Second International Conference on

Frontiers in Chemical Technology

20 - 22 June, 2024

Hotel Marino Beach
590, Marine Drive, Colombo 03

FCT2 - 2024 **Conference Proceedings**

DISCLAIMER

This conference proceedings book has been compiled for the purpose of providing general information to the participants of FCT 2-2024, which is organized by the Institute of Chemistry Ceylon. All presented abstracts included herein will be made available in the digital repository of Institute of Chemistry Ceylon to be indexed in bibliographic and citation indexing databases.

Institute of Chemistry Ceylon

The Institute of Chemistry Ceylon (IChemC), incorporated by the Act of Parliament No.15 of 1972, has been in operation for over forty years as the National Professional body of chartered chemists in Sri Lanka. It is the successor to the Chemical Society of Ceylon which was founded in 1941.

The objective of the Institute was to become a Professional and Academic Institution with the purpose of promoting and advancing chemistry. Moreover, it is responsible for the education of chemistry at all levels, assisting the Private and the Public Sectors and for catering to the interests of chemists in general.

Our Vision

"To uplift the quality of life for a better world through the advancement of chemical sciences"

Our Mission

"To be the center of excellence in chemical sciences for the socio-economic development through education, research and innovation"

PREFACE

Driven by its vision to "uplift the quality of life for a better world through the advancement of chemical sciences," the Institute of Chemistry Ceylon is proud to present the second international conference on "Frontiers in Chemical Technology 2024" (FCT-2, 2024). As the Institute celebrates its 83rd anniversary, FCT-2, 2024 marks a pivotal moment in promoting innovative chemical technology, offering a kaleidoscope of opportunities for chemists worldwide.

FCT-2, 2024 serves as a hub for empowering the future through chemical science for technological advancement. The conference themes have been chosen to align with the UN Sustainable Development Goals and the Emerging Technologies identified by IUPAC. It will tackle contemporary challenges in energy, food, environment, medicine and waste management, showcasing cutting-edge strategies that support innovators in the field and educate society. Enthusiastic chemists will gain exposure to the latest advancements while fostering dialogue on the frontiers of chemical technology.

We have received over 125 abstract submissions from renowned institutions both locally and globally. Intellectuals, professionals, and authors affiliated with Sri Lankan universities such as the University of Colombo, University of Peradeniya, University of Sri Jayewardenepura, University of Kelaniya, University of Ruhuna, University of Moratuwa and Sri Lanka Institute of Information Technology, and research institutes such as the Sri Lanka Institute of Nanotechnology and the National Institute of Fundamental Studies, as well as ten foreign institutions from the USA, UK, India, South Korea, Germany, Australia and Taiwan, will be joining the proceedings, in the hope of sharing knowledge in their areas of expertise.

Despite the recent economic challenges in Sri Lanka, the dedicated team behind FCT-2, 2024 has worked tirelessly to bring this event to fruition. The inaugural FCT conference in 2020, held during the pandemic, was a notable success, enabling over 300 participants worldwide to join, despite its hybrid format with limited physical attendance. Building on this foundation, FCT-2, 2024 features five plenary lectures, seven keynote speeches, two panel discussions, a pre-conference workshop, and a comprehensive three-day conference offering numerous opportunities to present and discuss groundbreaking science.

Through FCT-2, 2024, we aim to bolster the development of chemical and applied industries in Sri Lanka. By collaborating with successful industrialists and multifaceted scientists and providing a platform for companies to commercialize their products, we hope to contribute significantly to the nation's growth. In the context of Sri Lanka's recent economic challenges, the discussion and awareness of new technologies are crucial for recovery and progress. Together, let us explore the frontiers of chemical technology to build a better tomorrow.

Dr. Sameera R. Gunatilake
Conference Secretary, FCT-2

Message from the Conference Chair

I am extremely delighted to provide this message to mark the 2nd International Conference on Frontiers in Chemical Technology organized by the Institute of Chemistry Ceylon within the theme of the 2023/24 Council year; "Chemical Science for Technological Advancement: Empowering the Future".

As per the aims and objectives of the Institute, it is expected to promote the acquisition, dissemination, and interchange of knowledge in Chemistry. Further, the 'Top Ten Emerging Technologies in Chemistry' identified by the International Union of Pure and Applied Chemistry include aerogels, fiber batteries, film-based fluorescent sensors, nanozymes, sodium-ion batteries, and textile display, emphasizing the importance of chemical science for technological advancement, to empower the future. Technology grows to liberate mankind from the constraints of the past. The most revolutionary aspect of technology is its mobility, which has led to the fourth industrial revolution, which concentrates on digitalization and artificial intelligence being experienced by humans today. In these respects, the Council of the Institute decided to hold the above symposium under many themes of chemical science and technological advancement, in conjunction with its Annual Sessions and Anniversary Celebrations of the year 2024.

In addition to more than 110 oral and poster presentations in the sub-themes, many plenary and keynote speeches are to be delivered during the three-day conference from the 20th to 22nd of June 2024, together with the pre-conference workshop devoted to chemical education, an integral aspect of moving toward advances of chemical technology. I am very grateful to Dr. Ale Palermo and Prof. Sabu Thomas for agreeing to be present at the conference as the Chief Guest and the Guest of Honour, respectively. While congratulating the presenters of technical sessions, I appreciate the time devoted by the resource persons who will deliver excellent presentations sharing their knowledge and experience. I am very much thankful to the Organizing Committee for their untiring efforts and dedication to organizing this event on a grand scale, overcoming many challenges faced.

I sincerely wish the 2nd International Conference on Frontiers in Chemical Technology a great success, allowing researchers in the field of chemical science to interact with each other, and paving the way forward to proceed with technological advancements empowering the future.

Prof. H M D Namal Priyantha, *BSc (Perad), PhD (Hawaii), FNASSL, FIChemC, CChem*
President, Institute of Chemistry Ceylon & Conference Chair, FCT-2
Senior Professor in Chemistry, University of Peradeniya

Message from the Editor-in-Chief

It is a great pleasure to write this message at the successful bringing up of the Proceedings of the 2nd International Conference of Frontiers in Chemical Technology (FCT) organized by the Institute of Chemistry Ceylon in 2024. As the Editor-in-Chief, I am pleased to witness the culmination of our collective efforts in bringing up this comprehensive compilation of abstracts of cutting-edge research and scientific advancements. The Proceedings highlight the collaborative efforts of scientists from Sri Lanka and around the world in advancing scientific knowledge and innovation in the field of chemical technology, spanning a broad spectrum of research topics ranging from Energy and Environment to Food, Medicine, and Waste. We are honoured to have Dr. Ale Palermo from the United Kingdom as the Chief Guest, Prof. Sabu Thomas from India, as the Guest of Honour, and 05 Plenary speeches by distinguished Professors from Australia, India, and Sri Lanka, and 07 Keynote speeches by distinguished scholars from Malaysia, USA, India, and Sri Lanka. The global participation of esteemed scientists and scholars is underscoring the global impact and relevance of the conference and contributing their expertise and insights to enrich our discussions is highly appreciated.

This year, we have received about 130 abstracts, all the abstracts together with their extended abstracts were thoroughly peer-reviewed by eminent academics and researchers, and based on their recommendations, 111 abstracts were accepted for presentation at the conference; oral (83) and poster (28). Accepted research papers are presented under 5 key themes: Energy (15), Environment (22), Food (12), Medicine (38), and Waste (15), in parallel technical sessions. In addition, 9 papers are presented at the Sultanbawa Session to select the best paper for the Prof. Sultanbawa Memorial Award.

The successful outcome of the Proceedings is the collective efforts of the authors for their invaluable contributions, the reviewers for their meticulous evaluation and constructive feedback, and the members of the Editorial Committee for their unwavering dedication and expertise in guiding the publication process. Special thanks are also due to the Technical Assistant, Teaching Assistants, and the FCT Chairperson and Secretary for their indispensable support and coordination throughout the Editorial process.

I am sure that the insights and findings presented in this Proceedings will serve as a source of inspiration for researchers, guiding and paving their way for continued innovation and discovery in chemical technology.

Prof. A. D. L. Chandani Perera, *BSc (Perad), MSc (Tokyo), PhD (Tokyo), FNASSL, C.Chem., F.I.Chem.C*
Emeritus Professor, University of Peradeniya
Dean, College of Chemical Sciences, Institute of Chemistry Ceylon

Message from the Chief Guest

Championing the contribution of the chemical sciences to a sustainable world

Our planet and its people are under increasing pressure. While on average people around the world enjoy longer, healthier lives than they did a century ago—thanks in large part to advances in science and technology—our collective well-being is under growing threat from climate change, environmental damage, threats to water, food and energy security, and health and economic inequalities. The COVID-19 pandemic has worsened these issues and jeopardized progress towards achieving the United Nations Sustainable Development Goals (UN SDGs), but it has also highlighted the power of the scientific community to solve urgent problems, as demonstrated by the rapid development of vaccines where chemical scientists have made major contributions.

We are entering an era of unprecedented discovery and impact in our discipline. Today's researchers have tools and techniques that are transforming our understanding of chemistry and revolutionising innovation.

Wherever you look, there are chemical solutions to the problems we face, whether that's solid-state batteries or reusing waste materials. According to one of our surveys, 99 % of chemical researchers say their work has potential application in at least one global challenge area,

I am therefore honoured, on behalf of the Royal Society of Chemistry (RSC) and the IUPAC, to be invited by the Institute of Chemistry Ceylon as the Chief Guest at this important event, the 2nd International Conference on Frontiers in Chemical Technology,

At the RSC, we aim to catalyse change at multiple levels, and we work closely with partners across the global chemical science community to achieve this.

Our work touches on a range of sustainability priorities. For example, we campaign to improve inclusion and diversity in the profession—making chemistry for everyone a reality. Our focus is on increasing the diversity of people entering and progressing in the chemical sciences, empowering chemical scientists to contribute to areas where their expertise is sorely needed.

First, we facilitate knowledge sharing between scientists. For example, ahead of the 2021 United Nations Climate Change Conference (COP26), we brought together chemical entrepreneurs, industry experts, academics and researchers from around the world for a series of online discussions on sustainability challenges.

Our twenty virtual events highlighted the huge range of areas where chemists are needed, from developing protective paints for wind turbines, to improving air quality in the Global South, and researching sustainable alternatives to plastics and cement.

We also showcased innovative SMEs that are developing essential technologies for the future, including better carbon capture solutions, faster charging batteries, more efficient solar power and higher efficiency green hydrogen production.

As a leading science publisher, we have also signed the SDG Publishers Compact, which aims to accelerate progress to achieve the UN-SDGs by 2030.

We publish a range of journals related to green chemistry and global challenges, including RSC Applied Interfaces and RSC Applied Polymers. Last

year, we also announced the publication of three new titles: RSC Sustainability, Sustainable Food Technology and EES Catalysis.

Each of these new journals is gold open access and we will cover all article processing charges until mid-2025, so that scientists and institutions from around the world can share research at no charge.

Those closest to problems are often the best placed to solve them. It is therefore essential that scientists in countries most impacted by sustainability challenges have access to the research they need.

That is why we are committed to being a fully open access publisher within five years and to supporting open science more widely, to enable fair access to scientific knowledge around the world.

As well as helping to share knowledge, we support bringing together key players to tackle complex problems. For example, we have created an industry taskforce to tackle the environmental impact of polymers in liquid formulations (PLFs).

PLFs are found in millions of consumer and industrial products, from the paints on our walls to the shampoo and detergents in our cupboards. But the way they are made, used and disposed of is putting unnecessary strain on the environment by releasing carbon dioxide into our atmosphere, using up the earth's finite resources and generating physical waste.

While advancing scientific solutions and skills is crucial, we also need to help policymakers and the public to understand and act on the science.

We found that there is a real appetite for more sustainable technology options, but that people are frustrated with the lack of information around the topic, as well as the lack of straightforward options for recycling or extending the lifespan of electronics.

As well as urging individuals to be more conscious about how they use and reuse technology, we are calling on companies and policymakers to make it easier for consumers to repair, update or recycle technology.

Lots of the sustainability challenges we face require a coordinated international response—we advocate for a global approach to chemical governance where this is needed. For example, we are campaigning for the creation of an independent intergovernmental panel on chemical and waste-management. Together with international partners, we are engaging with UN processes to help make this a reality and to keep the issue of chemical pollution firmly on the agenda.

Finally, while chemists have an important role to play in providing solutions, we must also make sure we are not part of the problem. Many areas of chemical research and industry are by their nature resource and energy intensive. We support efforts to reduce the environmental footprint of the chemical sciences, as well as working to achieving net zero carbon emissions in our own operations by 2040.

We recently asked chemical scientists to share their views on how scientific research can be conducted in a more environmentally sustainable way, forming the basis of our new Sustainable laboratories report, and will inform our ongoing efforts to support the community in their efforts towards creating greener labs.

