystals of AmB with quinidine, chrysin, decanoic acid, and vanillic acid were synthesized using neat and liquid-assisted grinding techniques and characterized by PXRD, FT-IR, UV–Vis, $^1$H-NMR spectroscopy, DSC/TGA analyses, and HPLC chromatography. Selected co-crystals-particularly AmB–vanillic acid-demonstrated a remarkable increase in solubility (up to ~8-fold at phosphate buffer solution pH 6.8), AmB–decanoic acid (up to ~6-fold at phosphate buffer solution pH 7.4), and AmB-quinidine (up to ~4-fold at distilled water). These modifications correlated with improved antileishmanial activity ($IC_{50} \approx 2.4–3.0$ µM compared with 3.38 µM for AmB) and significantly lower cytotoxicity toward 3T3 fibroblast cells (up to 4-fold safer). In conclusion, co-crystallizing AmB with the coformers listed above is a simple, cheap, and scalable way to improve its solubility, safety, and therapeutic effectiveness. This approach offers a promising pathway for developing safer, affordable, and accessible antileishmanial therapies in regions with rising disease prevalence.

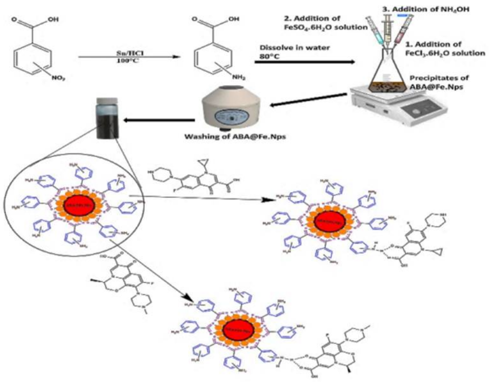
# An Efficient Synthesis of Iron oxide Nanosensor for Selective Detection of Fluoroquinolone Based Pharmaceutical Pollutants

**Ziana Manzar*, Erum Hasan, Aiman Aleem, Yusra, Aleena & Syed Nawazish Ali***
*Department of Chemistry, University of Karachi, Karachi-75270, Pakistan.*
*Corresponding author E-mail:* zianamanzar@gmail.com

## Abstract:

The pharmaceutical waste in marine water has been a serious concern which is not only imposing human health but also influencing the aquatic lives. In response to this complication, an effective synthesis of aminobenzoic acid stabilized iron oxide nanoparticles (ABA@Fe.Nps) have been achieved. These nanoparticles have shown great potential for the detection of pharmaceutical pollutants in water. Nitrobenzoic acid was reduced into aminobenzoic acid by Sn/HCl which was employed as a capping agent for ABA@Fe.Nps. The characterization was carried out through several techniques including Electron Impact Mass Spectrometry (EIMS), Ultraviolet-Visible (UV-Vis), Nuclear Magnetic Resonance (NMR) and Fourier-Transform Infrared (FTIR) Spectroscopy as well as the Atomic Force Microscopy (AFM). The average size of these particles was found to be 2.2 to 3.6 nm. The synthesized nanoparticles were found to be highly stable over a range of $p^H$ and used for specific detection of fluoroquinolone based drugs. The UV-Vis analysis also revealed high selectivity between the fluoroquinolone based drugs and nanosensor. The complex was found to be stable with the stoichiometric ratio of 1:1. The limit of detection for two of fluoroquinolone drugs (ciprofloxacin and levofloxacin) was found to be 0.7 and 0.5 µM respectively. These nanoparticles have successfully sensed various drug molecules in well water, tap water as well as in human blood which suggest strong capability and potential as selective nanosensor in future.

***Keywords:*** Pharmaceutical waste, aquatic life, iron oxide nanosensor, fluoroquinolones, UV-Visible spectroscopy.



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PP-41

# Sustainable Development and Multi-technique Characterization of Bio-Based Chitosan Cartridge for Efficient Removal of Toxic Heavy Metals from Drinking Water

**Abdul Moiz[a], Rabia Aziz[a], Muhammad Imran Malik[a], Khalid Muhammad Khan[a] & Muhammad Tahir Rafique[b]**

*[a]H.E.J. Research Institute of Chemistry, International Centre for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi 75270, Pakistan.*
*[b]Pakistan Council of Scientific and Industrial Research, Laboratories Complex, Karachi.*
*Corresponding author E-mail: abdulmoizbukhari@gmail.com*

**Abstract:**

This research is focused on the development of a chitosan-based cartridge for use in domestic and commercial water filters aimed at removing toxic metal contaminants from drinking water. The study was conducted in two phases. In the first phase, nine different chitosan products were synthesized from shrimp shell waste—an abundantly available and underutilized biowaste, using varied acid-base combinations during demineralization, deproteination, and deacetylation. These samples, along with commercial chitosan, were characterized using $^1$H-NMR, XRD, ATR-FTIR, SEM-EDX, TGA-DSC, and titration techniques. The analysis revealed that the processing conditions significantly influenced the physicochemical properties of chitosan, including degree of deacetylation, solubility, crystallinity, thermal stability, surface morphology, and most important the cost-effectiveness of each chemical treatment route.

In the second phase, the most effective chitosan—exhibiting high metal adsorption capacity and superior material properties—was selected for the fabrication of a filtration cartridge. The resulting cartridge effectively removed hazardous metals such as $Pb^{2+}$, $Cu^{2+}$, $Cd^{2+}$, $Co^{2+}$, $As^{3+}$, $Hg^{2+}$, $Ni^{2+}$, and $Mn^{2+}$ from contaminated water, demonstrating strong adsorption performance and good reproducibility over multiple cycles. By utilizing abundant shrimp shell waste and simple, low-cost processing routes, this work highlights a sustainable, economically viable, and scalable solution for metal-contaminated water treatment—particularly relevant for communities in resource-limited or at-risk regions.

***Keywords:*** Chitosan, Degree of Deacetylation, Physiochemical Properties, Heavy Metal Adsorption.

PP-42

# Gelatin-Stabilized Gold Nanoparticles for Efficient and Selective Colorimetric Detection of Chlorothalonil

**Alkhader Salem Kassem, Daim Asif Raja & Muhammad Imran Malik**
*International Center for Chemical and Biological Sciences (ICCBS),*
*University of Karachi, Karachi-75270, Pakistan*
*Corresponding author E-mail:* alkhadernu2013@gmail.com

**Abstract:**

Development of simple, facile, and on-spot colorimetric assays for pesticides based on metal nanoparticles is an emerging field of modern scientific research. Herein, a gelatin is used to stabilize gold nanoparticles (AuNPs) through reduction method. As the primary goal of the research, the synthesized gelatin-AuNPs are employed for an efficient and selective quantitative detection of Chlorothalonil (CTL). The typical wine red color of gelatin-AuNPs changed to bluish-purple as soon as CTL is added which is further endorsed by an increase in the intensity of the SPR band. The electrostatic forces are responsible for the steric stabilization of gold ions in the micro-domains of the gelatin, attributed to aggregation-induced surface plasmon resonance (SPR) shift. Electrostatic and hydrogen-bonding interactions between the functional groups of gelatin and the polar groups in CTL play a crucial role in this aggregation. CTL addition in gelatin-AuNPs changed the average hydrodynamic size and zeta potential, indicating strong nanoparticle–analyte interaction. These changes might be attributed to the presence of the nitrogen group in CTL. The limit of detection of CTL through gelatin-AuNPs was observed significant in µM. Moreover, gelatin-AuNPs allowed reliable, efficient, selective, and quick quantitative detection of CTL in environmental samples. The proposed CTL sensor renders an excellent platform for its quick and on-spot detection without requiring a well-equipped lab setup. Up to the best of our knowledge, the proposed CTL sensor is the first of its kind (colorimetric) in the list of proposed instrumental methods for determination of CTL.

***Keywords:*** Chlorothalonil, Gelatin-AuNPs, Colorimetric sensor, Environmental samples

**PP-43**

# Application of Calcium-Coated $Fe_3O_4$ Nanoparticles Incorporated in Humic Acid for Textile Dye Removal using Central Composite Design

**Sana Imam*, Fakhar N. Memon, Humera Moosa, Areesha Ashraf & Alveena Khan**
*Department of Chemistry, University of Karachi-Pakistan*
** Corresponding author E-mail:* sanaimam25@gmail.com

**Abstract:**

The presence of dye contamination in wastewater represents serious environmental risk. The treatment and recycling of wastewater offers a solution to the global water scarcity issue [1,2]. Numerous techniques have been used for this purpose. Adsorption is one of the most effective methods for dye removal due to its efficiency.

In this study Ca-modified $Fe_3O_4$ magnetic HA-Ca/$Fe_3O_4$ coated with Humic acid were synthesized by co-precipitation method [5], their modification with calcium enhances their adsorption capabilities, and encapsulation in humic acid increases the stability and dispersibility in water. Humic acid is a natural macro-molecular compound, and it is fraction of humic substance.

The characterization of HA-Ca/$Fe_3O_4$ was carried out by employing different analytical techniques to validate the successful synthesis and modification of HA-Ca/Fe3O4. These HA-Ca/$Fe_3O_4$ were used to remove methylene blue dye from wastewater. A central composite design (CCD) methodology was employed to investigate and optimize the various parameters such as pH, initial concentration of dye, dosage of adsorbent, facilitating a comprehensive evaluation of each factor's effect on adsorption performance.

The material was applied for adsorption which revealed that more than 90% dye was adsorbed successfully. The kinetic study is performed to understand the rate at which adsorption occurs and the mechanism of the interaction between HA-Ca/$Fe_3O_4$ and dye molecules. The thermodynamic study showed that the adsorption process was both spontaneous and endothermic. Adsorption isotherm analyses were conducted to evaluate the relationship between HA-Ca/$Fe_3O_4$ and dye molecule, with the Langmuir and Freundlich adsorption isotherms offering information about the adsorption capacity and surface variability, respectively.

These results imply that HA-Ca/$Fe_3O_4$ are a promising and eco-friendly material for dye removal, with significant potential for use in wastewater treatment applications.

***Keywords:*** Adsorption, Central Composite Design, Dyes, Humic acid, Nanoparticle

PP-44

# Development of Solvent Microextraction Procedures for Preconcentration, Separation and AAS and HPLC for Determinations of Nickel at Trace Levels in Environmental Samples

**Waheed Ali Soomro* & Muhammad Yar Khuhawar**
*Institute of Advanced Research Studies Chemical Sciences University of Sindh Jamshoro, Sindh Pakistan*
*Corresponding author E-mail: waheedsoomro88@yahoo.com*

**Abstract:**

The work examines the determination of gold from environmental samples by Dispersive Liquid-Liquid Micro extraction (DLLME) methods. The method was developed for the separation of Ni (II) ions after chelating with bus (salicylaldehyde) ethylenediamine (H2SA2en) Schiff-base as derivatizing reagent. High permormane liquid chrometography (HPLC) and Inductively Coupled Plasma-atomic emission spectroscopic (ICP's-AES) techniques were used for quantitation of Ni (II). These techniques are sensitive and rapid methods for the determination of Nickel concentrations in water and sediment samples. The influence of factors on extraction productivity and analytical signals of Ni (II) ions such as pH, reagent concentration, solvents (extracting) (disperser) and solvents volumes were studied and optimized by univariate and multivariate techniques. The calibration curve of nickel was prepared by measuring the concentration against average peak height/peak area (n = 3) using 0.005–0.025 µg/mL of metal ion with R2 = 0.9891, the limits of detection and quantification (LOD and LOQ) were 0.002 µg/mL and 0.006 µg/mL and the preconcentration factor was 50.. The proposed method was successfully hired for the determination of nickel from water and sediment samples of Indus River, Kori Barrage,. The results found from HPLC were compared with those obtained from ICP technique and good correlation with analogous selectivity and sensitivity was specified.

***Keywords:*** DLLME, HPLC, Nickel, Preconcentration, Determination,

**PP-45**

# Spectrophotometric Analysis of Calix[4]arene Derivative for its Application in detection of $Al^{3+}$ in food samples

**Aysha, Tuba Saleh & Asif Ali Bhatti**
*Department of Chemistry, GC University Hyderabad*
*Corresponding author E-mail:* ayesha.rajput@gcuh.edu.pk

**Abstract:**

Calixarenes are a prominent class of organic compounds with cup-shaped molecules containing a repeating phenolic unit formed into a macrocycle via methylene bridges [1]. The calixarene "cups" have a vase like structure defined by an upper rim, lower rim, and central annulus [2]. The polar and non-polar features of cavities enable calixarenes to interact with a wide range of guest species, depending on the binding groups and the number of repeating units in the calix[n]arene moiety [3]. The current study demonstrates spectrophotometic study of 25,27-dicarbomethoxydiamide-bis-(N,N-dimethylethaneamine)-26,28-dihydroxycalix[4]arene toward detection of $Al^{3+}$ ion. Different parameters were analyses such as, ligand behavior in different solvent, effect of different metal on ligand in selected solvent, concentration effect. It was observed from the spectra that calixarene derivative showed selective complexation with $Al^{3+}$ ion at very low concentration. The stoichiometric calculations obtained from Job's plot reveals that it forms metal:ligand complex in 1:1 ratio. The developed method will be used to analyse the $Al^{3+}$ ion in different food samples that used Aluminum foil as wrapper.

***Keywords:*** Calix[4]arene, Spectrophotometer, Aluminum, ligand.

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PP-46

# Carcinogenic and Non-Carcinogenic Health Risk Assessment of Heavy Metals Consumption Through Spices on Human Health in Karachi, Pakistan

**Faiza Nayyer[1]*, Saima Imad[2], Nasreen Fatima[1], Shazia Nisar[1], Sheraz Shafiq[2] & Faisal Ghazanfer[2]**
[1]*Department of Chemistry, Faculty of Sciences, University of Karachi, Pakistan*
[2]*Pakistan Council of Scientific and Industrial Research, Laboratories Complex, Karachi, Pakistan*
**Corresponding author E-mail: faizanayyarzaidi@gmail.com*

**Abstract:**
Spices are frequently used in household diets, monitors them in foodstuffs is quite important to ensure the safety of an individual's health. This study aimed to evaluate the risk of heavy metals through spices consumption on human health and compare their contamination levels with packed spices. In this experimental study spice samples were collected from five local open markets of Karachi, Pakistan, i.e. Empress, Jona, Gulshan e Iqbal, Nazimabad, and Korangi Market and the same packed spice samples were collected from the Super Market. The concentration of heavy metals was evaluated with an atomic absorption spectrometer. The risks to human health were assessed by hazard index or non-carcinogenic index (HI). The obtained results were analyzed with Two-way ANOVA. The procured findings demonstrated that all collected samples accumulated with heavy metals. The total hazard quotient (THQ), and hazard index (HI) for heavy metals in various spices were lower than the acceptable limit of unity (THQ and HI <1). Strong positive correlation was observed in Ni, Cr, Pb, and Cu in cinnamon, dried ginger and Fenugreek. However, the carcinogenic risk values were within the acceptable threshold limit, representing that consuming different spices in the studied area will not pose a potential health risk to human health.

***Keywords:*** Heavy metals, total hazard quotient, health hazard

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PP-47

# Synthesis and Characterizations of Highly Efficient Nickel Nanocatalysts and Their Use in Degradation of Organic Dyes

**Irum Sarfraz Junejo*[a], Nazar Hussain Kalwar*[a,b], Razium Ali Soomrob[c], Mariam Manzoor[a], Adeel Ahmed Bhatti[a] & Farhan Ali[a]**
*[a]Institute of Chemistry, Shah Abdul Latif University Khairpur, 66020 - Pakistan*
*[b]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
*[c]Beijing Advanced Innovation Centre for Soft Matter Science and Engineering, Beijing University of Chemical Technology, Beijing, 100029, China*
*Corresponding author E-mail:* irumsarfrazjunejo@gmail.com

**Abstract:**

The present study describes the synthesis of highly active and ordered structures of nickel nanocatalysts by a facile, green and economically viable approach. The study reveals efficient catalytic activity for the degradation of a number of toxic and lethal organic dyes, such as Eosin-B (EB), Rose Bengal (RB), Ereochrome Black-T (ECBT) and Methylene Blue (MB). The stable colloidal dispersions of ordered nickel nanostructure (Ni NSs) arrays were prepared via a modified hydrazine reduction route with unique and controllable morphologies in a lyotropic liquid crystalline medium using a nonionic surfactant (Triton X-100). Characterization studies optimizing various parameters for the preparation of the fabricated Ni NSs and their surface binding interactions, size and morphologies were carried out using UV-Vis spectroscopy, fourier transform infra-red (FTIR) spectroscopy, X-ray diffraction (XRD) and scanning electron microscopy (SEM).

***Keywords:*** Nickel nanostructures, TX-100, Aqueous dispersions, Nanocatalysts, Dye degradation

PP-48

# Conducting Polymeric Zinc Ferrite Platform for Voltammetric Sensing of Esomeprazole

**Shakoor Ahmed Solangi[a], Jameel Ahmed Baig[a,b]* & Imam Bakhsh Solangi[c]**
*[a]Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro 76080, Pakistan*
*[b]Department of Chemistry, College of Science, Imam Mohammad Ibn Saud Islamic University (IMSIU), P.O.Box 90950, Riyadh 11623, Saudi Arabia*
*[c]Dr. M.A Kazi Institute of Chemistry, University of Sindh, Jamshoro 76080, Pakistan*
*Corresponding author E-mail: shakoorahmed95@yahoo.com*

## Abstract:

Esomeprazole (ESO), a proton pump inhibitor, is used to manage gastroesophageal reflux disease (GERD), prevent nonsteroidal anti-inflammatory drugs (NSAIDs)- induced gastric ulcers, aid in *Helicobacter Pylori* eradication, and treat hypersecretory acid conditions. The present investigation introduces an innovative electrochemical sensing strategy for detecting esomeprazole (ESO) using a screen-printed electrode (SPE) modified with a newly synthesized $ZnFe_2O_4$/PTh nanocomposite. The $ZnFe_2O_4$ NPs were prepared using the sol-gel auto combustion method, while $ZnFe_2O_4$/PTh nanocomposites were synthesized through in situ chemical oxidative polymerization. The $ZnFe_2O_4$ NPs display a cubic spinel crystalline structure and possess a rough surface morphology, with particle sizes less than 50 nm. The sensor was employed for the quantitative analysis of ESO utilizing differential pulse voltammetry (DPV). The $ZnFe_2O_4$/PTh/SPE sensor exhibited high analytical performance, demonstrating remarkable sensitivity and selectivity for trace-level detection of ESO, achieving a detection limit of 0.071 μM. The electrochemical technique employing the sensor was effectively utilized for the quantification of ESO in both pharmaceutical, biological, and environmental matrices with recovery > 90%.

**PP-49**

# Antiglycation Activities of Dopamine Derivatives and Their Docking Against Human Serum Albumin

**Sheeba Rizvi[a], Sadaf Iqbal[a], Sidra Akhter[a], Nasreen Fatima[a]*, Shazia Nisar[a] & Umair Aleem[b]**
[a]*Department of Chemistry, University of Karachi, Karachi-75720, Pakistan.*
[b]*H. E. J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences, University of Karachi, Karachi-75720, Pakistan.*
**Corresponding author E-mail: nasreenfatima@uok.edu.pk*

## Abstract:

The comprehensive examination of ligand interactions with the human serum albumin (HSA) is of ultimate significance for today's drug discovery, since numerous regular drugs are proven to interact with HSA. In our ongoing research scenario, dopamine derivatives have been synthesized bearing catecholate moiety to assess their promising biological activities. Characterization of ten (10) new derivatives was done by FTIR and NMR which proved the presence of two free catecholic hydroxyl groups. Ten compounds showed novel antiglycation activities which were not found in dopamine analogues previously. In order to evaluate the molecular mechanism of antiglycation effects of synthesized dopamine derivatives, their molecular docking against HSA was performed. The prior evidence of amine derivatives binding to HSA subdomains IIA and IIIA has prompted us to investigate the binding of our newly synthesized dopamine derivatives into both of these sites. The binding priority and mechanism of dopamine derivatives against subdomains IIA and IIIA will be discussed in the poster.