The challenges we face are complex and no single organisation or country can solve them in isolation. International collaboration and cooperation are crucial to solve that society faces and to create a world where everybody has the opportunity flourish.

Chemical societies such as the RSC and the Institute of Chemistry Ceylon, institutions such as Commonwealth Chemistry and the IUPAC can help in making sure that the global chemical science community fulfils this potential for positive impact.

There is no doubt that in a world where global sustainability challenges and technological advances bring both uncertainty and new opportunities, chemists have a central role to play. Meetings like this one, are crucial for providing platforms for chemists across the world to share ideas and drive innovation.

Dr Ale Palermo, *FRSC*
Head of Global Inclusion, Royal Society of Chemistry
Science Board member, IUPAC
Executive Board Member, Commonwealth Chemistry

Message from the Guest of Honour

It is a pleasure to note that Institute of Chemistry Ceylon is organizing International Conference on "Frontiers in Chemical Technology" in June 2024. I understand that there is very enthusiastic response to the Call for Papers both from within and outside the country. Conferences of this nature provide a platform to young researchers, faculty members and industry professionals to present their research and development work and get feedback and suggestions to improve their quality of work.

This Conference will provide an opportunity to exchange ideas on latest algorithms, standards, technologies, and applications pertaining to above topics and thus serve very useful to students, teachers, and practicing industry professionals. I take this opportunity to express my sincere appreciation to the team and I am sure that the delegates will carry with them pleasant memories of the Conference. I wish the delegates very productive technical interactions and enjoyable stay.

Prof. (Dr) Sabu Thomas, *DSc, PhD, FRSC, FEurASc*
Former Vice Chancellor, Mahatma Gandhi University, Kottayam, Kerala, India
Founder Director, School of Energy Materials, School of Nanoscience and Nanotechnology, & IIUCNN, Mahatma Gandhi University, Kottayam, Kerala, India

Frontiers in Chemical Technology 2024 (FCT-2024)

The International Conference on "Frontiers in Chemical Technology 2024 (FCT-2024)" marks a new step that the Institute aspires to take together with renowned global and local scientists and industrialists. The conference will focus on technological developments in the fields of energy, environment and climate change, medicine, waste management and food security.

Areas of Interest of the Conference;

1. Energy: Sustainable and Cost-Effective Solutions.
2. Environment: Climate Change, Pollution, and Green Chemistry.
3. Medicine: Chemistry, Pharmaceutical, and Herbal Technology.
4. Waste: Management, Value Addition, and Circular Economy.
5. Food: Security, Safety and Quality Innovation strategies in Chemical education.
6. Women empowerment in chemistry.
7. Linking the chemical industry with academic research.

The Conference aims;

1. To introduce the latest technological innovations to the chemical industry.
2. To provide chemical inventors a platform to commercialize their inventions.
3. To provide economic benefits to the country.
4. To update the chemical community with the frontiers in chemical technology.
5. To provide an opportunity for early career chemists to attend this conference.
6. To provide opportunities for professional development of women chemists

Anticipated outcomes of the Conference;

- To encourage Sri Lankan chemists to network with eminent foreign scientists in order to establish a collaborative research network
- To provide chemical inventors a platform to showcase their inventions and expose themselves to national and international commercialization opportunities
- To attract economic opportunities to the country through value addition of inherent resources
- To provoke young scientists to aspire in the field of chemical technology

Relevance to Sri Lanka;

- The conference will examine the current status, challenges and future developments in chemical technology
- The conference will also highlight the application of advanced and emerging chemical technologies which could be exploited for the betterment of developing countries such as Sri Lanka
- To unveil new economic opportunities to the developing world as well as to those countries in economic transition

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Plenary Lecture 01

BIOCHAR-BASED CIRCULAR ECONOMY: TRANSFORMING WASTE INTO WEALTH FOR SOIL FERTILITY, WATER TREATMENT AND GLOBAL CLIMATE CHANGE MITIGATION

Dinesh Mohan

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According to the Ministry of New and Renewable Energy, India currently has access to approximately 750 million metric tons of biomass annually. The highest amounts of crop residues are generated in Uttar Pradesh (~60 Mt), followed by Punjab (~51 Mt), and Maharashtra (~46 Mt). These crop residues are valuable natural resources utilized for various purposes including animal feed, fodder, fuel, soil mulching, bio-manure, packaging, and roof thatching. Unfortunately, a significant portion of unused crop residues, such as wheat, rice, cotton, sugarcane, maize, millet, rapeseed-mustard, jute, and groundnut, are burned in agricultural fields to clear residue stubble after harvest and prepare the land for the next crop cycle. This practice has severe environmental consequences, as one ton of biomass/stubble burning emits SO_2 (~2 kg), PM (~3 kg), CO (~60 kg), CO_2 (~1460 kg), and ash (~199 kg). Additionally, burning agricultural residues generates black carbon particulates, contributing to air quality deterioration and negatively impacting individuals with cardiovascular and respiratory diseases. Furthermore, long-term burning exacerbates soil degradation by reducing total carbon and nitrogen levels in the 0-15 cm soil layer, along with the loss of soil organic matter.

Crop residues offer the potential to be transformed into biofuels, heat, and power through various thermal, biochemical, and mechanical methods. The biological platform can convert biomass into biogas or ethanol. Meanwhile, the thermochemical platform, utilizing combustion, gasification, pyrolysis, and liquefaction, can convert biomass into biofuels and energy. Gasification produces a fuel gas suitable for direct heat generation or for use in engines or turbines for electricity generation. This gas can also undergo processing to produce methanol or liquid hydrocarbons through Fisher-Tropsch synthesis. Pyrolysis involves the thermal decomposition of biomass in the absence or near absence of oxygen. Depending on the operating conditions such as residence time, temperature, and mass transfer rate, pyrolysis processes may be categorized as conventional or fast pyrolysis.

Addressing the pressing issue of agricultural residue burning and solid waste residue burning is paramount. Utilizing slow or fast pyrolysis techniques to convert crop residues and agricultural wastes into biochar can yield numerous economic and environmental benefits. These biochars not only mitigate air pollution stemming from crop residue open burning but also establish a sustainable agricultural model for recycling and reusing agricultural waste, contributing to a circular economy. Biochar has also been recognized by IPCC in its Special Report on Global Warming of 1.5 °C, as one of only a handful of negative emission technologies. Biochar half-life in soil is hundreds to two thousands of years, such that carbon (as CO_2) arises in the atmosphere, captured by plants permanently sequestered in the soil (a carbon-negative process) and simultaneously provides fertilizer. Incorporating biochar into soil enhances water-holding capacity, promotes plant growth, reduces soil acidity, minimizes nutrient leaching, increases water retention, and diminishes the need for irrigation and fertilizers. Furthermore, it mitigates greenhouse gas emissions, thus addressing the factors contributing to climate change.

Thus, biochar, being an affordable, clean, and efficient product, holds the potential to simultaneously address multiple challenges including environmental conservation, climate change, soil amendment for enhanced fertility, water treatment, feed additive in the livestock and poultry industry, as well as in controlling manure odor and remediating land and water contaminants.

Keywords: Biochar, carbon sequestration, circular economy, pyrolysis

Dinesh Mohan is a professor in the School of Environmental Sciences at Jawaharlal Nehru University, New Delhi, India. He is an Elected Fellow of Royal Society of Chemistry, London and National Academy of Agricultural Sciences, India. He is also an adjunct professor at the Chemistry Department, Mississippi State University, USA. He was a visiting professor at Czech University of Life Sciences Prague, Czech Republic, and an adjunct professor at University of Southern, Queensland, Australia. Dinesh Mohan earned his Master's and Ph.D. degrees from the esteemed Indian Institute of Technology Roorkee. His academic journey also includes valuable experiences as a Postdoctoral Associate at both Penn State University and Mississippi State University. Prof. Mohan has made remarkable strides in environmental sciences, particularly in water treatment and management, and the innovative use of biochar for climate change mitigation and soil improvement. His sustainable materials effectively eliminate a wide range of contaminants from water, including heavy metals, pesticides, and emerging pollutants like PFAS. Notably, his development of cost-effective biochars addresses the water treatment challenges prevalent in India. Mohan's pioneering "3-D" approach to assessing biochar's adsorbent potential has garnered widespread recognition. In a recent breakthrough, he has pioneered a sustainable technology designed to effectively combat the issue of stubble burning in India.

He published >170 research papers with a total citation of >51553 & h-factor: 86 in the high impact factor Journals. He has also authored 3 books. In addition, two patents have been granted to him. He has received global recognition as the Clarivate Highly Cited Researcher in 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, and 2022. In addition to his extensive accomplishments, Professor Mohan has garnered a multitude of esteemed academic and professional awards. These accolades include the 2007 Scopus Young Scientist Award and the Hiyoshi Environmental Award in 2009. He was also recognized as a Research Giant by the University of Southern Queensland, Australia, in 2017. Furthermore, he was honored with the Clarivate Analytics India Research Excellence Citation Awards in 2019, received the prestigious Dr. S. S. Deshpande Memorial Award in 2017, and holds the distinguished title of Outstanding Scientist, conferred upon him by CSIR, India.

Plenary Lecture 02

UNLEASHING THE POTENTIAL OF TEA FLAVONOIDS–TWO DECADES OF RESEARCH

P. A. Nimal Punyasiri

Institute of Molecular Biology, Biochemistry and Biotechnology, University of Colombo, Colombo 03, Sri Lanka

Tea Flavonoids are ubiquitous secondary metabolites with a multitude of biological properties. Flavones, flavonols, flavanols, anthocyanins and proanthocyanins are the main classes of flavonoids present in the tea plant, *Camellia sinensis*. In both green and black tea flavanols (flavan-3-ols) popularly known as catechins play a vital role in imparting taste, colour, astringency and a plethora of health-promoting effects. Considering the amount and variety of metabolites present in the tea plant could indeed be called a natural products laboratory. Since the year 2000 our research has revealed the immense potential of flavonoids in the tea plant. Our findings include Biochemical markers for identifying resistance and/or susceptibility of a tea plant to blister blight leaf disease caused by the fungus *Exobasidium vexans*. Findings of enhancement of levels of proanthocyanidins with the fungal infections, elucidation of the flavonoid biosynthesis pathway in tea, reporting of the enzyme, anthocyanidin reductase for the first time from the tea plant, establishment of role of different types of flavan-3-ols (catechins) in identifying high quality in tea cultivars suitable for both green tea and black tea manufacture, confirmation of the involvement of the major flavonols in tea accessions and correlating them with exotic tea accessions and isolation and characterization anthocyanins of purple tea cultivar (TRI 2043) for the first time, are significant advancements in the tea plants, particularly in understanding the biochemical pathways.

The above findings are presently applied in the plant breeding programme of the Tea Research Institute, Sri Lanka. The research findings were disseminated through the articles published in peer reviewed journals

Research Team
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Professor Nimal Punyasiri graduated from the Institute of Chemistry Ceylon, and has obtained a Postgraduate Certificate in Advanced Biochemistry and PhD from the University of Peradeniya. He has received postdoctoral fellowships from the Swedish University of Agricultural Sciences, Alnarp, IBMBB, University of Colombo, and Technical University of Braunschweig Germany.

He has received 17 awards for his research, Prof. Kandiah and Dr. C. L. De Silva awards of the Institute of Chemistry Ceylon, and 8 Presidential Awards for Research Excellence. He started his career at the Biochemistry Division of the Tea Research Institute of Sri Lanka. He teaches both undergraduate and postgraduate students in 06 Universities and at the Institute of Chemistry Ceylon. He is a Chartered Chemist and a Chartered Biologist and Fellow of Royal Society of Chemistry, UK, Institute of Chemistry Ceylon and Institute of Biology, Sri Lanka.