***Keywords:*** Antiglycation, catecholic hydroxyl, dopamine derivatives, docking, human serum albumin.

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**PP-50**

# Highly Selective Separation of Fe, Co, and Ni using a Task-Specific Salicylate Imidazolium Ionic Liquid

**Shoaib Muhammad, Muhammad Naveed Javed, Komal Aziz Gill, Firdous Imran Ali, William Henderson, Ahmed Bari, Syed Ghulam Musharraf, Jameel Ahmed Baig & Imran Ali Hashmi**
*Department of Chemistry, University of Karachi, Sindh, Pakistan*
*Corresponding author E-mail:* karachi85@ymail.com

## Abstract:

The selective extraction method has significant potential for metal extraction in Pakistan, particularly for domestic recovery of valuable elements like iron, cobalt and nickel. Utilizing this green, efficient technology could enhance local metal processing, reduce reliance on imports, and address environmental concerns in the country's developing industrial sector. The problem is the iron triad elements; iron (Fe), cobalt (Co), and nickel (Ni) share similar chemical and physical properties on the periodic table. To selectively separate these elements from their aqueous mixtures, a green, highly efficient, and environmentally benign water-ionic liquid (IL) biphasic solvent extraction system was created. This system utilizes a new salicylate-functionalized imidazolium-based task-specific ionic liquid (TSIL), specifically 1,3-dioctylimidazolium 2-hydroxybenzoate ([DOIM][OHB]), at room temperature. The process is highly selective: Co (II) was rapidly extracted (within 5 minutes) as a blue complex. Over time, and without the addition of any oxidants, the remaining Fe (II) was oxidized to Fe (III) and subsequently extracted as a red-colored complex. Atomic absorption spectroscopy (AAS) confirmed that less than 1% of Ni (II) was extracted. UV-visible spectroscopy revealed that the heavy metal ions were extracted via a neutral extraction mechanism.[1]

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**PP-51**

# Determination of Toxic and Essential Elements in Cow, Buffalo, and Goat Milk Samples from Various Areas of Taluka Tandojam District Hyderabad Sindh, Pakistan

**Soha Anwar & Mazhar Iqbal Khaskheli**
*Department of Chemistry, Government College University Hyderabad*
*Corresponding author E-mail:* sohaanwar125@gmail.com

**Abstract:**

Milk is a vital component of the human diet, providing essential macro- and micro-minerals that support growth, immunity, and overall health. However, it may also contain toxic elements such as lead (Pb), arsenic (As), and cadmium (Cd), which can pose significant health risks if present in elevated concentrations. The mineral composition of milk varies with species and environmental factors, making its evaluation critical for nutritional safety.

The present study aimed to determine the levels of toxic elements (Pb, Cd, and As) and essential electrolytes (Na, Mg, Ca, and Zn) in cow, buffalo, and goat milk samples collected from various areas of Taluka Tando Jam, District Hyderabad, Sindh, Pakistan. Estimated Daily Intake (EDI) values were calculated for five age groups ranging from infants (0–6 months) to children (6–10 years) and compared with Recommended Dietary Allowances (RDA). Results revealed that buffalo milk contained the highest concentrations of calcium (Ca) and zinc (Zn), whereas goat milk was richest in magnesium (Mg) and sodium (Na). Arsenic (As) levels were higher in cow milk, while elevated lead (Pb) concentrations were detected in both goat and buffalo milk. The EDI values of essential minerals were lower than the corresponding RDA values across all age groups, indicating that milk alone may not meet the complete mineral requirements of children. Despite this, cow and goat milk were identified as the most suitable alternatives to human breast milk for infants. The detection of toxic elements, even within permissible limits, raises concerns about potential long-term health risks, particularly for infants and young children. These findings highlight the need for regular monitoring of milk quality, stricter environmental controls, and increased consumer awareness to ensure both nutritional adequacy and safety.

PP-52

# Sugar to Nano Sponge

**Tooba Abid*[1], Shoaib Mohammad[1], Firdous Imran Ali[1], Kashif Riaz[2], Agha Arslan Wasim[1], Faisal Rafique[3], Furkan T. Saricaoglu[4] & Imran Ali Hashmi1**
*[1]Department of Chemistry, University of Karachi, Pakistan.*
*[2]Department Applied Chemistry, University of Karachi Pakistan*
*[3]Department of Applied Physics, University of Karachi Pakistan*
*[4]Department of Food Engineering, Bursa Technical University, Turkiye*
*Corresponding author E-mail: toobaabid2019@gmail.com*

## Abstract:

We've developed a new Galactose-Triazole-based low molecular weight organogelator derived from sugar that shows a remarkable ability: it can selectively form a stable, thermoreversible gel in organic solvents even when water is present. This unusual phase-selective gelation points to exciting possibilities in the design of smart, sugar-based materials.

Our goal was to create a gelator that not only self-assembles through non-covalent interactions but could also function as a nano sponge for real-world problems, such as cleaning up toxic dyes from wastewater.

To explore how this material works, we used a range of techniques including Fourier transform infrared spectroscopy, Ultraviolet visible spectroscopy, Powder X-ray Diffraction, and Scanning Electron Microscopy. These studies revealed that the gel's formation relies on a precise network of hydrogen bonding, π–π stacking, and Van der Waals forces. The resulting morphology demonstrated a highly porous system (pore size: 12–132 nm), formed by an interwoven network of smooth, thin, and flexible nanofibrils with diameters from 25 to 109 nm key structural features that give this material its sponge-like behaviour at the nanoscale.

When we tested this sugar-derived nano sponge for environmental clean-up, the results were impressive: within just one hour, it removed 80% to 90% of toxic disperse dyes from wastewater. This strong performance is driven by favourable hydrogen bonding between the gel and dye molecules.

Our findings show that carefully designed supramolecular systems, built on non-covalent chemistry, can lead to effective, recyclable, and sustainable solutions for environmental remediation.

Diagrammatic representation of self-assembly: a) a molecule, b) aggregation through π–π stacking, c) assemblage formation through Van der Waals interaction, d) formation of cluster through hydrogen bonding.

***Keywords:*** Low molecular weight organogelator, multilamellar nanostructure, non-covalent interactions, environmental remediation, dye absorption.

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PP-53

# Microencapsulation of Bioactive Components Extracted from Deodorizer Distillate of Vegetable Oil by Spray Drying Technology

**Zahid Hussain Laghari[1]*, Sarfaraz Ahmed Mahesar[1] & Abdul Hameed Kori[1]**
*[1]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan*
**Corresponding author Email: zahidhlaghari@gmail.com*

**Abstract:**

Microencapsulation is a process by which small particles of core products are packaged within a wall material to form microcapsules. One common technique to produce encapsulated products is spray-drying which involves the conversion of liquid oils in the form of an emulsion into dry powders. The spray drying method was used for encapsulate to avoid the physical and chemical changes of core and wall material to maintain the biological, functional properties of bioactive components.

The development of stable emulsion is a prerequisite condition for encapsulation. Different concentrations of Maltodextrin (MD) and Gum Arabic (GA) 15, 20, 25 and 30% were prepared. So smaller size droplets were obtained (10 µm) of 30% wall materials of MD/GA combination. Maximum Encapsulation Efficiency (EE) of deodorizer distillate (DD) was found 80.6 % at 180°C. Scanning Electron Microscopy (SEM) was used to check the morphology of encapsulated materials. It was found smaller and spherical, with a smooth surface and some dents on its surface. The storage oxidative stability of encapsulated DD was calculated in terms of peroxide value (PV) at 42°C for thirty days. The lower PV (10.23 meq$O_2$/kg) was observed in the encapsulated DD. The result revealed that the encapsulation of DD was a successful method in improving the oxidative stability of bioactive components.

***Keywords:*** Microencapsulation, Soybean oil Deodorizer Distillate, Oxidative Stability

**PP-54**

# Enhancement in the Antibacterial Activity of Rifaximin by Delivery Through Gelatin Nanoparticles

**Amber Bano[a], Nida Iqbal[a], Imran Saleem[b] & Muhammad Imran Malik[a]**
*[a]H.E.J. research Institute of Chemistry, International Center for Chemical and Biological Sciences, University of Karachi, Karachi, Pakistan*
*[b]School of Pharmacy & Biomolecular Sciences, Liverpool John Moore University, UK*
*Corresponding author E-mail:* mimran.malik@iccs.edu

**Abstract:**

Bacterial infections are a noteworthy global health concern that necessitates the development of new strategies to enhance the potency and efficacy of antibiotics. Rifaximin (RFX), a broad-spectrum antibiotic, exhibits promising antibacterial activity against several bacterial strains. however, its insolubility and impermeability impede the exploitation of its full potential. the objective of the current study is to overcome the inherent caveats of RFX to exploit its maximum potential.

The exploitation of the full potential of antibiotics is necessary for reduction in their dosage and to minimize antibiotic pollution. This is a preliminary study aiming for maximum utilization of RFX at the target site and reduction in its release in unmetabolized form.