Plenary Lecture 03

CIRCULAR ECONOMY: NEW OPPORTUNITIES IN SUSTAINABLE NANO MATERIALS AND POLYMER BIO-NANOCOMPOSITE

Sabu Thomas

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Green chemistry started for the search of benign methods for the development of nanoparticles from nature and their use in the field of antibacterial, antioxidant, and antitumor applications. Bio wastes are eco-friendly starting materials to produce typical nanoparticles with well-defined chemical composition, size, and morphology. Cellulose, starch, chitin and chitosan are the most abundant biopolymers around the world. All are under the polysaccharides family in which cellulose is one of the important structural components of the primary cell wall of plants. Cellulose nanoparticles (fibers, crystals and whiskers) can be extracted from agro waste resources such as jute, coir, bamboo, pineapple leafs, coir etc. Chitin is the second most abundant biopolymer after cellulose. It is a characteristic component of the cell walls of fungi, the exoskeletons of arthropods and nanoparticles of chitin (fibers, whiskers) can be extracted from shrimp and crab shells. Chitosan is the derivative of chitin, prepared by the removal of acetyl group from chitin. Starch nanoparticles can be extracted from tapioca and potato wastes. These nanoparticles can be converted into smart and functional biomaterials by functionalization through chemical modifications (esterification, etherification, TEMPO oxidation, carboxylation and hydroxylation etc.) due to presence of large amounts of hydroxyl group on the surface. The preparation of these nanoparticles includes both a series of chemical as well as mechanical treatments; crushing, grinding, alkali, bleaching and acid treatments. Transmission electron microscopy (TEM), scanning electron microscopy (SEM) and atomic force microscopy (AFM) are used to investigate the morphology of nanoscale biopolymers. Fourier transform infra-red spectroscopy (FTIR) and X-ray diffraction (XRD) are being used to study the functional group changes, crystallographic texture of nanoscale biopolymers respectively. Since large quantities of bio wastes are produced annually, further utilization of cellulose, starch and chitins as functionalized materials is very much desired. The cellulose, starch and chitin nanoparticles are currently obtained as aqueous suspensions which are used as reinforcing additives for high performance environment-friendly biodegradable polymer materials. These nanocomposites are being used as biomedical composites for drug/gene delivery, nano scaffolds in tissue engineering and cosmetic orthodontics. The reinforcing effect of these nanoparticles results from the formation of a percolating network based on hydrogen bonding forces. The incorporation of these nanoparticles in several bio-based polymers have been discussed. The role of nanoparticles dispersion, distribution, interfacial adhesion and orientation on the properties of the ecofriendly bio nanocomposites have been carefully evaluated.

Keywords: Circular economy, Nano Cellulose, Nano Chitin, Nano Starch, Sustainable Nano Materials

Professor Sabu Thomas is Director of the International and Interuniversity Centre for Nanoscience and Nanotechnology, Mahatma Gandhi University, Kottayam, Kerala, India. He is also currently the Chairman of the Trivandrum Engineering Science and Technology Research Park (TrEST Research Park), Trivandrum, Kerala, India. He was the former Vice Chancellor of Mahatma Gandhi University, Kottayam, Kerala, India (2019-2023). Prof. Thomas is an outstanding leader with sustained international acclaims for his work in Nanoscience, Polymer Science and Engineering, Polymer Nanocomposites, Elastomers, Polymer Blends, Interpenetrating Polymer Networks, Polymer Membranes, Green Composites and Nanocomposites, Nanomedicine and Green Nanotechnology. In collaboration with India's premier tyre company, Apollo Tyres, Professor Thomas's group invented new high performance barrier rubber nanocomposite membranes for inner tubes and inner liners for tyres. Professor Thomas has received more than 30 national and international awards which include, FRSC, Distinguished Professorship from Jozef Stefan Institute, Slovenia, MRSI medal, CRSI medal, Distinguished Faculty Award, Dr. APJ Abdul Kalam Award for Scientific Excellence – 2016, Mahatma Gandhi University- Award for Outstanding Contribution –Nov. 2016, Lifetime Achievement Award of the Malaysian Polymer Group, Sukumar Maithy Award Faculty Research Award, Trila – Academician of The Year, European Academy of Sciences. He is in the list of most productive researchers in India and holds a position of No.5. Prof. Thomas has been conferred Honoris Causa (DSc) by the University of South Brittany, Lorient, France, Siberian Federal University, Russia and University of Lorraine, Nancy, France. He was awarded the prestigious Senior Fulbright Fellowship and National Education Leadership Award – 2017 for Excellence in Education. Prof Thomas also won 6th contest of "mega-grants" - Russian Federation. Very recently, Prof. Thomas received the coveted Kailali award from Government of Kerala. He also received the Chancellor's Trophy for the best University of the state from the Chancellor. Very recently Prof. Thomas has been ranked by Stanford university under 2 percent top leading researchers in the world. In the year 2023, Prof. Thomas won of the most coveted Lifetime achievement Award of Clarivate and Careers 360 award from Mr. Rajeev Chandrasekhar, Minister of State for Skill Development and Entrepreneurship and Minister of State for Electronics and Information Technology. Professor Thomas has published over 1600 peer reviewed research papers, reviews and book chapters. He has co-edited 210 books and is the inventor of 16 patents. The H index of Prof. Thomas is 142 and has more than 100,000 citations. Prof. Thomas has delivered over 350 Plenary/ Inaugural and Invited lectures in national/international meetings over 30 countries. Prof. Thomas has supervised 125 PhD programmes and his students occupy leading positions in academia and industry in India and abroad.

Plenary Lecture 04

ASSURING A SAFE FOOD SUPPLY FOR ALL: CHALLENGES AND WAY FORWARD

Terrence Madhujith

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Food security, encompassing the provision of safe and nutritious food for everyone, is a critical public health issue in Sri Lanka. This issue is influenced by a myriad of factors including environmental pollution, urbanization, biotechnological advances, economic downturns, import regulations, government policies, and regulatory frameworks. From the farm to the consumer's table, food safety can be compromised at any stage, with the complexity further heightened by global trade. Several contaminants threaten food safety, including pathogens, pesticide residues, toxic metals, antimicrobial residues, environmental contaminants, process-induced toxicants, and natural toxins. Issues like adulteration, food fraud, the use of inferior quality raw materials, improper processing, handling or storage methods, and the incorporation of unpermitted food additives such as colorants and flavors exacerbate these threats. Lipid-rich food, such as corn, peanut, corn, and coconut products can easily be contaminated with mycotoxins such as aflatoxins and ochratoxins. Improper handling of coconut products can lead to the generation of potent carcinogens, such as aflatoxins, commonly found in coconut oil, peanuts, corn, and their products. Feeding cattle with aflatoxin-laden coconut cake can result in aflatoxin-contaminated milk, and recent studies indicate the presence of aflatoxins in cow's milk. Aflatoxins are extremely heat-stable, making their destruction challenging. The repeated use of frying oil leads to the formation of polymerized products, polycyclic aromatic hydrocarbons (PAHs), carbonyls, hydrocarbons, and organic acids, some of which are toxic. Process-induced toxicants such as 3-MCPD, 2-MCPD, glycidyl esters, acrylamide, and PAHs are generated during food processing. Notably, acrylamide, which is now considered a carcinogen, is synthesized during the heat processing of potatoes and the production of baked goods. Synthetic antioxidants, colorants, and flavors are known to have deleterious effects on human health, prompting a global trend towards reducing their use. Furthermore, fraudulent activities during food importation and poor law enforcement make it imperative to establish robust measures and policies to ensure food safety for all. Multiple ministries, departments, and other government bodies are involved in food safety, supported by various legislations. However, there is a severe lack of coordination among these institutions. This underscores the importance of establishing a dedicated food safety authority to coordinate the efforts of all institutions involved in ensuring food safety in Sri Lanka.

Keywords: Contaminants, food additives, food safety, mycotoxins

Professor W. M. Terrance Madujith is the current deputy Vice-Chancellor of the University of Peradeniya. He specializes in Food Science & Lipid Chemistry and is the Chair Professor of Food Science and Technology at the University of Peradeniya, Sri Lanka. He obtained his BSc (Agri) from the University of Peradeniya, Sri Lanka, and MSc and PhD from the Memorial University, Canada. He has published over 100 research papers in international and local peer-reviewed journals, 25 Book Chapters, 05 Books, and Monographs. He has presented over 150 International and local conference papers and received about 12 awards for research. He is a Tier 4* researcher, and his current Google h-index is 30. He received a Fullbright Research Fellowship from the University of Georgia, USA, in 2018 for one year. He worked as a Visiting Professor, University of Guelph, Canada, and Harbin University of Commerce, China. He also served in several university administrative positions, as the Director, University Research Council and Deputy Director-Training, Center for Distance and Continuing Education, University of Peradeniya. His main research areas are lipid oxidation, trans fat, antioxidants, plant bioactives, probiotics & prebiotics, food safety and lifestyle modification, and NCDs.

Keynote Lecture 01

NEXT GENERATION TEXTILES

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Next-generation textiles leveraging advanced materials based on nanotechnology hold immense potential to revolutionize the textile industry and redefine the functionalities of clothing and fabrics. The innovative approaches can contribute to mitigating impact of climate change and promote environmental sustainability. There are key areas where nanotechnology-enabled textiles are making significant advancements. Nanomaterials, such as nanoparticles, nanofibers and nanocomposites, can be incorporated into textiles to enhance their performance characteristics. The addition of nanofibers can improve mechanical strength, durability, and flexibility, making textiles more resistant to wear and tear. Nanocoatings containing hydrophobic nanoparticles can be applied to textiles to impart water and stain resistance, creating a protective barrier on the fabric surface, preventing water, oil, and other liquids from permeating the fibers and causing stains. Nanoparticles with inherent antibacterial and antiviral properties, such as silver nanoparticles and copper oxide nanoparticles, can be incorporated into textiles to inhibit the growth of bacteria and viruses. This functionality is particularly beneficial for healthcare garments, sportswear, and protective clothing. Nanomaterials like phase-change materials (PCMs) and thermoregulating nanoparticles can be embedded in textiles to regulate temperature and improve thermal comfort. These materials absorb, store, and release heat in response to changes in environmental conditions, helping to maintain optimal body temperature. Nanoparticles with UV-absorbing or UV-blocking properties can be integrated into textiles to provide enhanced protection against harmful ultraviolet radiation. This feature is crucial for outdoor apparel and fabrics used in sun-sensitive applications. In addition, nanotechnology enables the development of smart textiles with embedded sensors, actuators, and electronic components. These textiles can monitor physiological parameters, detect environmental changes, and respond dynamically to user needs, opening new possibilities for wearable technology and smart clothing applications. Nanocoatings with self-cleaning properties, such as photocatalytic nanoparticles, can be applied to textiles to repel dirt, dust, and contaminants. These coatings harness the power of sunlight to break down organic substances and maintain the cleanliness of the fabric surface. Due to the depleted resources on the planet, nanotechnology offers opportunities to develop sustainable textiles with reduced environmental impact. By incorporating nanomaterials that improve dye uptake, reduce water consumption during manufacturing, and enhance biodegradability, the textile industry can move towards more eco-friendly production processes. In summary, next-generation textiles enabled by nanotechnology are poised to redefine the functionalities, performance, and sustainability of clothing and fabrics. Continued research and innovation in this field will drive the development of novel materials and manufacturing techniques, paving the way for a new era of advanced textiles with unprecedented capabilities.

Keywords: Nanofibers, nanotechnology, self cleaning, sustainable textiles

K. M. Nalin de Silva is the Chair Senior Professor of Chemistry at the University of Colombo, Sri Lanka. He obtained his B.Sc. (Chemistry, First Class) from the University of Colombo, Sri Lanka and PhD from the University of Cambridge, UK. He has gained postdoctoral experience from the University of Cambridge and Louisiana State University, USA. He worked as the Science Team Leader in Sri Lanka Institute of Nanotechnology (SLINTEC) from 2012-2019. Upon completion of the assignment at SLINTEC he returned to his university position in 2017. He has published 100 Science Citation Index papers and four US patents. His present h-index is 37. He won the Presidential Research Award for ten consecutive years and a National Research Award presented by National Research Council (NRC) and National Science Foundation (NSF), Sri Lanka. He was also named 'Young Scientist of the Year' in 2004 by The World Academy of Science (TWAS) and NSF. He received the Vice Chancellors Award for Research Excellence in 2017 & 2020. He was a member of the National Nanotechnology Committee and Chairman of the National Nanotechnology Research Panel at NSF. Recently he was awarded with the most prestigious professional qualification, Fellow of the Royal Society of Chemistry (FRSC), United Kingdom. He was also a member of the committee at NSF for drafting the National Nanotechnology Policy of Sri Lanka. He also served as the Chairman of National Basic Sciences Research Committee and National Committee for Technology at the NSF. His main research focus areas are advanced material for healthcare, water purification, textiles and apparel, natural resources and Nanobiotechnology. His research team has brought approximately Rs. 70 million external funding to the university and established a state-of-the-art materials lab, Center for Advanced Materials and Devices (CAMD) in 2018.

Keynote Lecture 02

EMPOWERING COASTAL COMMUNITIES TOWARDS SUSTAINABILITY *via* TRANSFORMATION OF WASTE TO WEALTH

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Mangroves play an integral part in the livelihood of coastal communities. The Kampung Kuantan village which is situated adjacent to the Selangor river is a tourism spot for firefly sightings. Both boatmen and vendors depend on this natural ecosystem for raw materials, agricultural activities and for tourism. During the COVID-19 epidemic, and the nationwide lockdown, the tourism area became not operational and faced challenges, such as intermittent pollution, land degradation and loss of income. River pollution led to eyesore, erosion of riverbanks, flooding and the reduction of fireflies' population due to habitat disturbance at the riverside. In line with the focus on United Nations Sustainable Development Goals, the Malaysian Society of Soil Science embarked on a project, funded by the UNDP-GEF Malaysia to assist the coastal communities by firstly removing organic waste from the river to produce biochar, and secondly to use biochar as a soil enhancer to increase plant productivity. Biochar is a product of thermal degradation of organic biomass under low- oxygen conditions known as pyrolysis. It contains almost 70% carbon and the remainder consists of nitrogen, hydrogen and oxygen among other elements. Organic wood waste was collected from the rivers, air dried for several days and cut into small pieces to be inserted into a DIY 500 litre retort kiln made out of oil drums. At the laboratory, organic wood wastes predominantly derived from *Sonneratia caseolaris* were pyrolyzed at 300, 450 and 600 °C. Results showed that the moisture content, volatile matter, ash content and the fixed C were in the range 1.2-1.3%, 28.4-55.3%, 3.3-5.3% and 40.0-64.8%, respectively. Values for H/C and C/N were the lowest for the biochars produced at 600 °C and 300 °C respectively. The highest fixed C (64.8%) and pore volume (0.155 $cm^3 g^{-1}$) was found for samples produced at 600 °C. Fixed carbon increased upon carbonization and the values correlated with the increasing C content resulting in lower H/C value. At 450 °C, more macropores and micropores were visible, but predominantly macropores were visible at 600 °C pyrolysis temperature. In a probing study conducted by the community groups, results showed that the application of biochar produced from the wood waste was able to relatively increase the diameter of planted *S. caseolaris* seedlings (5%) as compared to that of the control. Future research and engagement with the community will involve establishment of more robust data for biochar properties, technical know-how on optimum pyrolysis processes and testing biochars as soil amendments on various species for plant growth and productivity.

Keywords: biochar, organic waste, pyrolysis, *Sonneratia caseolaris*, soil amendment

Dr. Jeyanny Vijayanathan is a senior research officer in the Forest Plantation Programme of Forest Research Institute Malaysia (FRIM). She graduated with her PhD in Soil Science in 2015. Her specialization includes soil chemistry, fertility, carbon dynamics, precision agriculture, survey and plant nutrition management. Her current research interest spans on environmental soil science, regenerative agriculture & carbon stocks and fluxes in the natural and plantation ecosystems. She is currently the Vice Chair of the Intergovernmental Technical Panel on Soils for FAO, a certified chemist of the Malaysia Institute of Chemistry. Jeyanny is also an Associate Member of the Committee on Chemistry and Industry for the IUPAC 2024-2025 session. She is the recipient of the Excellent Service Medal 2022 under the Public Service Department of Malaysia and the Outstanding Women Researcher by the Venus International Foundation. Her major publications include books, book chapters, peer-reviewed journals, and peer-reviewed journal articles.

Keynote Lecture 03

WHY IS SMALL SO BIG? – CURRENT ADVANCES IN NANOTECHNOLOGY

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Nanotechnology, defined as the technology dealing with the science and engineering of materials at dimensions roughly ranging from one to one hundred nanometers in length, holds immense promise for future applications in various fields, particularly in biomedical sciences. Nanotechnology promises future applications in biomedical sciences, including cellular imaging and diagnosis, drug delivery, cancer treatment, antimicrobial uses, and gene therapy. Ancient historical findings have confirmed that nanotechnology existed centuries ago. Current advances in nanotechnology include, but are not limited to, drug delivery, biomedical imaging, theragnostic applications, antimicrobial applications, the paint industry, the agriculture and food sector, the polymer industry, the electronic industry, and environmental technologies. This review highlights recent advances in nanotechnology, focusing on the preparation methods, characterization, and biomedical applications of metal-based nanoparticles. Among these nanoparticles, calcium fluoride and zinc oxide have garnered significant attention due to their limited toxicity, biocompatibility, and stability, making them ideal candidates for biomedical applications. Moreover, lanthanide-doped calcium fluoride and zinc oxide nanoparticles exhibit remarkable luminescent properties, including narrow luminescent bands, longer lifetimes, large Stokes shifts, and limited photo-bleaching. Herein, a microwave-assisted synthetic method is presented for producing metal-based nanoparticles with high reproducibility, colloidal stability, and monodispersity. Powder X-ray diffraction studies confirm the crystallinity of the nanoparticles, with europium doping levels (ranging from 1% to 35%) showing minimal alteration to the crystal structures. Transmission electron microscopy images confirm the production of highly monodispersed nanoparticles with nearly spherical shapes. The nanoparticles exhibit europium (III)-based luminescence at 615 nm upon excitation at 340 nm, with a full-width at half maximum of 15 nm. Epifluorescent imaging of the nanoparticles using HEK293 cells demonstrates their potential for cellular imaging. Furthermore, the antimicrobial properties of zinc oxide nanoparticles against three different bacterial species are evaluated using agar diffusion and minimum inhibitory concentrations. The surface functionalization of the nanoparticles further enhances their potential for biomedical applications, promising exciting opportunities for the development of novel diagnostic and therapeutic strategies in the field of nanomedicine.

Keywords: Antimicrobial, biomedical imaging, lanthanides, luminescence, nanoparticles

Dr. Channa De Silva is a Professor of Chemistry and the Head of the Department of Chemistry & Physics at the Western Carolina University, USA. He completed his BSc degree in Chemistry with first-class honors at the University of Kelaniya, Sri Lanka, in 2000 and earned his PhD in Chemistry with a perfect GPA of 4.0 at the University of Arizona in the USA in 2007. He worked as a Research Associate at the Pacific Northwest National Laboratory, USA, and the Bio5 Institute at the University of Arizona, USA, from 2008 to 2010. His research focuses on developing metal-based nanomaterials for potential biotechnological applications and computational studies of materials containing heavy metals.

Dr. De Silva has won numerous teaching and research awards, including the Innovative Scholarship Award (2017), SoCon Faculty Member of the Year Award (2019), Hunter Scholar Award (2020), Visiting Faculty Program Scholar, Department of Energy (DOE) - USA (2021), Teaching Award, College of Arts & Sciences, Western Carolina University (2022), Chancellor's Distinguished Teaching Award (2024), and the Brinson Honors College's Faculty and Staff Excellence Award in 2024.

In his free time, he enjoys playing music, including northern Indian music, Sri Lankan music, and Appalachian and old-time music in the USA.

Keynote Lecture 04

INTEGRATING AI AND EDUCATIONAL TECHNOLOGY TO ENHANCE ENVIRONMENTAL EDUCATION

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The global concerns such as climate change, pollution, and the imperative of green chemistry, escalate the need for innovative educational strategies. This keynote speech presents a compelling vision for the integration of Artificial Intelligence (AI) and educational technology to revolutionize environmental education. This integration not only enhances the delivery and comprehension of complex environmental issues but also empowers students to actively participate in crafting sustainable solutions. The presentation begins by examining the current state of environmental education, which often struggles with outdated methodologies that fail to actively engage students or inspire practical involvement. Traditional educational approaches, while foundational, are frequently insufficient for conveying the intricate and interconnected nature of global environmental issues. This gap highlights the need for a more dynamic, technologically enhanced educational framework that can more effectively capture students' imaginations and encourage meaningful engagement. In response to these challenges, the keynote explores specific AI applications that hold the potential to transform environmental education. This includes advanced data simulation tools that provide detailed and interactive visualizations of environmental phenomena, enabling scalable learning experiences that allow students to interact with and manipulate complex data in real-time. AI-driven adaptive learning systems offer personalized educational experiences, catering to individual learning paces and styles, which enhances students' understanding and retention. Furthermore, AI facilitates collaborative projects that connect students from around the world, fostering a global perspective and collective problem-solving capabilities. A significant portion of the speech is dedicated to the integration of AI in teaching core concepts of green chemistry and pollution management. For instance, virtual reality (VR) simulations allow students to experiment with chemical processes in a safe, controlled environment, reducing the need for physical chemicals that can pose health risks and environmental hazards. AI models are also employed to predict and analyze pollution trends, enabling students to propose and test potential interventions and solutions. However, the deployment of AI in educational settings is not without challenges. The speech addresses several obstacles, such as the ethical implications of AI, the need for comprehensive teacher training, and the importance of ensuring equitable access to technology. Practical strategies for overcoming these barriers are discussed, emphasizing policy reform, the development of partnerships between educational institutions and tech companies, and ongoing professional development for educators. The conclusion of the presentation proposes a detailed framework for the systematic integration of AI and educational technology into environmental education curricula. This framework advocates for an interdisciplinary approach that not only focuses on environmental science but also incorporates elements of ethics, technology, and social studies. It aims to develop critical thinking and problem-solving skills among students, preparing them to tackle environmental challenges proactively. Through the strategic use of AI and educational technology, this keynote argues for a shift in educational paradigms from passive learning to active problem-solving. By empowering students with knowledge, tools, and a collaborative mindset, the proposed approach seeks to cultivate a generation of informed and motivated individuals capable of leading the change towards a sustainable and environmentally responsible future.

Keywords: Artificial intelligence in education, environmental education, green chemistry

Dr. T.M.S.S.K. Yatigammana Ekanayake is currently serving as a Professor in Education in the University of Peradeniya. She obtained her BSc degree from the Facutly of Science, University of Peradeniya. After completing her Master of Science in Science Education, in 2011, she obtained her PhD from the University of Bristol, United Kingdom with the thesis titled "The Potential of Mobile Phones to Support Science Teachers in Sri Lanka: A Focus on Pedagogy". In addition, she obtained several other postgraduate qualifications such as National Diploma in Teaching (1994), Postgraduate Diploma in Education (2000), Postgraduate Diploma in IT Education (2005), and Postgraduate Diploma in Research Methods (2011). Up-to-date Professor Ekanayake has published 04 books, 08 book chapters, 19 journal papers, and 23 conference papers. Her current research mainly focuses on the modes of education such as mobile learning, e-learning, pedagogy, educational technology and science education.

Keynote Lecture 05

MEDICINE: CHEMISTRY, PHARMACEUTICALS AND HERBAL TECHNOLOGY

Sameera R Samarakoon

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The intersection of Chemistry, Pharmaceutical Science, and Herbal Technology has sparked a revolution in modern Medicine. This speech delves into the dynamic landscape where traditional pharmacology meets cutting-edge research, highlighting the synthesis of chemical compounds, formulation of pharmaceutical products, and utilization of herbal remedies. Current therapies have limitations in terms of increased drug resistance resulting in short term efficacy, demanding the discovery of new therapeutic agents. Natural products have a pivotal role in drug discovery worldwide. Sri Lanka is one of the main biodiversity hotspots in the world with more than 850 endemic plants. By examining the intricate processes involved in drug discovery, development, and delivery, this speech elucidates the synergistic relationship between these disciplines. Through case studies and advancements in bioinformatics, this keynote underscores the pivotal role of interdisciplinary collaboration in addressing complex health challenges. Computer-based drug screening and development techniques are now being used by scientists with the aim of minimizing the time and money for scientific research. From plant-derived compounds to synthetic molecules, this speech navigates the diverse avenues shaping the future of medicine, promising innovative therapies and enhanced patient care.

Keywords: Chemistry, drug discovery, herbal technology, pharceutical science

Sameera R Samarakoon is a Professor in the IBMBB University of Colombo. He is also working as the Chairperson of the Business Development Unit at the same institute. He obtained his PhD in 2014 from the University of Colombo and completed a postdoctoral fellowship at the University of Pittsburg USA in 2014. In addition, Prof Samarakoon has completed his master's degree from IBMBB, University of Colombo on Molecular Life Sciences in 2008. Prof. Samarakoon's current research focuses on the development of anti cancer natural therapies and development of solutions for selected non communicable diseases. He has established cancer stem cell research first time in Sri Lanka in 2013. He has obtained several national and international grants for his research. Prof Samarakoon has supervised about 30 MSc and 3 PhD students and is currently supervising six PhD/MPhil students. Prof Samarakoon has received several national and international awards for his research including Presidential Awards in 2014, 2015 2016, and 2021 NRC merit awards in 2013, CVCD Excellence Award for most outstanding young researcher In the fields of Biological Science/Agriculture/Allied Science in 2018, Hiran Tillelerathne Special Awards in 2014, Award for the best postgraduate (PhD) research in Sri Lanka organized by SLAAS in 2014, Vice Chancellor's Award- for the research excellence in 2017 and 2020, Senate Award for Research Excellence in 2016, 2017, 2018, 2019, 2020, 2021, 2022 and 2023 and NSF Media Award (commendation) in 2019. He has authored about 85 international peer reviewed publications and has authored 130 presentations at national and international conferences. Further Prof Samarakoon is collaborating with leading private industry partners and has introduced some products developed at IBMBB. He is also extremely active in popularizing science and research in Sri Lanka.