Gelatin is a biopolymer that has gained significant attention for biomedical applications owing to its inherent biocompatibility and biodegradability. In this study, bovine gelatin nanoparticles (BGNPs) were fabricated by the self-assembly method for their application as a carrier of RFX to enhance its antibacterial activity. The study employs a comprehensive range of experimental techniques to characterize the fabricated BGNPs such as DLS, Zeta Potential, FT-IR, AFM, SEM-EDX, and UV-VIS spectrophotometry.

The average size of the fabricated BGNPs was 100 nm with a zeta potential value of −15.3 mV. the loading of RFX on BGNPs rendered an increase in its size to 136 nm with a zeta potential value of −16 mV. In-vitro assays and microscopic analyses were conducted to compare the antibacterial efficacy of RFX and RFX@BGNPs. an excellent loading capacity followed by sustained release of RFX from RFX@BGNPs rendered a significant enhancement in its pharmaceutical efficacy. The release of RFX from RFX@BGNPs followed the Higuchi and Korsmeyer-Peppas models. The antibacterial efficacy of RFX against *Staphylococcus aureus* has doubled by delivery through RFX@BGNPs, assessed by inhibitory and biofilm inhibitory assays. The enhancement in the antibacterial efficiency was further endorsed by SEM and microscopic imaging of the control and treated bacterial colonies.

**Conclusion:** The study demonstrates an enhancement in the antimicrobial efficacy of RFX by its delivery in the form of RFX@BGNPs to exploit its full potential for practical applications.

PP-55

# Nature-Derived Oral Care: Extraction and Characterization of Papain From Papaya Leaves For Herbal Tooth Paste Formulation

**Fatima Shahid, Farah Rehman & Ayisha Aman Ullah**
[a]*Department of Biotechnology, Jinnah University for Women, Karachi.*
**Corresponding author E-mail: ayisha.aman@juw.edu.pk*

## Abstract:

Enzymes extracted from plant sources have become progressively crucial in biotechnology, and pharmaceuticals owing to their biocompatibility. Amid them, papain is extensively used in industries. Conventionally, papain enzyme is extracted from unripe papaya fruits, now it can also be obtained from leaves and stems. Comparative studies have revealed that leaves give higher enzyme yield and activity. Nowadays, papain has gained ground for its application in oral hygiene products. Blend papain into toothpaste not only boosts cleaning efficiency but also gives a safe and natural solution to chemicals. This study aimed to extract, partially purify, and characterize papain from papaya leaves (*Carica papaya*), followed by its utilization in herbal toothpaste formulation.

The goals of this study are included (i) extraction and partial purification of papain enzyme from papaya peels, (ii) characterization of papain & (iii) formulation of enzyme-based toothpaste for better oral hygiene.

Papaya leaves were collected and subjected to extraction and partial purification, followed by characterization in order to exploit enzymatic properties. Partially purified enzyme was then incorporated in toothpaste formulation.

The partially purified papain showed optimum activity at 60°C, pH 6.0 after 10 minutes of reaction time with 30 mM substrate concentration. The purified papain is assembled to an herbal toothpaste base. The formulation was mixed uniformly and evaluated for color, texture, and foaming ability. The papain-based herbal toothpaste displayed stable consistency.

The study reveals the successful extraction and partial purification of papain enzyme from papaya leaves. Formulation of an herbal toothpaste incorporating papain showed its applicability as a natural, biodegradable, and effective oral care product. The results support further research into enzyme-based formulations as natural alternatives to synthetic dental products.

***Keywords:*** Enzyme, papain, papaya, toothpaste

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**PP-56**

# Biomediated Synthesis of Ag-Cu-Co Trimetallic Nanoparticles & Their Applications

**Ume Hanee Khanzada**[a], **Muhammad Younis Talpur**a
[a]Dr. M. A. Kazi Institute of Chemistry, University Of Sindh Jamshoro-76080, Sindh, Pakistan.
*Corresponding author E-mail:* haniiikhanzada@gmail.com.

## Abstract:

The present study reports the eco-friendly and biomediated synthesis of Ag–Cu–Co trimetallic nanoparticles (TMNPs) using the aqueous extract of Citrus hystrix (kaffir lime) leaves rich in polyphenols and flavonoids. These phytochemicals act as both reducing and stabilizing agents, facilitating the one-pot formation of biologically active trimetallic nanoparticles under ambient conditions. The biosynthesized nanoparticles were characterized using UV–Visible spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Dynamic Light Scattering (DLS), Scanning Electron Microscopy (SEM), and Energy Dispersive X-ray (EDX) analyses. The UV–Vis spectrum exhibited a characteristic surface plasmon resonance (SPR) band at approximately 450 nm, confirming nanoparticle formation. FTIR analysisrevealed distinct peaks around 3419 $cm^{-1}$ (O–H stretching), 1606 $cm^{-1}$ (C=O stretching), and 1381 $cm^{-1}$ (C–N stretching), indicating the role of phenolic and flavonoid compounds in reduction and capping. DLS measurements showed an average particle size with a low polydispersity index, confirming good stability and uniform size distribution.

SEM micrographs demonstrated spherical morphology with slight agglomeration, while EDX spectra confirmed the elemental composition of Ag, Cu, and Co, validating the formation of trimetallic nanoparticles.The synergistic interaction among silver, copper, and cobalt significantly enhanced the physicochemical properties of the synthesized nanoparticles. These trimetallic nanoparticles are anticipated to exhibit potent antibacterial, catalytic, and environmental remediation capabilities, outperforming their monometallic counterparts due to synergistic effects. Therefore, this green synthesis strategy offers a sustainable, cost-effective, and efficient route for fabricating Ag–Cu–Co trimetallic nanoparticles with potential applications in biomedical, environmental, and industrial nanotechnology fields.

***Keywords:*** Green synthesis, Trimetallic nanoparticles, Ag–Cu–Co, Kaffir lime extract, Biomedical applications

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**PP-57**

# Advanced Hybrid Membranes Integrated with Functionalized Carbon-Based Nanomaterials for Safe PFAS Filtration

**Hajira Akbar[a], Muhammad Imaran Malik[a], Dilshid Hussan[a], Syed Sibt-e-Hassan[a] & Syed Ghulam Musharraf[a]***
*[1]H.E.J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences, University of Karachi, Karachi-75270, Pakistan*
**Corresponding author E-mail: musharraf1977@yahoo.com,*

## Abstract:

The persistent contamination of water bodies by emerging micropollutants, especially polyfluoroalkyl substances (PFAS) or "forever chemicals," particularly pentadecafluorooctanoic acid, poses a severe threat to environmental and public health due to their chemical stability and resistance to conventional treatment methods. This study explores a nanotechnology-based approach for the enhanced removal of PFAS using functionalized carbon-based nanomaterials integrated into a vacuum filtration setup with 0.22 µm nylon membranes. Three nanomaterials were synthesized and evaluated: (1) chitosan nanoparticles suspended with graphene oxide (GO), (2) carbon nanodots, and (3) graphene nanosheets. These materials were selected for their high surface area, strong adsorption affinity, and capacity for surface functionalization. The chitosan–GO composite was prepared via ionic gelation and crosslinking, while carbon nanodots and graphene nanosheets were synthesized through hydrothermal and exfoliation techniques, respectively. Characterization confirmed the successful synthesis and functionalization of all nanomaterials. FTIR spectra revealed key peaks such as O–H/N–H (3340 $cm^{-1}$), C=O (1725 $cm^{-1}$), and C=C (1440 $cm^{-1}$), indicating relevant functional groups. AFM measured a GO sheet thickness of 1.4 nm, while DLS showed hydrodynamic diameters of 130 nm (GO), 100 nm (chitosan NPs), and 8nm (carbon dots). SEM images displayed the characteristic wrinkled morphology of GO and spherical chitosan nanoparticles (100–150 nm). Each nanomaterial or composite was applied as a coating on nylon, CA, PVDF, CE, and Millipore membranes. Vacuum filtration of synthetic wastewater containing 100 µg/L pentadecafluorooctanoic acid was conducted to evaluate removal efficiency. The GO–GO-chitosan-modified membrane exhibited the highest PFAS rejection (94.1%), while graphene nanosheets and carbon dots showed slightly lower removal (81.2–89.4%). These results demonstrate that integrating functionalized carbon-based nanomaterials with PVDF membranes significantly enhances PFAS removal through adsorption and electrostatic interactions, offering a low-cost, scalable wastewater treatment strategy.

***Keywords:*** Chitosan-GO Nanocomposite, PFAS Removal, Membrane Technology

## References:

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PP-58

# Isoxazole- and Triazole-Tethered Tricyclic Analogues: Synthesis and Biological Activities

**Umm-E-Farwa[a], Fatima Z. Basha[a], Keykavous Parang[b] & Maria Aqeel Khan[a,c*]**
*[a]H.E.J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi-75270, Pakistan*
*[b]School of Pharmacy, Chapman University, Irvine, California, USA.*
*[c]Third World Center for Science and Technology, International Center for Chemical and Biological Sciences (ICCBS), University of Karachi, Karachi-75270, Pakistan*
**Corresponding author E-mail: drmaria.aqeel@iccs.edu*

## Abstract:

Isoxazole is characterized by a heterocyclic ring with consecutive oxygen and nitrogen atoms. It displayed a wide variety of applications in the pharmaceutical industry, including antiepileptics, anticonvulsants, as well as in anti-inflammatory medications. Valdecoxib (COX-2 inhibitor), leflunomide (anti-rheumatic), dicloxacillin (antibiotic), and flucloacillin (antibiotic) are some examples of isoxazole-containing drugs. On the other hand, triazole is characterized as a 5-membered heterocycle with three nitrogen atoms. It showed numerous pharmacological properties, such as anti-hypertensive, anti-oxidant analgesic, anti-cancer, anti-depressant, anti-diabetic, anti-fungal, anti-bacterial activities. Traditional synthesis of isoxazole and triazole analogues generate large amounts of hazardous materials. Herein, we have reported the synthesis of new isoxazole and triazole analogues using click chemistry as a key step, which is copper-catalyzed 1,3-dipolar cycloaddition reaction between dipolar molecule and dipolarophile. For this, tricyclic compounds i.e., carbazole and dibenzazepine were selected as starting materials; and functionalized to corresponding propargyl analogues as precursor dipolarophile molecules. They were then treated with dipolar molecule i.e., nitrile oxide and azide, respectively, under copper-catalysis to afford subsequent isoxazole and triazole analogues of carbazole and dibenzazepine regioselectively. The method is widely applicable, and can efficiently prepare a large variety of substituted isoxazole and triazole-tethered tricyclic analogues. All the synthesized compounds were analyzed by different spectroscopic techniques including MS, NMR, and IR spectroscopy. Synthesized compounds were further evaluated for different biological activities and cytotoxicity studies.