Keynote Lecture 06

NATURAL ANTIMICROBIAL COMPOUNDS AND THEIR ROLES IN IMPROVING FOOD SAFETY, SECURITY, AND QUALITY

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Food systems are nutrient-dense materials made up of macromolecules and small molecules. Different classes of macromolecules include carbohydrates, proteins and lipids, while small molecules include vitamins, minerals, colors, flavor compounds, free monosaccharides and free amino acids. Chemically, food systems are complex colloidal systems where the macromolecules are arranged in the form of emulsions, foams, gels, and sols. Food systems are also prone to extreme microbial degradation due to the growth of microorganisms including spoilage and pathogens. The leading microbes responsible for hospitalizations include Salmonella (non-typhoidal), Norovirus, *Campylobacter* spp., *Toxoplasma gondii*, and *Escherichia coli* O157: H7. The major microbes which cause death through food systems include Salmonella (non-typhoidal), *Toxoplasma gondii*, *Listeria monocytogenes*, Norovirus, and *Campylobacter* spp. Different types of food processing technologies, such as high temperature, high pressure, pulsed electric field, ultrasound, atmospheric cold plasma and radio frequency processing, are available to protect food systems. As these techniques are expensive and require extensive maintenance cost, novel approaches need to be applied. One viable option is to use natural plant-based or animal-based antimicrobial compounds. The important plant-based antimicrobial agents include flavonoids, polyphenols, terpenes, alkaloids and organic acids, while the major animal-based antimicrobial compounds include lactoperoxidase, lactoferrin and lysozyme. Flavonoids are a class of physiologically active substances that possess bacteriostatic and antioxidant properties. Some promising polysaccharides that demonstrate antimicrobial activities include alginate, fucoidan, and kelp polysaccharides. Essential oils are a diverse group of molecules that exhibit broad-spectrum antimicrobial activity which includes ketones, aldehydes, esters, ethers, acids, and lactones. Some important essential oil components include thymol, ugenol, carvacrol, cinnamaldehyde, among many other molecules. The major antimicrobial peptides of plant-based sources include defensins, lipid transfer proteins, snakins, heveins, knottins, cyclotides, and thionins. Our laboratory has primarily focused on the synthesis, characterization, and application of biodegradable food packaging systems functionalized with antimicrobial agents from plant sources. A major focus of our research has been directed towards the application of essential oils in the preparation of such bioactive food packaging systems. The application of plant and animal-derived antimicrobial compounds can serve as robust materials for the overall improvement of food safety, security, and quality.

Keywords: Antimicrobial compounds, bioactive food packaging, foodborne pathogens, food safety

Dr. Preetam Sarkar is an Assistant Professor of Food Sciences at the Department of Food Process Engineering, National Institute of Technology Rourkela, Odisha, India. He completed his PhD in Food Sciences from Purdue University, USA and MS in Food and Nutritional Sciences from California State University-Fresno. The research at Dr. Sarkar's lab at NIT Rourkela focuses on the development of films, coatings, and emulsions for the protection of bioactive compounds such as antimicrobial compounds for food safety applications. He has published 48 articles in SCI cited journals, 12 book chapters, and co-edited 4 books. Dr. Sarkar has been nominated to become a full member of Sigma Xi, The Scientific Research Honor Society in 2023.

Keynote Lecture 07

FOOD: SECURITY SAFETY AND QUALITY

Anoma Chandrasekara

Department of Applied Nutrition, Wayamba University of Sri Lanka

Food security of a country ensures having physical, social and economic access to sufficient, safe and nutritious food to provide food preferences and dietary needs for an active and healthy life of its all people at all times. Food insecurity can lead to a triple burden of malnutrition which may exist simultaneously in a country and even within a single household. Food safety and quality play a critical role in ensuring food security as two complementing elements. Unsafe and poor-quality foods can pose a health risk from foodborne illnesses which leads to reduction of productivity, a considerable number of deaths and a challenge to human survival, through long term effects towards non communicable diseases. Thus, food security, safety and quality are imperative components of a sustainable food system. Thus, the strategies to maintain food safety and quality need to be addressed every single sector of food chain from farm to fork. National food control systems play a critical role in protecting the safety and health of consumers. The world increasingly depends on the global food supply chain to source ingredients as well as finished products. Food control systems make it possible to ensure the safety and quality of the foods entering international trade and to certify the conformity of the imported foods to national requirements. The growing interest of consumers in the way food is produced, processed and marketed, cannot be undermined. They are increasingly calling for the attention of national bodies and the government to take the responsibility for food safety and quality. Hazards associated with food include microbiological pathogens, naturally occurring toxins, allergens, intentional and unintentional additives, modified food components and agricultural chemicals, among others. The terms food safety and food quality could be confusing as food safety refers to all those hazards, whether chronic or acute, that may make food injurious to the health of the consumer. Food quality includes all other attributes such as product sensory and nutritional characteristics, correct labelling, proper packaging, ingredient standard and traceability that influence the value of the product to the consumer. Food standards build the confidence of the consumers in safety, quality and authenticity of foods they eat. Today, food suppliers, producers and manufacturers operate in such an environment that new hazards and pathogens regularly emerge in the global food supply chain in addition to allergens and food fraud. The added pressures of climatic changes, economic crisis and population growth compound the problem of ensuring food security of the populations in countries. It is imperative to identify strategies, technologies, commitments and human and institutional capacity that will make sustainable and resilient global food security systems to provide regular access to diverse diets with adequate amounts of nutritious foods that are safe and affordable to populations. Thus, each of the component of food safety and food quality is essential with the collaboration among all multisectoral stakeholders to leverage the food safety and food quality standards knowledge, risk management methods and interventions across the global food supply chain.

Keywords: Food control system, food standards, food system, multisectoral collaborations

Dr. Anoma Chandrasekara is a Professor in Food Science & Human Nutrition at the Department of Applied Nutrition, Wayamba University of Sri Lanka. She received her MPhil from University of Peradeniya, Sri Lanka and PhD from Memorial University of Newfoundland, Canada. Having trained in both nutrition and food science she has developed a unique research program for investigating the bioactivities and mode of actions of phenolic compounds of underutilized tropical foods such as cereals, legumes, roots and tubers and herbal beverages. Working on the interface of food science and nutrition she investigates the impact of food components, processing and preparation on health and nutrition. Her current teaching and research interests are focused around biochemistry and nutritional aspects of foods, natural antioxidants, food toxicology, phytochemicals and their bioaccessibility, bioavailability and bioactivities, functional foods, diet and diseases and nutritional risk factors of non-communicable diseases. Dr Chandrasekara has authored and coauthored over 100 conference abstracts, and over 40 research articles and book chapters on food and nutrition. She has served as a member of various expert committees, advisory boards and scientific journal editorial boards.

Energy:

Chemistry, Technology and Engineering

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PHYSICOCHEMICAL AND ANTIOXIDANT PROPERTIES OF CHITOSAN/PECTIN BLENDED BIO-NANOCOMPOSITE FILMS WITH GREEN TEA EXTRACT AND TiO_2

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The present work is based on the fabrication and comparative investigation of physicochemical properties, total phenolic content (TPC) and antioxidant properties of chitosan/pectin (CS/PC) blended nanocomposites reinforced with TiO_2 nanoparticles (NPs) integrated with green tea extract (GTE). Four different GTEs were prepared named GTE 1 [in 10% ethanol, at Room Temperature (RT)], GTE 2 (in 10% ethanol, at 40 °C), GTE 3 (in 25% ethanol, at RT), and GTE 4 (in 25% ethanol, at 40 °C). Different films were fabricated using solvent casting technique with equal amounts of concentrated GTEs as CS/PC/TiO_2/GTE 1, CS/PC/TiO_2/GTE 2, CS/PC/TiO_2/GTE 3, CS/PC/TiO_2/GTE 4, CS/PC/TiO_2, and CS/PC. The incorporation of TiO_2 NPs into films has exhibited a slight variation in film thickness, according to thickness measurements obtained. Incorporation of TiO_2 NPs raised the moisture content [CS/PC – (36.25±0.39)%, CS/PC/TiO_2 – (38.13±0.13)%], while assimilation of GTE reduced the moisture content [CS/PC/TiO_2/GTE 4 – (31.27±0.06)%]. Film solubility decreased with adding TiO_2 NPs, while adding GTE firmly increased the water solubility [CS/PC – (36.37±0.35)%, CS/PC/TiO_2 – (35.85±0.66)%, CS/PC/TiO_2/GTE 4 – (39.52±0.48)%]. Reduction of water vapor permeability was observed with TiO_2 and NPs, and further reduction was achieved with GTE integration with films [6.34±0.16, 5.17±0.08, (1.75±0.04)×10^{-11} g m^{-1} s^{-1} Pa^{-1}, respectively, for CS/PC, CS/PC/TiO_2 and CS/PC/TiO_2/GTE 4]. No notable variation was observed in the oil permeability coefficient as all films were supported with amphiphilic CS polymer. Integration of GTE compatibly enhanced the antioxidant activity, emphasizing film with GTE 4 with the highest scavenging activity (30.70±0.33)%, owing to its potential extraction conditions compared with the other three GTEs. This is also in good agreement with the highest TPC values for the film GTE 4, 18.63±0.37 mg GAE g^{-1} obtained. This study emphasized the potential of the use of all the fabricated membranes as novel active food packaging films. The film CS/PC/TiO_2/GTE 4 showed the best properties compared to other fabricated films.

Keywords: Chitosan, green tea extract, pectin, TiO_2

EN_002

ATOMISTIC SIMULATION STUDY OF $Na_2Ti_3O_7$: DEFECTS, DIFFUSION AND DOPANTS

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Sodium-ion batteries are emerging as prominent candidates for large-scale energy storage systems owing to raw materials being high abundance and low cost. $Na_2Ti_3O_7$ has demonstrated several crucial abilities essential for serving as a promising anodic material for sodium-ion batteries. Limited studies hinder a full theoretical grasp of this material. Computational modeling offers a pathway to expand understanding, guiding experiments and offering insights into its energy trends. Therefore, lattice-based atomic simulations based on classical pair potentials are employed to scrutinize defects, Na-ion diffusion pathways together with activation energies, and promising dopants on the Na and Ti sites in $Na_2Ti_3O_7$ material using guided utility lattice software (GULP). The Na-Ti anti-site cluster defect process is energetically favorable indicating the presence of cation mixing in this $Na_2Ti_3O_7$ material which can influence the properties of this material. Notably, the Na Frenkel defect, which creates Na vacancies in the lattice, is the second most favorable defect process which is higher in energy by 0.27 eV than the anti-site cluster defect energy. The lowest Schottky energy is reported for the formation of TiO_2. The lowest activation energy in a promising three-dimensional constructed Na-ion diffusion pathway is 0.23 eV along the *bc* plane indicating that the Na-ion diffusion along this pathway is fast and favorable. The most favorable monovalent dopant on the Na site is the K, with the lowest dopant energy observed for the K^+ ion at 1.75 eV. The Ge is the most promising tetravalent dopant on the Ti site. Aliovalent dopants were considered on the Ti site to create additional Na-interstitials in this material. The promising aliovalent dopant on the Ti site is predicted to be the Ga^{3+}. The presence of this dopant can create additional Na-interstitial and improve the capacity of Na-ion batteries.

Keywords: Atomistic simulation, defect, ion migration, $Na_2Ti_3O_7$

EN_003

ANALYSIS OF DEMAGNETIZATION ENERGY IN FERROMAGNETIC THIN FILMS USING THE FOURTH ORDER PERTURBED HEISENBERG HAMILTONIAN WITH ALL SEVEN MAGNETIC ENERGY PARAMETERS

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The investigation of magnetic properties in ferromagnetic thin films is crucial for understanding their behaviour in various applications. In this study, we analyse the energy behaviour of such films for simple cubic structure with two spin layers using the fourth order perturbed Heisenberg Hamiltonian with all seven magnetic energy parameters. Spin exchange interaction, magnetic dipole interaction, second and fourth order magnetic anisotropy constants, in and out of plane applied magnetic fields, demagnetization energy, and stress induced anisotropy constant were considered in the model. 3D plot of total magnetic energy versus angle and demagnetization energy were plotted using different values of fourth order magnetic anisotropy constants. All the other magnetic energy parameters were fixed at constant values. All peaks are closely packed in graphs plotted using the fourth order perturbed Heisenberg Hamiltonian compared to that of the graphs plotted using the second and third order perturbed Heisenberg Hamiltonian. In this study, the order of magnetic energy was found in the range of 10^{49} to 10^{50}. The order of magnetic energy slightly changes when the values of fourth order anisotropy constants of two spin layers are interchanged. The higher order magnetic energy was observed when the fourth order magnetic anisotropy of top spin layers is increased. In addition, the graphs of energy versus angle were plotted to find the magnetism in easy and hard directions. The angle between magnetic easy and hard direction is approximately 90° in all cases.

Keywords: Demagnetization energy, fourth order perturbed Heisenberg Hamiltonian, magnetic anisotropy constant, magnetic thin films, spin

EN_004

TAILORING CRYSTALLINE MORPHOLOGY IN POLY(ETHYLENE OXIDE)-POLY(ETHYLENE GLYCOL) BLENDS FOR ENHANCED PERFORMANCE IN QUASI-SOLID DYE-SENSITIZED SOLAR CELLS

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This study investigates the morphology and microstructure of blends of poly(ethylene oxide) (PEO) and poly(ethylene glycol) (PEG) in different ratios using polarized optical microscopy (POM). PEO and PEG, known for their versatile properties, are applied in pharmaceuticals, materials science, biotechnology, electrophysics and electrochemistry. PEGs typically have molar masses below 20,000 g mol^{-1}, while PEOs exceed this threshold. POM analysis, aided by ImageJ software, determined spherulite sizes in the polymer blend samples prepared using the solvent casting method with acetonitrile solvent. The 100% PEG containing sample exhibited a maximum average spherulite size of 374.49 μm, contrasting with the 100% PEO sample's minimum of 205.97 μm. It was observed, that spherulite size increases with increasing PEG content, except for the 75:25 PEO:PEG sample, deviating at 257.44 μm. Exploring pleochroism in the polymer blend revealed notable findings. It is observed that high pleochroism in the 100% PEO sample gradually diminished with increasing PEG content. This study contributes to an advanced comprehension of crystalline morphology, spherulite size, and pleochroism in PEO-PEG blends, providing valuable insights for potential applications in diverse scientific and industrial fields, particularly in renewable energy technologies, such as dye-sensitized solar cells (DSSCs) and their gel polymer electrolytes. The polymer blends synthesized were used to prepare gel electrolytes. Quasi-solid DSSCs were fabricated utilizing electrolytes prepared using blends of PEO and PEG polymers. The quasi-solid DSSCs exhibited varying power conversion efficiencies (PCEs) correlated with the spherulite sizes observed in the PEO-PEG blends. Notably, the DSSC containing a 75:25 PEO:PEG-based electrolyte demonstrated the highest PCE at 8.76%, while in recent studies on PEO-based mixed electrolytes for DSSCs, the highest efficiency recorded was 6.56% for PEO-PANI (polyaniline) system. This finding establishes a compelling correlation between spherulite sizes in the polymer blends and the photovoltaic performance of the resulting DSSCs. Overall, the study shows optimizing the crystalline structure of PEO-PEG blends is crucial for enhancing quasi-solid DSSC efficiency and advancing their potential in renewable energy conversion.

Financial support provided by the Postgraduate Institute of Science, University of Peradeniya, Sri Lanka (Grant no: PGIS/2020/05) is acknowledged.

Keywords: Dye-sensitized solar cells, gel electrolytes, mixed polymer, pleochroism, spherulites

EN_005

ELECTROCHEMICAL SYNTHESIS OF POROUS POLYANILINE FOR HIGH-PERFORMANCE SUPERCAPACITOR APPLICATION

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The escalating demand for sustainable and efficient energy storage technologies has positioned polyaniline as a desirable material for energy storage devices, such as supercapacitors due to its properties, including high conductivity, redox activity, excellent environmental stability, low-cost and easy preparation. However, the challenge of enhancing its charge storage capability remains a significant impediment to achieving its full potential in high-performance supercapacitors. In response to this challenge, a novel and facile electrochemical approach to synthesize porous polyaniline is proposed. This novel approach diverges from conventional methods by eliminating the necessity for templates to form pores in the polyaniline matrix, and it promotes pore formation using a readily available organic dye. This method consists of electrochemical polymerization of aniline by cyclic voltammetry (CV) in the presence of methylene blue (MB) in acidic media, and the extraction of MB using ethanol. The introduction of porosity in the polyaniline matrix significantly enhanced the material's surface area facilitating rapid ion diffusion and promoting improved charge storage capabilities. The polyaniline synthesized after the extraction of MB was characterized structurally through Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM). FTIR spectroscopic analysis confirmed the deposition of polyaniline on the electrode substrate, while SEM images showed pore structures in the polyaniline matrix. The electrochemical characterization of material was carried out using CV in 0.5 mol L^{-1} H_2SO_4 electrolyte solution using a three-electrode configuration to illustrate the capacitive behavior of the material. The CV data showed a significant enhancement in the capacitance of porous polyaniline to 13 mF cm^{-2} at a scan rate of 5 mV s^{-1} compared to the capacitance of traditional polyaniline of 7.6 mF cm^{-2}. These findings show the efficacy of the proposed electrochemical synthesis method in enhancing the charge storage capability of polyaniline for its potential for high-performance supercapacitor applications.

Financial support provided by the Asian Development Bank (Grant no: CRG-R2-SB -1) is acknowledged.

Keywords: Electrochemical polymerization, polyaniline, porous structure, supercapacitor

EN_006

SYNTHESIS AND CHARACTERIZATION OF *N,N′,N′′*-DONOR SULFONAMIDE LIGANDS TERMINATED WITH QUINOLINE RINGS AND THEIR PLATINUM COMPLEXES

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Platinum complexes have been extensively studied for their antimicrobial and anticancer properties owing to their ability to interact with DNA and proteins and in recent years there has been a growing interest in the development of novel N-donor ligands that can enhance the biological activity. This study focuses on the synthesis and characterization of novel *N,N′,N′′*-donor linear sulfonamide ligands terminated with quinoline rings and their corresponding platinum complexes to explore their potential biological applicability. Specifically, we are investigating two bis(2-methylquinolinyl)sulfonamide ligands (**L**), in which the central N is within a tertiary sulfonamide containing a dangling R group (R = Me and 5-(dimethylamino)-naphthalene). The ligands and their neutral platinum complexes were characterized using various spectroscopic techniques including ^{1}H and ^{1}H–^{1}H ROESY NMR, UV/Visible, FTIR, and fluorescence. Analysis of ^{1}H NMR spectral data shows a sharp singlet corresponding to methylene protons indicating that L binds to the metal monodentately to produce a symmetrical complex. If the ligands were bound bidentately or tridentately, the free rotation of the methylene protons will be restricted, producing complicated NMR signals. Further, it is reported that the tertiary sulfonamide (in similar ligands) do not favor anchoring meridionally coordinated five-membered chelate ring/s with Pt(II) ions. Thus, we conclude that the new complexes are formed in [*trans*-Pt(DMSO)Cl_2]$_2$(μ-**L**) form, which is strongly supported by the 2D NMR data. However, confirmation of the structure would be achieved by an X-ray crystallographic analysis. Currently, the [*trans*-Pt(DMSO)Cl_2]$_2$(μ-**L**) complexes are being evaluated for their potential antimicrobial activity against both gram-positive and gram-negative bacterial growth *via* the disc diffusion method. In addition, the potential anticancer activity of these compounds will be evaluated. These studies will provide valuable insights into the potential therapeutic applications of the newly synthesized compound.

Keywords: Anticancer, antimicrobial, N-donor sulfonamide ligands, quinoline

EN_007

CORROSION INHIBITION EFFECTS OF PHOSPHATE SPECIES ON GRADE 202 STAINLESS STEEL IN THE PRESENCE OF OTHER CHEMICAL CONSTITUENTS

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Grade 202 stainless steel (SS) possesses high corrosion resistance towards mild acidic environments, because of the interference caused by forming a passive film of chromium oxide on the surface of stainless steel. Nevertheless, the corrosion stability of Grade 202 SS in certain acid environments, especially under aggressive conditions is questionable. On the other hand, although the corrosion inhibitory action of phosphate species on Grade 202 SS has been well documented, the effect of various chemical constituents under moderate and aggressive acidic conditions on its corrosion has not been given due attention despite the wide use of Grade 202 SS-based machinery in industrial applications. As such, variation of corrosion inhibition efficiency of HNO_3 and H_3PO_4 on Grade 202 SS at different concentrations, and impact of these acids in the presence of chloride ions along with the effect of various phosphate species were investigated in this study. Mass loss measurements of rectangular specimens immersed separately in HNO_3 and H_3PO_4 acid solutions at different concentrations in the presence of HCl, under ambient conditions, conclusively demonstrate the superior corrosion inhibitory behavior of H_3PO_4 and HNO_3 on Grade 202 SS, even in chloride-rich environments under low acidic conditions, despite the pitting corrosion promotion action of chloride species. Polarization resistance determined by electrochemical impedance spectroscopy further supports the corrosion inhibitory action of H_3PO_4 on Grade 202 SS, while open circuit measurements indicate the strong correlation between H_3O^+ and surface characteristics. The order of corrosion inhibition ability of phosphate species on Grade 202 SS, as determined by mass loss measurements, follows the order, $Na_3PO_4 > Na_2HPO_4 \sim NaH_2PO_4 > H_3PO_4$.

Keywords: Corrosion, impedance, inhibition, stainless steel

EN_008

CINNAMON LEAF OIL EMBEDDED POLYANILINE FILMS FOR CORROSION INHIBITION OF GRADE 202 STAINLESS STEEL

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Corrosion is a major problem faced by industries leading to significant economic loss. It is thus necessary to employ corrosion inhibition methodologies, especially for metals and metallic objects used in industry. Stainless steel (SS) is an alloy of steel known for its elevated corrosion resistance, surpassing that of other iron-based alloys, and it is heavily used in industrial machineries. However, it undergoes corrosion in aggressive environments requiring corrosion inhibition. It is important that corrosion inhibitors should be economical and environmentally friendly, and sustainable in aggressive environments. In this respect, this research is focused on the evaluation of corrosion inhibition ability of different coatings: polyaniline (PANI) layer, cinnamon leaf oil layer, and composite layer consisting of both PANI and cinnamon leaf oil, on Grade 202 SS in 0.5 mol L^{-1} HCl medium. Electrochemically deposited PANI layer formed on the surface of SS using the aniline monomer in oxalic acid solution shows an increased corrosion inhibition of 75% according to Tafel slope analysis. The PANI layer serves as a conducting polymer, acting as a physical barrier on the SS surface, effectively inhibiting corrosion. On the other hand, cinnamon leaf oil extracted through steam distillation, when applied to the SS surface by immersing the specimen in the oil for 12 h, inhibits corrosion *via* anodic protection by reversing the anodic reaction. Both mass loss measurements and electrochemical impedance spectroscopy indicate that various coatings follow the order of corrosion inhibition: blank < oil < PANI < PANI/oil. The composite layer of PANI/oil thus shows a synergistic corrosion inhibition effect, demonstrating an excellent inhibition, as determined by a multi-technique approach using mass loss measurements, electrochemical impedance spectroscopy and Tafel slope analysis.

Keywords: Impedance, PANI, stainless steel, Tafel plots

EN_009

EXPLORING THE ELECTRONIC/SEMICONDUCTING PROPERTIES OF Co, Ni, Mg, Zn-MOF-74s UPON ANILINE AND ANILINE DERIVATIVE ENCAPSULATION

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Metal-organic frameworks (MOFs) represent a versatile class of hybrid organic-inorganic materials, known for their diverse properties including tunability, high porosity, and structural versatility. The honeycombed-shaped MOF-74 stands out due to its unique one-dimensional channel network, with each metal ion bonded to five oxygen atoms leaving one coordinate site vacant. Here, Co, Ni, Zn, and Mg-MOF-74s were synthesized *via* room-temperature synthesis, and their semiconducting properties were fine-tuned using electron-rich guest molecules; aniline and aniline derivatives, through vapor phase encapsulation. Powder X-ray diffraction patterns confirmed the successful synthesis of MOF-74s, with major diffraction peaks of ~6.7° and ~11.7° corresponding to (110) and (300) crystal planes, respectively. Solid-state UV-Visible diffuse reflectance data analysis, employing Kubelka-Munk equations, revealed band gaps indicative of the influence of transition and non-transition metal ions. Accordingly, Co exhibited the lowest band gap of 2.72 eV, followed by Ni, Zn, and Mg at 2.75 eV, 2.87 eV, and 2.86 eV, respectively. Encapsulation of aniline, *m*-toluidine, *p*-toluidine, *o*-anisidine, and *p*-anisidine resulted in a reduction of band gap across Co, Ni, Zn, and Mg-MOF-74 compounds. Noteworthy was the reduction achieved through aniline and *p*-anisidine encapsulation over the other guests. Aniline-encapsulated Co, Ni, Zn, and Mg-MOF-74 band gaps were reduced to 2.14 eV, 2.72 eV, 2.83 eV, and 2.78 eV, respectively. Moreover, *p*-anisidine encapsulation led to even lower band gaps, 1.92 eV, 2.58 eV, 2.59 eV, and 2.56 eV respectively. The photoanodes were subjected to cyclic voltammetric analysis with three cycles, following aniline and *p*-anisidine encapsulation, they exhibited higher efficiencies compared to the pristine counterparts. Moreover, aniline performed best, boosting efficiency by 2-13 times for Co, Mg, Ni, and Zn-MOF-74. These results highlighted the influence of guest molecule encapsulation and electrochemical polymerization on MOF electronic properties. This approach offers dual benefits of sensitization and semiconductor enhancement, producing MOF-sensitized solar cells.