***Keywords:*** Isoxazoles, Triazoles, Carbazole, Dibenzazepine

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**PP-59**

# Synthesis of Thiourea Based Organogelators Derived from DAA and Their Applications

**Afsheen Afsar*[a], Kashif Riaz[a,b], Shoaib Muhammad[1], Imran Ali Hashmi[a], Muhammad Naveed Javed[a], Ahmad Bari[c], & Firdous Imran Ali[a]**
[1]*Department of Chemistry, University of Karachi*
[2]*Department of Applied Chemistry, University of Karachi*
[3]*Department of Pharmaceutical Chemistry, College of Pharmacy, King Saud University*
*Corresponding author E-mail: afsheen822001@gmail.com*

## Abstract:

The synthesis of Gelators involves a sequential synthetic route initiated from (+)-DAA.The primary amine of DAA is first converted into the highly reactive isothiocyanate intermediate through a series of chemical reactions. This isothiocyanate is then cross-coupled directly with various aliphatic amines to yield the final thiourea-linked products. This two-step process provides an efficient means of forming the thiourea linkage at room temperature when primary amines are used, minimizing energy consumption during synthesis.Structural confirmation of the final gelators was achieved through a suite of high-resolution analytical techniques. The molecular weight and purity were definitively established using (HRESI–MS) in positive mode. Complementary data was provided by 1H-NMR and 13C-NMR spectroscopy to verify the bonding environment and proton/carbon connectivity within the complex diterpene structure and the alkyl spacers. Crucially, the successful identification of characteristic absorption bands in the FTIR spectra verified the conversion of the isothiocyanate intermediate to the target thiourea functional group, validating the structural foundation required for the robust H-bonding network that drives self-assembly. The thiourea-based LMOGs, have been demonstrated as an environmentally sound material for purifying aqueous media. This application leverages the high surface area and porous structure of the gelator's xerogel state to act as an effective adsorbent. The kinetics of the process are particularly favorable for industrial implementation. The dye removal efficiency was consistently measured in the range of 80% to 90% within just one hour, notably without the need for external mechanical agitation. Achieving such high removal rates rapidly and passively implies an exceptionally high binding affinity and rapid mass transfer between the aqueous dye solution and the gelator molecules. The synthesized thiourea-based LMOGs have demonstrated substantial potential as effective, sustainable tools for managing oil spills and separating petrochemicals from water. This application relies on the unique phase-selective gelation behavior exhibited by these supramolecular materials.

***Keywords:*** Thiourea (+) dehydroabietyl amine, Low molecular weight organogelators (LMWOGs), Organogels

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**PP-60**

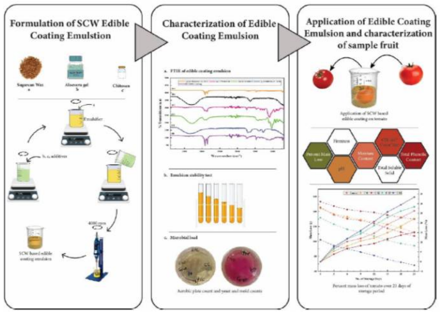
# Synthesis and Characterization of Sugarcane wax Based Edible Coatings to Enhance the Post-harvest Quality of Tomatoes

**Muhammad Fahad Kashif[1]*, Sameera Zaki[1], Saeeda Nadir Ali[1]*, Mahwish Touheed[1], Philippe Daniel[3], Aneela Siddiqui[4], Ali Dad Chandio[2] & Iftikhar Ahmed Channa[2]**
*[1]Department of Chemistry, NED University of Engineering and Technology, Karachi, Pakistan.*
*[2]Thin Film Lab, Department of Metallurgical Engineering, NED University of Engineering and Technology, Karachi-75270, Pakistan.*
*[3]Institut des Molécules et des Matériaux du Mans, UMR CNRS 6283, Université du Maine, Le Mans, France.*
*[4]PCSIR Laboratories Karachi*
*Corresponding author E-mail: fahadkashif033@gmail.com*

## Abstract:

Tomatoes are nutritionally rich and widely consumed due to their taste, color, and health-promoting compounds. However, their short shelf life caused by rapid weight loss, softening, and microbial spoilage limits marketability. In this study, sugarcane wax–based edible coatings were developed in four concentrations (0.5, 1.0, 1.5, and 2.0%) and applied to fresh tomatoes to evaluate their effectiveness in maintaining physicochemical and microbial quality during ambient storage. The coated samples were assessed for mass loss, moisture content, pH, firmness, total soluble solids, total phenolic content, aerobic plate count, and yeast and mold count. The 1.0% sugarcane wax coating (C-02) proved most effective, showing the lowest weight loss (15.2 ± 0.7%) compared with the highest loss in the control (33.41 ± SD%). It also maintained greater firmness (19.0 ± 0.5 N) than the control, which deteriorated rapidly (4.25 ± 0.25 N), and showed good color attributes. Furthermore, C-02 effectively suppressed microbial growth and retained higher total soluble solids (5.03 ± 0.12 °Brix) compared with the control (6.27 ± 0.12 °Brix) after 21 days of storage. Overall, sugarcane wax– based coatings significantly improved tomato quality, extended shelf life under ambient conditions, and demonstrated strong potential as an eco-friendly approach to reducing postharvest losses.

***Keywords:*** Sugarcane wax, edible coating, post-harvest losses, shelf life, tomato



PP-61

# Rapid sono-adsorptive removal of Congo Red Dye by CuO-$TiO_2$ nanoparticles

**Muhammad Asif**[a], **Muhammad Saad**[a]* & **Muhammad Tauqeer Ahmed**[a]
[a]*University of Karachi.*
* *Corresponding author E-mail: saad@uok.edu.pk*

## Abstract:

Water pollution is one of the most critical problems currently. Waste from various industries such as textile and leather is hazardous because it not only poses chemical toxicity but also it abates natural photosynthesis thereby disturbing underwater ecosystem. In this research, CuO-$TiO_2$ nanocomposites were prepared by bottom-up approach, and they were characterized by various techniques including Scanning Electron Microscopy (SEM), Fourier Transform Infrared (FT-IR) Spectroscopy, X-ray diffraction (XRD), Energy dispersive X-Ray spectroscopy (EDS), Ultraviolet-Visible (UV-Vis) spectroscopy and pH at point of zero charge (pHpzc). The synthesized nanocomposites were applied for the removal of Congo Red (CR) dye through adsorption. The experiments were optimized using Response Surface Methodology (RSM) by constructing a Central Composite Design (CCD) of 4 variables. The optimum conditions for CR dye removal were time (8.0 min), pH (4.50), amount of NPs (0.4g/L), concentration of pollutant (18.87 mg/L) and the % removal was obtained as 94.86%. The optimized parameters were validated 5 times for validating the model's prediction. The kinetic studies were carried out to assess the adsorption kinetics. The surface neutrality was studied by drift by pH method and found to be 7.2. The presence of various ions did not significantly alter the % removal and the synthesized nanocomposites were effective even after five cycles of their usage. Hence, the proposed method is an economical and reliable method to remove unwanted substances from the wastewater.

***Keywords:*** Adsorption; Isotherm; Kinetics; Nanotechnology; Wastewater treatment.

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PP-62

# Synthesis and Characterization of Cellulose Iron Oxide Nanocomposite for Removal of Metronidazole Antibiotic Drug from Waster Water

**Noor zaman & Farah Naz Talpur**
*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshor, Pakistan*
*Corresponding author E-mail: noorzamanbaloch767@gmail.com*

## Abstract:

Antibiotics are recognized as emerging environmental contaminants due to their persistence and adverse ecological impacts. Metronidazole (MMZ), a widely used nitroimidazole antibiotic, is of particular concern because of its extensive use and resistance to biodegradation. Its accumulation in the environment highlights the urgent need for effective removal strategies. The aim of current study was to synthesize economical cellulose-iron oxide nanocomposite (CI-NC) catalyst from an indigenous sugar mill waste bagasse as source for cellulose via coprecipitation process for the sequestration of MMZ antibiotics from hospital waste water. CI-NC was characterized by energy-dispersive X-ray EDX, scanning electron microscopy (SEM), UV-visible spectroscopy and Fourier transform spectroscopy (FTIR). The hospitals wastewater was analyzed using HPLC for presence of MMZ. Experiments were designed by faced centered central composite design (FCCCD) in deign expert 13 and response surface modeling (RSM) was employed for optimization of experimental variables used to analyze the main andinteraction effects. The design variables were nanocomposite dose, pH, MNZ, temperature, hydrogen peroxide, and contact time. It was raveled that 98.00% degradation achieved at composite dose of 10 mg and MMZ 30 ppm, pH of 6, time of 30 min, temperature of 313 K, H2 O2 and 0.6 mmol/L. A high degree of fit was achieved with the cubic model.

The kinetic study revealed that the experimental data were best described by the pseudo-second-order kinetic model, with $R^2$ of 0.99. The present findings demonstrate the potential of CI-NC as sustainable and efficient material for the sequestration of MMZ antibiotics form hospital waste and pharmaceutical industries.