Keywords: Bandgap, guest molecules, metal-organic framework, semiconductor

EN_010

ELECTROCHEMICAL PERFORMANCE OF CuO ANODE MATERIAL SYNTHESIZED BY CHEMICAL PRECIPITATION TECHNIQUE AT DIFFERENT TEMPERATURES, FOR RECHARGEABLE LITHIUM-ION BATTERIES

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Copper oxide (CuO) is a desirable anode material for the rechargeable lithium ion battery (LIB) due to its high theoretical capacity (675 mA h g^{-1}), good capacity retention, affordability, non-toxicity, and ease of storage. The electrochemical performance of CuO mainly depends on morphology and anode/current collector interfacial properties, which can significantly be manipulated by the synthesizing technique. Therefore, this study aims for preparing CuO anode materials by a chemical precipitation technique with enhanced crystallinity, morphology, and anode/current collector interfacial properties. The lithium ion rechargeable coin cells were assembled in an argon-filled glove box with anodes fabricated with synthesized CuO at different bath temperatures (25 °C, 50 °C and 75 °C). The galvanostatic charge-discharge characterization study of the CuO electrodes reported high initial discharge capacities of 2827.1, 3371.9 and 2009.9 mA h g^{-1} with a Coulombic efficiency (CE) of 58%, 40.6% and 33.1% at a rate of C/5 for those synthesized at 25 °C, 50 °C and 75 °C bath temperatures, respectively. Further it showed discharge capacities of 466.2, 442.9 and 232.3 mA h g^{-1} with Coulombic efficiencies of 88.7, 97.4 and 95.9% after 50 cycles for those synthesized at 25 °C, 50 °C and 75 oC bath temperatures, respectively. The results revealed that CuO anodes prepared in this study show considerably better electrochemical performance compared to that of the previously reported. However, the best performance was reported by CuO synthesized at 25 °C compared to that synthesized at 50 °C and 75 °C. The enhanced electrochemical performance could be related to the enhanced contact surface area between CuO and electrolyte and anode/current collector interfacial properties. It could have led to the enhanced contact between CuO and electrolyte, hence reducing diffusion length for lithium ions. The enhanced anode/current collector interfacial properties may facilitate for electrons to transfer between current collector and active material. Accordingly, the present study reveals that the chemical precipitation method is a promising technique, which improves the crystallinity with favorable morphology and anode/current collector interfacial properties of electrode materials indicating a high potential for the anode application in next-generation high-performance LIBs.

Keywords: Anode materials, chemical precipitation, CuO, Li-ion battery

EN_011

SYNTHESIS OF REDUCED GRAPHENE OXIDE/$CaWO_4$ COMPOSITE PHOTOANODE FOR ENHANCED ACTIVITY TOWARDS PHOTOELECTROCHEMICAL WATER SPLITTING

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Hydrogen is a clean, energy-efficient, and environmentally friendly fuel that holds promise for the future. Photoelectrochemical water splitting has attracted tremendous interest in low-cost clean hydrogen production. Researchers have started to develop potential photocatalysts to improve the efficiency of the water-splitting reaction. The scheelite oxides and their derivatives comprise a large family of promising semiconductor photocatalysts because of their structural simplicity and flexibility, good stability, and efficient photocatalytic performance. In this study, scheelite calcium tungstate ($CaWO_4$) [coated on fluorine doped tin oxide (FTO)] and graphene oxide were synthesised using chemical bath deposition-calcination and Hummers' methods, respectively. Furthermore, prepared graphene oxide was deposited on $CaWO_4$ to form a rGO/$CaWO_4$ composite by electrophoretic deposition, which improved the photoelectrochemical performance of the $CaWO_4$ photoelectrode. Electrode characterization was done by Fourier transform infrared spectroscopy, X-ray diffraction, Mott-Schottky analysis and UV-Visible spectroscopy. Photoelectrochemical oxidation of water was monitored in a standard three-electrode cell using a platinum counter electrode, and Ag/AgCl (3.33 mol L^{-1} KCl) reference electrode. The PEC activity of the films has been derived through linear sweep voltammetry under periodic chopped UV-Vis illumination of 35 mW cm^{-2} (using Xe-lamp) in 0.1 mol L^{-1} Na_2SO_4 (pH 7, PBS) within the potential range of 0 to 1.2 V at a scan rate of 10 mV s^{-1}. Under periodic UV-Vis irradiation for water oxidation, the composite material (rGO/$CaWO_4$) showed the highest photocurrent of 10 µA cm^{-2}, while $CaWO_4$ only showed 0.25 µA cm^{-2} when measure at 0.8 V. Photocurrent is increased as charge transfer resistance at the electrode surface decreases, allowing charge transfer reactions to occur more easily. Furthermore, the photoelectrodes prepared demonstrate excellent stability for water splitting.

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Keywords: Calcium tungstate, photocurrent, reduced graphene oxide, water splitting

EN_012

DEVELOPMENT OF AN INEXPENSIVE BATTERY-OPERATED POTENTIOSTAT FOR MICROFLUIDIC STUDIES

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Microchip electrophoresis stands as a pivotal method in analytical chemistry and biochemistry, enabling rapid and precise analysis of biological samples. This research endeavors to address pertinent challenges inherent in microchip electrophoresis by introducing a low-cost, battery-powered potentiostat tailored for microfluidic experiments. Portable and versatile setups are imperative for field applications where power sources may be limited, rendering battery-operated potentiostats indispensable. The selection of a direct current (DC) power supply for microchip electrophoresis is paramount to prevent potential potentiostat damage. Concerns regarding higher voltage grounding through alternating current (AC)-powered potentiostats underscore the necessity for DC sources, which inherently mitigate risks and ensure the integrity of the potentiostat system. This study pioneers an innovative approach utilizing 1.5 V zinc-carbon batteries to energize an Arduino-controlled circuit. Central to the apparatus is an Arduino Uno microcontroller, facilitating programmability and adaptability in experiment design and data acquisition. The developed potentiostat provides researchers with the ability to perform fundamental techniques in electrochemical analysis such as cyclic voltammetry and amperometry, and integrates mobile phones as readout devices, eliminating the need for specialized equipment and improving accessibility and user convenience. Such versatility extends the applicability of the potentiostat across domains such as chemical sensing, environmental monitoring, and biological research. By amalgamating these features into a lightweight, battery-powered apparatus, this research represents a significant advancement in microfluidic investigations. The most remarkable feature of the newly developed potentiostat is its lower cost and simplicity than most of the commercially available potentiostats. This innovation enables scholars and professionals to perform electrochemical evaluations with unparalleled convenience and efficacy, thereby heralding a new era in portable microchip electrophoresis applications.

Keywords: DC potentiostat, microchip electrophoresis, microfluidic experiments

EN_014

OPTIMIZATION OF GEL POLYMER ELECTROLYTES FOR ZINC/ BROMINE GEL BATTERIES

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The highly reversible zinc-bromide redox combination has been effectively utilized in zinc/bromine gel batteries. Gel polymer aqueous electrolytes (GPAEs) are being explored as an alternative to liquid electrolytes for creating safer and hassle-free zinc/bromine gel batteries due to the minimization of bromine evaporation, thereby reducing health risks. This study investigates the impact of varying concentrations of zinc bromide and 1-ethyl-1-methylpyrrolidinium bromide (QBr) solution on gel polymer electrolytes. Here, QBr contributes as the complexing agent that captures bromine in the cathode. Additionally, the effects of individual incorporation of supporting electrolytes such as potassium bromide, ammonium sulfate, ammonium chloride, and sodium chloride were explored. Further, the effects of the supporting electrolytes when incorporated in combination with two or more of each other were tested for zinc/bromine gel batteries. A graphite felt and glass mat was modified by incorporating graphite powder and used to mitigate sedimentation of the bromine complex due to gravity in zinc/bromine gel batteries. Another issue with these batteries was the formation of zinc dendrites, which was minimized by the addition of ethylenediaminetetraacetic acid (EDTA). The assembled cells utilizing aqueous polymer gels were tested for energy efficiency, stability, cycle life, and Coulombic efficiency by measuring the current and voltage over time. The optimal pH range was stable around 2.50-3.00 for zinc/bromine gel batteries. The charging voltage and charging current density were 1.95 V and 10 mA cm^{-2}, respectively. Thereby the developed zinc/bromine gel battery provides more than 90% Coulombic efficiency, more than 65% energy efficiency, and 1.84 V theoretical voltage and 1.65 V output voltage. Due to the hardness of the graphite felt, the downward sedimentation of the bromine complex is reduced, thereby increasing cell efficiency.

Keywords: Coulombic efficiency, dendrites, gel polymer, supporting electrolyte

EN_015

DEVELOPMENT OF POLYMER GEL FOR ZINC/BROMINE GEL BATTERY

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Due to the high cost and scarcity of lithium, there is a growing need to develop a high-energy density battery as an alternative to Li-ion battery. An environmentally friendly, cost-effective zinc/bromine gel battery presents a better energy solution, due to its deep discharging ability, long cycle life, and low degree of fire risk. This study focuses on the development of polymer gels specifically designed for zinc/bromine gel batteries, aiming to resolve the problem of the intriguing phenomenon of bromine complex migration under gravitational forces. The novel gels were developed using varying concentrations of polyethylene oxide (PEO), polyethylene glycol (PEG), sodium stearate incorporated PEO and sodium stearate incorporated PEG, and a combination of silica and PEO which were stable around pH 2.75. The incorporation of PEO was found to be advantageous due to its inherent stability and strong ion conduction affinity. Coulombic efficiency, stability, cycle life, and energy efficiency of the assembled cells which are assigned with the developed aqueous polymer gels were tested by measuring the charging and discharging current and the voltage with time. The cell contains graphite electrodes, a polypropylene membrane separator, polymer gel, and zinc bromide aqueous solution as the main electrolyte. The charging voltage and charging current density were 1.95 V and 10 mA cm^{-2}, respectively. Thereby, the developed zinc/bromine gel battery provides 1.84 V theoretical voltage and 1.65 V maximum output voltage with more than 95% coulombic efficiency and more than 65% energy efficiency. Further, improvements in conductivity and optimization of gel viscosity are required to elevate the performance.

Keywords: Aqueous polymer gel, coulombic efficiency, energy efficiency, zinc/bromine gel battery

EN_016

ELECTROCHEMICAL STUDIES OF MAHANIMBINE ISOLATED FROM *Murraya koenigii*

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Materials extracted from biological sources, such as natural products, are of significant interest for future electronics due to reproducibility and avoidance of tedious synthesis steps which may include harsh conditions and corrosive or toxic reagents. Currently, available D-A type (donor-acceptor type) electronically conducting polymers (ECPs) utilize synthetic donor (D) and acceptor (A) materials although there is a rich wealth of naturally available materials that fulfill requirements as A or D units, and it would open up the horizon of a novel area of materials design. There are few reports on the use of carbazole and isoquinoline alkaloids to synthesize ECPs and application on optoelectronic devices and bio-imaging techniques. Carbazole and its derivatives consist of extended conjugated systems and they have become important materials for optoelectronic applications in recent years. *Murraya koenigii* is a well-known plant, rich in carbazole alkaloids. However, none of the carbazole alkaloids has been electrochemically characterized. In this research, conjugated molecules present in *Murraya koenigii* leaves (called curry leaves) have been investigated to incorporate for synthesizing D-A type polymers by considering the electrochemical analysis of the compound. Mahanimbine (3,5-dimethyl-3-(4-methylpent-3-en-1-yl)-3,11-dihydropyrano[3,2-a]carbazole) is a natural compound that can be classified as a monoterpenoid indole alkaloid which is a carbazole alkaloid found in the root, leaves, and stem of *Murraya koenigii*. It was isolated from *Murraya koenigii* leaves in 0.004% yield, and the structure was confirmed using UV-Visible, ^{1}H-NMR, ^{13}C-NMR and electrochemical techniques. Electrochemical studies of mahanimbine were done in acetonitrile solution containing tetrabutylammonium hexafluoroborate background electrolyte and the resulting mahanimbine solution was analyzed using Fourier transform infrared spectroscopy. Overall, the cyclic voltammogram of mahanimbine showed that it is an electrochemically active molecule that undergoes an oxidation reaction. It has a sharp oxidation peak centered at +1.05 V due to radical cation formation and leads to oxidative polymerization. Therefore, future studies will be conducted to co-polymerize mahanimbine with acceptor molecules. Hence it can be concluded that mahanimbine could be considered as an important molecule that could be developed in future optronic and photonic applications.

Financial assistance from the US Air Force (Grant No. FA2386-21-1-4096) is acknowledged.