***Keywords***: metronidazole, response surface methodology, nanocomposite, water and water treatment, antibiotics.

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PP-63

# Sugarcane Wax-based Solid Lipid Nanoparticles as an Atorvastatin Carrier: Characterization and In-Vivo Evaluation of Antihyperlipidemic Activity in Rats

**Ramsha Shamshad[1], Saeeda Nadir Ali[1]*, Somia Gul[2], Syed Sarim Ahmed[1], Ali Dad Chandio[3], Ayesha Aziz[2,5], Philippe Daniel[4] & Iftikhar Ahmed Channa[3]**

*[1]Department of Chemistry, NED University of Engineering and Technology, Karachi-75270, Pakistan.*

*[2]Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Jinnah University for Women, Karachi 74600, Pakistan*

*[3]Thin Film Lab, Department of Metallurgical Engineering, NED University of Engineering and Technology, Karachi-75270, Pakistan.*

*[4]Institut des Molécules et des Matériaux du Mans, UMR CNRS 6283, Université du Maine, Le Mans, France.*

*[5]Department of Pharmacology, Faculty of Pharmacy, Jinnah University for Women, Karachi 74600, Pakistan*

**Corresponding author E-mail: fahadkashif033@gmail.com*

**Abstract:**

Due to the significant advantages of nanoparticles over conventional systems, there is growing interest in using them for drug delivery and pharmaceutical research. This is especially relevant for statins, which are primarily used to lower cholesterol but generally have low bioavailability. This paper investigates the use of a single emulsion solvent evaporation method to create the necessary solid lipid nanoparticles of sugarcane wax dispersed with atorvastatin. Atorvastatin is a well-known drug for having a low oral bioavailability, particularly because of first-pass metabolism. Sugarcane wax is a biocompatible, economical as well as resourceful raw material and is utilized in this work to synthesis nanoparticles. X-ray diffraction analysis (XRD) revealed that the synthesized nanoparticles had a mean particle size of around 258 nm and a crystallinity of around 60%. In addition to that Fourier transform infrared (FTIR) method of spectroscopy was also carried out to further investigate and characterize the nanoparticles. In order to understand the effects of atorvastatin together with sugarcane wax lipid nanoparticles, *in-vivo* studies in rats were carried out to investigate and find total cholesterol (TC), low-density lipoprotein (LDL), triglycerides (TG), and very low-density lipoprotein (VLDL). The atorvastatin loaded sugarcane wax nanoparticles treatment significantly reduced TC, VLDL, TG, and LDL levels compared to blank nanoparticles and free atorvastatin, demonstrating enhanced anti-hyperlipidemic activity. Overall, atorvastatin loaded sugarcane wax lipid nanoparticles showed improved therapeutic efficiency with a reduced dose. Greenness assessment was performed using AGREE tool revealing excellent greenness of the proposed technique.

***Keywords:*** Sugarcane wax, Solid lipid nanoparticles, Atorvastatin, In vivo studies, Anti-hyperlipidemic

PP-64

# Biosynthesis of Transition Metal Doped Oxide Nanoparticles and Their Multifaceted Applications

**Ruqia Ghayoor**[a], **Qadeer Khan Panhwar**[a] **& Muhammad Younis Talpur**[a]
[a]*Dr. M. A. Kazi Institute of Chemistry, University Of Sindh Jamshoro-76080, Sindh, Pakistan.*
*Corresponding author E-mail: ruqayyakhan098@gmail.com.*

**Abstract:**

Tis study introduces a sustainable green chemistry route for the high-yield synthesis of transition metal (TM) doped metal oxide nanoparticles (NPs). To justify our approach, we first performed a detailed phytochemical screening of the *Citrus paradisi* (grapefruit) fruit extract, which confirmed the abundant presence of key reducing and stabilizing agents, including flavonoids, alkaloids, saponins, tannins, and phenolics. These natural compounds serve as the core of our method, enabling the extract to completely replace harsh synthetic chemicals and thus significantly reduce the environmental impact of conventional synthesis. In this work, zinc oxide nanoparticles (ZnO NPs) were synthesized using this extract and further doped with copper sulfate ($CuSO_4$) to obtain Cu-doped ZnO NPs. Both undoped and doped samples were thoroughly characterized using UV-VIS, FTIR, SEM, and EDX to confirm their spectral, structural, and morphological features. The study's main focus is a dual performance evaluation: first, assessing the nanoparticles' catalytic efficiency for the rapid degradation of organic pollutants in wastewater, and second, evaluating their antimicrobial activity against selected bacterial strains. Ultimately, this work establishes a technically feasible and ecofriendly foundation for developing high-performance, biocompatible Cu-doped ZnO nanoparticles suitable for practical environmental remediation and biological applications.

***Keywords:*** Green Synthesis, Zinc Oxide Nanoparticles, Copper Doping, *Citrus paradisi*, Metal Oxide Nanoparticles,

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PP-65

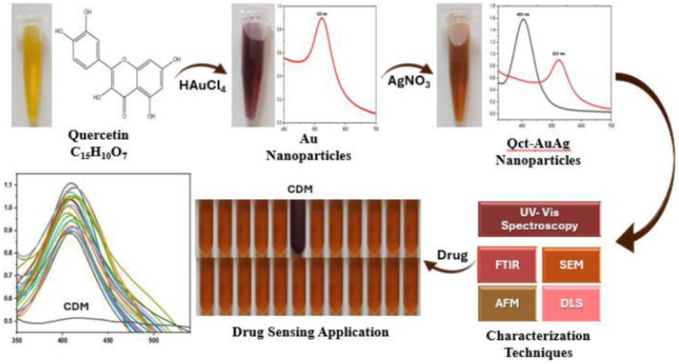
# Quercetin Capped Au-Ag Bimetallic Nanoparticles for the Detection of Calcium Dobesilate Monohydrate in Biological and Environmental Samples

**Shaz Asrar[a]*, Amtul Qayoom[a]*, Saeeda Nadir Ali[a] & Dilshad Hussain[b]**
[a]*Department of Chemistry, NED University of Engineering and Technology, Karachi-75270, Pakistan.*
[b]*HEJ Research Institute of Chemistry, International Centre for Chemical and Biological Sciences, University of Karachi, Karachi 75270, Pakistan*
* *Corresponding author E-mail: shazasrar74@gmail.com*

## Abstract:

The study details the synthesis of quercetin-capped Au-Ag bimetallic nanoparticles (Qct-AuAg BMNps) in an aqueous environment. UV visible spectra showed absorbance peak of gold and bimetallic nanoparticles at 524 nm and 403 nm, respectively. The SEM analysis of Qct-AuAg BMNps showed an average particle size of 67.5 nm with good uniformity (PdI: 0.386). FTIR confirmed the presence of respective functional groups in Qct-AuAg BMNps. The Qct-AuAg BMNps were used as a colorimetric sensor for detecting calcium dobesilate monohydrate (CDM) in aqueous solutions, showing a linear spectrophotometric relationship with CDM concentration ranging from 0.000001 mM to 10 mM ($R^2 = 0.9984$). The detection and quantification limits were $1.66 \times 10^{-6}$ and $2.71 \times 10^{-5}$ mM, respectively. The binding constant (Ka) was $9.8 \times 10^{4}$ $M^{-1}$, with a 1:1 stoichiometry confirmed by Job's plot. The Qct-AuAg BMNps were successfully used to detect CDM in tap water and serum samples. The synthesis process was optimized using Box Behnken Design, with the optimal conditions found at 50 ◦C, 2 mM quercetin, and a 5:1 silver-to-gold ratio. Therefore, the synthesized quercetin capped gold silver bimetallic nanoparticles were proved effective for the detection of CDM in liquid samples.

***Keywords:*** Calcium dobesilate monohydrate, Quercetin, Bimetallic nanoparticles, Colorimetric nanosensor



**PP-66**

# Binary Nickel–Cobalt Ferrite Nanocomposite-Based Electrochemical Sensor for the Simultaneous Detection of Trace Elements in Environmental Samples

**Zahid Ali[a], Hassan Imran Afridi[a] & Jameel Ahmed Baig[a,b]**
*[a]Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro 76080, Pakistan*
*[b]Department of Chemistry, College of Science, Imam Mohammad Ibn Saud Islamic University (IMSIU), P.O.Box 90950, Riyadh 11623, Saudi Arabia*
*Corresponding author E-mail: zahiddahri1201@gmail.com*

## Abstract:

Environmental pollution has intensified due to the continuous discharge of toxic substances such as heavy metals, industrial dyes, and pharmaceutical residues. Among these, metals like cadmium (Cd), copper (Cu), and manganese (Mn) are particularly concerning because of their persistence, bioaccumulation, and harmful effects on both human health and ecosystems. In this study, a binary nickel–cobalt ferrite nanocomposite ($NiFe_2O_4/CoFe_2O_4$-NC) was synthesized via a sol–gel route followed by a green synthesis process for the electrochemical detection of Cd, Cu, and Mn. Characterization confirmed a coral-like, porous morphology with a cubic spinel structure, high crystallinity (<53.7 nm), and excellent electronic properties. The $NiFe_2O_4/CoFe_2O_4$-NC modified glassy carbon electrode (GCE) exhibited enhanced electrochemical performance with high sensitivity and rapid electron transfer, enabling accurate quantification of Cd, Cu, and Mn. The developed sensor achieved detection limits of 0.25, 0.57, and 0.08 nM and linear ranges of 0.05–500, 0.2–400, and 0.5–400 µM for Cd, Cu, and Mn, respectively.

PP-67

# Potassium Bromate–Mediated Decolorization of Reactive Black B

**Noshab Qamar[a,]* & Maria Ashfaq[a]**
[a]*Department of Chemistry, University of Karachi, Karachi, Pakistan*
**Corresponding author E-mail: noshab.qamar@uok.edu.pk*

## Abstract:

Reactive Black B (RB–B), a widely used dye in the textile industry, is a significant environmental pollutant due to its persistence in aqueous systems. These dyes pose significant economic, environmental, and health hazards. Therefore, it is essential to develop effective methods for reducing or removing dyes and colored compounds from industrial effluents. This study examined the decolorization of Reactive Black B (RB–B), a common textile dye, using potassium bromate in an aqueous acidic medium. Potassium bromate proved to be an effective oxidizing agent, achieving up to 99% color removal. The reaction, monitored spectrophotometrically at 591 nm, followed first-order kinetics with respect to both dye and oxidant under pseudo-first-order conditions. The observed salt effect indicated that similarly charged species participate in the rate-determining step. Activation parameters supported the proposed mechanism, and degradation was confirmed through TDS, EC, UV–Visible, and FTIR analyses, demonstrating the potential of potassium bromate for efficient dye removal from wastewater.

***Keywords:*** Bromate, Decolorization, Oxidation, Reactive Black B, Spectrophotometrically.

PP-68

# Mechanistic Insights into the Adsorption Kinetics and Isotherm Studies of Organic Pollutant

**Maria Ashfaq**[a,*] **& Noshab Qamar**[a]
*Department of Chemistry, University of Karachi, Karachi, Pakistan.*
**Corresponding author E-mail:* maria.ashfaq@uok.edu.pk

## Abstract:

Industrial effluents from sectors such as textiles, leather, paper, pulp, plastics, and food processing often contain large quantities of dyes and pigments used in product coloration. The discharge of these colored pollutants into water bodies can cause serious environmental problems, including reduced light penetration and inhibition of photosynthesis. Developing an economical and efficient method for the complete removal of these toxic dyes remains a major challenge. Among the various treatment approaches, adsorption is considered one of the most effective and promising techniques for the decolorization of dye-laden wastewater. This study evaluated activated charcoal as a low-cost adsorbent for removing acridine orange dye from aqueous solutions. The effects of pH, contact time, adsorbent dosage, and dye concentration were examined. Optimal conditions (pH 8, 0.9 g adsorbent, 185 mg dye) achieved nearly complete dye removal (99.24%) within 30 minutes. The adsorption process followed the Langmuir isotherm and pseudo-second-order kinetic model, indicating monolayer adsorption and strong interaction between dye molecules and charcoal. Overall, activated charcoal proved to be an efficient and economical adsorbent for dye removal from contaminated water.

***Keywords:*** Acridine Orange, Charcoal, Isotherms, Langmuir, Freundlich, Kinetics

**PP-69**

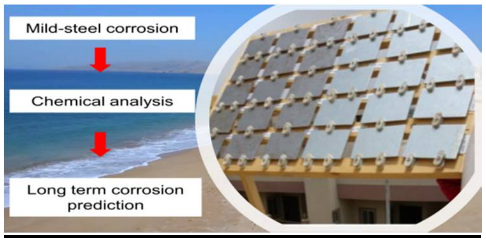
# An Examination of Long-Term Corrosion Behavior of Mild Steel in Ten Different Sites of a Coastal Megacity Located on China's One Belt One Road Initiative

**Faiza Zafar[a], Humaira Bano[a*], M. Farooq Wahab[b], Maryam Obaid[a] & Francisco Corvo[c]**
[a]*Department of Chemistry, University of Karachi, Karachi-75270, Pakistan*
[b]*Department of Chemistry and Biochemistry, The University of Texas at Arlington, 76019 USA*
[c]*Corrosion Research Center, Autonomous University of Campeche, Campeche, PO Box. 24030, Mexico*
**Corresponding author E-mail: humairab@uok.edu.pk*

## Abstract:

This study conducted a two-year investigation into mild steel corrosion in the coastal megacity of Karachi, Pakistan, to compare its findings with other global coastal cities. Karachi plays a significant strategic role in China's One Belt, One Road initiative through the China-Pakistan Economic Corridor (CPEC) project. As per the ISO and ASTM standards, atmospheric corrosivity, time of wetness, corrosion products, and pollutants (chloride and sulfur dioxide) were evaluated. Scanning electron microscopy combined with energy-dispersive X-ray spectroscopy, Fourier transform infrared spectroscopy, and X-ray diffraction were used to characterize corrosion products. Corrosion rates classified three urban test sites as C3, three marine test sites as C5, and two urban and two industrial test sites as C4. The power-linear function was also employed to predict long-term (20-years) corrosion rates and corrosivity categories. Long-term predictions turned out to be medium C3 for urban and industrial test sites and high C4 for marine test sites. Mild steel might be the most effective material at marine test sites (average corrosion rates of 383-416 µm/y). Different quantities and morphologies of lepidocrocite, goethite, and magnetite corrosion products were found at most sites, while akaganeite was occasionally detected.

**Keywords:** mild steel, corrosion, atmospheric corrosivity, corrosion rates, power-linear function



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**PP-70**

# $SrO/La_2O_3$-Decorated Rgo Nanoclusters for Efficient Degradation of Dyes

**Ramsha Shahid**[a*], **Huma Muddasar**[a]
[a] *National Center of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Sindh, Pakistan*
**Corresponding author E-mail: lodhi.ramsha@hotmail.com*

## Abstract:

Industrial dyes have become one of the major sources of water pollution. Because of their stable aromatic structures, many dyes are toxic, carcinogenic, and difficult to biodegrade. Heterogeneous photocatalysis, an advanced oxidation process (AOP), offers an effective and environmentally friendly way to degrade these dyes [1]. It works by generating reactive species that can break complex dye molecules into safer, simpler products. Metal nanoclusters are emerging as powerful catalysts due to their high surface area and unique chemical properties. In particular, bimetallic nanocluster often show stronger catalytic activity than single-metal systems because of their synergistic effects [2]. Supporting these nanoclusters on reduced graphene oxide (rGO) further enhances their performance. rGO provides a large surface area, excellent conductivity, and strong metal–support interaction, making it an ideal platform for improved catalytic degradation of dyes [3].

In this study, we synthesized a facile and environmentally friendly $SrO/La_2O_3$@rGO nanoclusters using a combined sonochemical and microwave-assisted method. The synthesized nanocomposite was thoroughly characterized for its composition and morphology using Fourier transform infrared spectroscopy (FTIR), Energy dispersive X-ray spectroscopy (EDS), Scanning electron microscopy (SEM), and X-ray diffraction spectroscopy (XRD), Charge distribution data through Zeta Potential. The results show $SrO/La_2O_3$@rGO nanoclusters were successfully synthesized and applied for the catalytic degradation of Methylene Blue and Congo Red dyes in the aqueous media. Different parameters such as pH, degradation time, catalyst dosage and initial concentration of each dye were optimized to accomplish maximum degradation accompanied by band-gap characterization and kinetic studies. Each dye showed degradation at different parameters, as Methylene Blue showed 99% degradation at pH 9, while Congo Red showed 98% degradation at pH 4 within 35 and 45 minutes of UV light irradiation, respectively, with the catalyst dosage of 0.005 g/L. Synthesized $SrO/La_2O_3$@rGO nanoclusters showed marvelous efficiency towards the degradation of both dyes in real aqueous waste water samples.

***Keywords:*** Nanoclusters, Heterogenous Catalysis, Advanced oxidation process, Methylene Blue Dye, Congo Red Dye.

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PP-71

# Synthesis of Smart Nanofibers and Their Application for Sustained Release of Fertilizer

**Irsa Munwara*, Huma Muddasara**
*National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan.*
**Corresponding author E-mail:* irsamunawararain@gmail.com

## Abstract:

The excessive use of conventional fertilizers poses a major environmental threat due to nutrient runoff and leaching, severely degrading water quality. This research introduces a sustainable solution: smart, biocompatible, and biodegradable Cellulose Acetate (CA) nanofibers (NFs) designed for sustained nutrient delivery. This approach aims to maximize nutrient use efficiency and minimize pollution. The core innovation is the synthesis of CA nanofibers utilizing Graphene Oxide (GO) intercalated with Monosodium Glutamate (Na Glu Int. GO). This composite significantly enhances the nanofibers' capacity for efficient nutrient loading and meticulously controls the release of essential macro- and micronutrients (NPKS and NPK). Nano-fertilizers were prepared by incorporating varying concentrations of Nitrogen, Phosphorus, Potassium, and Sulfur (NPKS) into a 17% CA solution containing the Na Glu Int. GO component. Comprehensive characterization employed techniques like SEM, XRD, FTIR, BET, and EDX, alongside the assessment of crucial physical properties like water retention and swelling ratio. Rigorous evaluation involved controlled cultivation experiments on sorghum and pearl millet, comparing NPKS and NPK-loaded NFs against control. Field trials were conclusive: the Na Glu-intercalated GO/CA NFs significantly enhanced crop growth. The NPKS-treated plants showed maximum improvement, achieving an average stem length of 214 cm for Sorghum and 129 cm for Pearl Millet. Crucially, the NPKS-loaded NFs boosted chlorophyll content by 22.3% in Sorghum and 23.7% in Pearl Millet compared to the control. This study successfully validates the development of novel, multifunctional nanofibers that effectively optimize nutrient delivery kinetics for enhanced crop yield and environmental protection.

***Keywords:*** Nanofibers, Cellulose Acetate, Sustained Release, Graphene Oxide, Nano-fertilizer.

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**PP-72**

# Remediation of Malachite Green Dye using SnO2 as a Photocatalyst

**Kamila**
*Department of Human & Rehabilitation Sciences*
*The Begum Nusrat Bhutto Woman University, Sukkur*
*Corresponding Author email:* kamila3.22bschm007@bnbwu.edu.pk

## Abstract:

Malachite green (MG) is a synthetic cationic dye extensively utilized in the textile industry for colouring purposes. It is a mutagenic agent and potentially carcinogenic for living organisms in nature. Therefore, it is necessary to treat and discharge the industrial effluents covering MG to avoid irreversible and serious effects on both living organisms and the environment. The photocatalyst $SnO_2$ was synthesized by a new method by complexation of sodium diethyldithiocarbamate with tin dichloride pentahydrate, followed by calcination at 450, 600 and 750 $_0$C and utilized for photocatalytic degradation of MG dye. The better remediation was obtained at calcination temperature 600 $_0$C. The fluorescent light exposure resulted better remediation of MG dye within 20 min, and the absorbance measurements were noted after every 5 min. The remediation of MG dye improved with an increase in the dose of $SnO_2$ photocatalyst up to 20 mg. The highest decomposition of MG dye was found at 10 pH which may be due to deprotonation. The effects of $Na_+$, $HCO_{3-}$, $Ca_{2+}$, $Cl_-$, $K_+$, $SO_{42-}$ and $Mg_{2+}$ on dye remediation were examined and results showed that the salts had no effect on degradation. The kinetics and isothermic studies were carried out where the kinetic model pseudo second-order and Langmuir isotherm were highly fitted. The factorial design was also drawn to checked the combined effects of variables, such as pH, dose, concentration and irradiation time on degradation of MG dye.

***Keywords:*** Remediation, $SnO_2$; malachite green; kinetic and isotherm models; fluorescent lamp

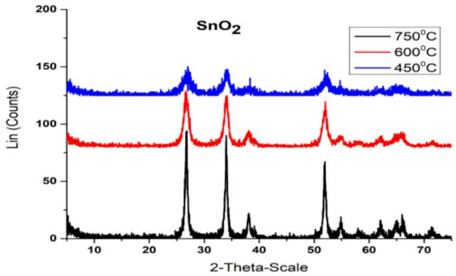

Figure 1a. X-ray differaction analysis of SnO2 at different calcination temperatures

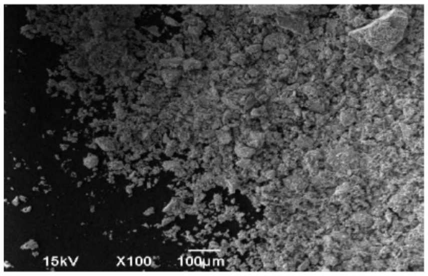

Figure 1b. SEM image of tin dioxide

**PP-73**

# Synthesis, Characterization, and Applications of Nano Fibrous Polystyrene Derivatives

**Aisha Siddiquaa & Waqas Jamilb**
*Dr. M.A. Kazi Institute of Chemistry, University of Sindh, Jamshoro.*
**Corresponding author E-mail: aisha.siddiqua@scholars.usindh.edu.pk*

## Abstract:

Nanotechnology has emerged as a transformative field that enables the manipulation of matter at the molecular and atomic scale, resulting in materials with unique and enhanced physicochemical properties. Polymeric nanofibers, owing to their large surface area, high porosity, and mechanical flexibility, have found diverse applications in biomedical, environmental, and industrial fields. In this study, modified polystyrene derivatives were synthesized and converted into ultrafine nanofibers using the electrospinning technique. Polystyrene was structurally modified by incorporating functional spacer groups such as nitro, amino, and thiourea to improve its hydrophilicity, reactivity, and bioactivity. The synthesized derivatives and their nanofibers were characterized through FTIR and SEM analyses to establish their structural and morphological features. These nanofibers will be evaluated for antimicrobial, catalytic, and sensor applications. The incorporation of thiourea and other polar groups is expected to enhance the functional performance of the polymeric matrix, providing a foundation for advanced materials with improved biocompatibility and selectivity. This research will contribute to the development of a new class of functionalized nanofibrous polymers with potential applications in biomedical devices, biosensors, and environmental remediation. The future outcomes of this study may help design multifunctional, sustainable materials with enhanced efficiency in catalysis and bioactivity.

***Keywords:*** Nanotechnology, Polystyrene Derivatives, Electrospinning, Thiourea Functionalization, Antimicrobial Activity.

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## Author Index

| | | |
|---|---|---|
| Fatih Eric | OP-12 | 48 |
| Fatima Iqbal | PP-17 | 83 |
| Fatima Javeed | PP-27 | 93 |
| Fatima Shahid | PP-55 | 121 |
| Firdous Imran Ali | KN-3 | 9 |
| Gulfam Nasar | OP-10 | 46 |
| Hafsa Ali | PP-28 | 94 |
| Haider A. Khwaja | KN-12 | 18 |
| Hajira Akbar | PP-57 | 123 |
| Hira Iaza Sahito | PP-29 | 95 |
| Huseyin Kara | PL-1 | 1 |
| Husnain Ali Khan | KN-28 | 34 |
| Ibrahim Ender Mulazimoglu | KN-25 | 31 |
| Imdadullah Qureshi | OP-6 | 42 |
| Imran Khan Rind | PP-7 | 73 |
| Imtiazullah Khawaja | KN-23 | 29 |
| Irsa Munwar | PP-71 | 137 |
| Irum Sarfraz Junejo | PP-47 | 113 |
| Ismail Murat Palabiyik | KN-26 | 32 |
| Ismail Tarhan | OP-20 | 56 |
| Izzah Batool | PP-24 | 90 |
| Jamil Anwar | KN-5 | 11 |
| Jamshed Ali | KN-13 | 66 |
| Kamila | PP-72 | 138 |
| Karim Adil | KN-14 | 20 |
| Kashan | PP-21 | 87 |
| Kayode Muritala Salawu | PP-30 | 96 |
| Khalida Parveen | KN-21 | 27 |
| Kissa E Zehra | PP-12 | 78 |
| Lala Faheem Memon | PP-8 | 74 |
| Maha Sharif | OP-15 | 51 |
| Mansoor Khan | OP-11 | 47 |
| Maria Ashfaq | PP 68 | 134 |
| Maira Naz | OP-19 | 55 |
| Mehrunnisa Tanzil | PP-20 | 86 |
| Mirza Muhammad Furrukh Waheed Baig | OP-1 | 37 |
| Mohammad Younis Talpur | OP-14 | 50 |
| Muahammad Iqbal Bhanger | KN-6 | 12 |
| Muhammad Ahmed Chang | PP-13 | 79 |

| | | |
|---|---|---|
| Muhammad Asif | PP-61 | 127 |
| Muhammad Balal Arain | OP-22 | 58 |
| Muhammad Fahad Kashif | PP-60 | 126 |
| Muhammad Farooque Lanjwani | OP-29 | 65 |
| Muhammad Imran Malik | KN-1 | 7 |
| Mustafa Soylak | PL-6 | 6 |
| Mustafa Topkafa | KN-19 | 25 |
| Mustafa Tuzen | PL-3 | 3 |
| Mustafa Yilmaz | PL-5 | 5 |
| Nadir Hussain Khand | PP-31 | 97 |
| Naved Iqbal | OP-18 | 54 |
| Nazar Hussain Kalwar | OP-17 | 53 |
| Noor Zaman | PP-62 | 128 |
| Noshab Qamar | PP-67 | 133 |
| Noshad Razzaque | PP-9 | 75 |
| Pirh Muqaddisa | PP-11 | 77 |
| Qurat-ul-ain Shaikh | OP-24 | 60 |
| Rafia Azmat | KN-29 | 35 |
| Ramsha Shahid | PP-70 | 136 |
| Ramsha Shamshad | PP-63 | 129 |
| Raza Shah | PL-2 | 2 |
| Renata Adami | KN-13 | 19 |
| Ruqia Ghayoor | PP-64 | 130 |
| Saba Iqbal | PP-33 | 99 |
| Sadaf Iqbal | OP-7 | 43 |
| Saima Mooro | PP-34 | 100 |
| Saima Q. Memon | KN-18 | 24 |
| Sana Imam | PP-43 | 109 |
| Sana-ul-Nisa | PP-19 | 85 |
| Sania Munawar | PP-35 | 101 |
| Sanjna | PP-38 | 104 |
| Sanya Khursheed | PP-32 | 98 |
| Sehrish Khadim Hussain | PP-10 | 76 |
| Shabir Ahmed Dharejo | PP-3 | 69 |
| Shagufta Noreen | OP-28 | 64 |
| Shakeela Abbas | PP-14 | 80 |
| Shakoor Ahmed Solangi | PP-48 | 114 |
| Shaz Asrar | PP-65 | 131 |
| Shazia Chohan | PP-36 | 102 |

| | | |
|---|---|---|
| Shazia Komal Junejo | PP-1 | 67 |
| Sheeba Rizvi | PP-49 | 115 |
| Shoaib Muhammad | PP-50 | 116 |
| Sirajuddin | KN-2 | 8 |
| Sobia Kunbhar | PP-37 | 103 |
| Soha Anwar | PP-51 | 117 |
| Syed Ghulam Musharraf | KN-16 | 22 |
| Syed Tufail Hussain Shehrazi | KN-4 | 10 |
| Syeda Sara Hassan | OP-2 | 38 |
| Tahir Rafique | KN-30 | 36 |
| Tahira Qureshi | OP-4 | 40 |
| Tajnees Pirzada | KN-10 | 16 |
| Tilok Chand | PP-15 | 81 |
| Tooba Abid | PP-52 | 118 |
| Ume Hanee Khanzada | PP-56 | 122 |
| Umm-E-Farwa | PP-58 | 124 |
| Waheed Ali Soomro | PP-44 | 110 |
| Weenghar Ali Chandio | PP-4 | 70 |
| Yahya Sifan Wahan | PP-39 | 105 |
| Zaheer Ahmed | KN-22 | 28 |
| Zahid Ali | PP-66 | 132 |
| Zahid Hussain Laghari | PP-53 | 119 |
| Zainab Manzoor Memon | OP-16 | 52 |
| Zeeshan Khatri | KN-8 | 14 |
| Ziana Manzar | PP-40 | 106 |