Keywords: Advanced functional materials, mahanimbine, *Murraya koenigii*, oxidative polymerization

Environment:

Climate change, pollution and Green Chemistry

EV_017

UTILIZATION OF *Parthenium hysterophorus* WEED FOR ECO-FRIENDLY BIOPLASTIC FILMS INCORPORATED WITH GREEN-SYNTHESISED ZnO NANOPARTICLES: ENHANCING UV SHIELDING PROPERTIES

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Petroleum-based plastic pollution poses a significant environmental threat, prompting the exploration of eco-friendly alternatives, such as biopolymers, derived from renewable plant sources. This study focuses on leveraging *Parthenium hysterophorus* weed, an invasive species, for the synthesis of cellulose-based bioplastics with enhanced ultraviolet (UV) shielding properties through the incorporation of green-synthesized zinc oxide (ZnO) nanoparticles. The methodology commenced with the extraction of cellulose from *P. hysterophorus* stems, yielding a cellulose extraction efficiency of 27%, followed by its conversion into cellulose acetate. Green synthesis of ZnO nanoparticles utilizing *P. hysterophorus* leaf extract was successfully accomplished, and these nanoparticles were then incorporated into the cellulose acetate matrix at various concentrations. Subsequently, bioplastic films were fabricated from the nanoparticle-infused cellulose acetate through casting method and subjected to characterization through X-ray diffraction (XRD) and UV analysis. XRD analysis clearly confirmed the successful integration of ZnO nanoparticles into the bioplastic films, leading to improved film crystallinity. Moreover, UV analysis showed a significant increase in absorbance within the UV-A range (315-400 nm) as the concentration of ZnO nanoparticles increased, with noticeable enhancements seen at concentrations of 7% and 10%. These findings highlighted the effectiveness of ZnO nanoparticles in enhancing the UV shielding abilities of the bioplastic films, thus offering a promising pathway for the development of environmentally friendly materials with better UV protection. This research demonstrates the successful synthesis of eco-friendly bioplastics with enhanced UV protection from *P. hysterophorus* weed, offering a sustainable solution to plastic pollution while contributing to invasive weed management. By repurposing an invasive species for beneficial purposes, this study showcases a dual-purpose strategy for ecological sustainability. Additionally, the integration of ZnO nanoparticles enhances the functional properties of bioplastics, making them suitable for diverse applications in packaging and beyond.

Keywords: Bioplastics, nanoparticles, *Parthenium hysterophorus*, UV-shielding

EV_018

TOXICITY ASSESSMENT OF A SUNSCREEN CREAM ON COMMON GUPPY, *Poecilia reticulata*

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Cosmetic residues are ubiquitous environmental pollutants, and they are mostly related to the development of the tourism industry. For instance, sunscreen cream is often applied by swimmers, boaters, and other recreational water users before entering the water, and its residuals are xenobiotic in the ecosystems. This study was conducted to test toxic effects of a commercial sunscreen cream on common guppy *Poecilia reticulata* under laboratory conditions. Two hundred and thirty *P. reticulata* (mean mass = 0.300±0.001 g; mean length = 1.80±0.01 cm) were collected from natural places and acclimatized in a glass aquarium tank (45 cm × 30 cm × 30 cm) filled with de-chlorinated water for a week. A water soluble sunscreen having a sun protection factor (SPF) of +30 and consisting of octyl methoxycinnamate, benzophenone-3, stearic acid, paraffinum liquidum, titanium dioxide and glycine saja (soya bean) was selected to study. The series of concentrations of the sunscreen was 0.000 (control), 0.125, 0.250, 0.375, 0.50, 1.00 and 1.50 (g L^{-1}) with four replicates filled with 2000 mL of water for each concentration. Ten fish were introduced to each tank. Mortality and response (back swimming) was observed for 24 h over a 72 h experimental period. The probit analysis showed that the 72 h-LC_{50} value of the sunscreen on *P. reticulata* was 0.535 g L^{-1}. Similarly, EC_{50} value and not observed effect concentration (NOEC) levels were detected as 0.421 g L^{-1} and 0.146 g L^{-1}. Therefore, the risk ratio (RR) for 72 h exposure of the fish was 2.88. Since the RR value was higher than 1, the risk was further characterized using the value of hazzard quotient (HQ). Accordingly, the HQ value for the 72 h exposure of *P. reticulata* for the sunscreen was 3.82. The sunscreen causes stress on the fish and eventual death of the organism at relatively low concentrations. Hence, this study concludes that there is an environmental risk of sunscreen when it is released to aquatic ecosystems. Furthermore, this information can be used to make decisions on the environmental health risk of cosmetics products.

Keywords: Hazard quotient, *P. reticulata*, risk ratio, sunscreen

EV_019

TRIPHENYLAMINE-SUBSTITUTED IRON PORPHYRIN AS CATALYSTS FOR CO_2 REDUCTION

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Although CO_2 helps to maintain global temperature, excessive emission from fossil fuel burning has worsened the greenhouse effect. Recent reviews delve into catalysts for CO_2 reduction, highlighting the efficiency of porphyrins in both aqueous and nonaqueous solvents. This report focuses on enhancing the CO_2 reduction reaction (CO2RR) by introducing triphenylamine (TPA) groups into Fe-porphyrin, improving electron donation for catalysis. Porphyrins are synthesized using McDonald coupling reaction as it offers a less scrambled, simple and cost effective pathway. This synthetic route produced the designed porphyrin free base at 14.0% yield. Cyclic voltammetry was carried out in DMF with 0.1 mol L^{-1} $TBAPF_6$ for the confirmation of Fe(III) to Fe(0) reduction. The third reduction peak, Fe(I)/Fe(0), corresponded to CO2RR. Using foot of the wave analysis (FOWA), turnover frequency (TOF) and overpotential (η) were calculated and compared with Fe-TPP. The presence of the electron-donating group of TPA resulted in higher η, pushing for increased efficiency. Fe-DiClPTPAP, Fe-MTPAP. Fe-MOPTPAP effectively reduces CO_2 compared to Fe-TPP due to the electron-donating effect of the TPA. Consequently, methoxy groups in 1,5 positions in the phenyl ring, mesityl groups in 1,3,5 positions in the phenyl ring, and chloro groups in 1,5 positions of the phenyl ring contributed to reduced Fe center in porphyrin ring (Fe-MOPTOP > Fe-MTPAP > Fe-DiClPTPAP > Fe-TPP). However, Fe-MTPAP displayed superior TOF and Faradaic efficiency (FE) compared to those of Fe-TPP. FOWA was used to obtain TOF and η of CO2RR, and it helps to reduce the effect of secondary phenomena (substrate consumption, deactivation of catalyst, inhibition by a product, and the effect of diffusion coefficient). Gas chromatography with helium carrier gas and thermal conductivity detector was used to analyze %FE of CO and H_2. The maximum TOF was produced by Fe-MPTPAP homogeneously 93% FE for CO. In CO2RR, bulk electrolysis current generated a stable value averaged for 1.5 h and confirmed the stability, selectivity and efficiency of all three porphyrins as catalysts.

Keywords: CO_2 reduction, electrochemistry, porphyrin synthesis

EV_020

A COMPREHENSIVE STUDY ON NOVEL ECO-FRIENDLY NATURAL RUBBER-CINNAMON OIL PEROXIDE VULCANIZE SYSTEM

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Organic peroxide crosslinked natural rubber (NR) materials generally encompass surface tackiness through the reactions with oxygen. Thus, such provisions are utilized less in commercial applications due to the difficulty in processing. This research implemented an eco-friendly strategy to mitigate the immediate tackiness of peroxy cured materials. Commercially available cinnamon oil (CIN.OIL) incorporated into centrifuged NR latex and cured using dicumyl peroxide (DCP) crosslinker. The impact of different ratios of CIN.OIL (2.5, 5.0, 7.5 and 10.0 phr) on the properties of DCP (5 phr) crosslinked NR sheets were investigated. FTIR and TGA have confirmed the incorporation of the CIN.OIL into the NR. Swelling percentages of reference (no CIN.OIL) and 2.5 to 10 phr CIN.OIL added sample were 591.38%, 591.38%, 588.46%, 579.62% and 580.66%, respectively which confirms that the addition of CIN.OIL has no effect on the degree of crosslinking. Maximum torques of moving die rheometer (MDR) results of reference and (2.5-10 phr) CIN.OIL added samples were 3.79 Nm, 0.92 Nm, 1.96 Nm, 3.71 Nm and 1.74 Nm, respectively, concluding a plasticizing effect of CIN.OIL. Adhesive peel test displayed the maximum forces of reference and 2.5 to 10 CIN.OIL added samples as 29.5 N, 28.9 N, 16.8 N, 13.8 N and 4.4 N, respectively. Tackiness was visually observed by analysing the remains of the detached tissue paper. These observations clearly concluded that an increased amount of CIN.OIL has reduced the tackiness of the material. The water contact angle of the reference, 2.5 CIN.OIL and 7.5 CIN.OIL samples were 100.13°, 96.21° and 95.96°, respectively, which implied that the surface of the material has converted towards hydrophilic nature. One-month outdoor weathering of reference and 7.5 CIN.OIL sample displayed a weight reduction of 4%, and 20%, respectively, which concludes that the CIN.OIL has facilitated the degradation of the material. Addition of CIN.OIL has reduced the tackiness of the NR latex films while it has further imparted additional degradable properties. Thus, it can be concluded that the CIN.OIL addition will be an eco friendly strategy for the DCP NR curing system.

Keywords: Cinnamon oil, dicumyl peroxide, natural rubber, tackiness

EV_021

PROXIMATE COMPOSITION OF TWO BROWN MARINE ALGAL SPECIES FROM THE NORTHERN COAST OF SRI LANKA: A COMPARATIVE ANALYSIS

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Marine algae are rich sources of bioactive compounds commonly utilized in food and pharmaceutical industries. Among the 320 species identified along the coastal area of Sri Lanka, two brown algal species *Sargassum polycystum* and *Turbinaria ornata* collected from the coastal area of Point Pedro, Jaffna were studied for proximate composition. Moisture, ash, crude protein, digestible carbohydrate and total dietary fiber contents were determined according to the standard AOAC methods. Fat content was determined with the Mojonnier method. Data are presented as mean±SD, and significance was calculated by the t-test at a 95% confidence interval using minitab software. *S. polycystum* and *T. ornata* contained moisture ((9.30±0.16)%, (10.95±0.12)% dry weight [DW]), ash ((21.88±0.66)%, (19.07±1.36)% DW), crude protein (10.93±0.03%, 11.2± 0.05% DW), digestible carbohydrate ((0.21±0.02)%, (0.17±0.02)% DW), fat ((2.48±0.06)%, (4.41±0.96) % DW) and total dietary fiber ((60.34±0.47)%, (49.16±3.55)% DW), respectively. According to the statistical analysis, moisture, protein, total dietary fiber and digestible carbohydrate contents were significantly different among the two species ($p < 0.05$) while ash and fat contents were not significantly different among the two species ($p > 0.05$). The notable high ash content observed in *S. polycystum* signifies the presence of elevated mineral concentrations within this algae. Given that both *S. polycystum* and *T. ornata* have commendable levels of dietary fiber, low digestible carbohydrate and high crude protein, they emerge as valuable additions to dietary regimes. This study underscores the nutritional richness of dried powder derived from both algal species, highlighting their significance as sources of essential nutritional components. However, ensuring the safety of these algal species for human consumption necessitates further analysis, particularly regarding heavy metal content.

Keywords: Nutritional components, proximate composition, *Sargassum polycystum*, *Turbinaria ornata*

EV_022

MAGNESIUM OXIDE NANOPARTICLES IMPREGNATED PYROLYZED COCONUT COIR AS AN ANTIFUNGAL AGENT

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Soil-borne pathogens infect plants *via* inoculum remaining in the soil, causing plant diseases. They have the potential to significantly reduce crop yield and have been linked to both human and animal illnesses. Some commercially available strong antifungal substances used in the field directly damage human health due to their high level of cytotoxicity. The research aimed to develop an environment-friendly, affordable and nontoxic antifungal agent. MgO and $Mg(OH)_2$ nanoparticles (NPs) which have antifungal properties were impregnated in a pyrolyzed carbon matrix prepared by coconut coir dust (Mg-PCC). In the *in situ* one-pot synthesis clean dry coconut coir was treated with $Mg(NO_3)_2$ and NaOH and followed by pyrolysis at 450 °C for 1 h. The Mg-PCC sample was characterized by powder X-ray diffraction (PXRD), Fourier transform infrared spectroscopy, and scanning electron microscopy (SEM). PXRD patterns show significant peaks corresponding to both $Mg(OH)_2$ and MgO NPs in Mg-PCC. According to Scherrer's formula, the average crystallite sizes of the synthesized $Mg(OH)_2$ and MgO NPs in Mg-PCC were 37 nm and 14 nm, respectively. The SEM images of the Mg-PCC show the formation of micro and meso pores. The antifungal effect of Mg-PCC was evaluated at three different concentrations (5000 μg mL^{-1}, 7500 μg mL^{-1}, and 10000 μg mL^{-1}) using soil-borne *Ganoderma* sp., *Mucor fusiformis*, and *Aspergillus niger* by mycelial growth inhibition assay. Higher efficiency in antifungal activity was observed for Mg-PCC at 10000 μg mL^{-1} concentration for all fungi species in the laboratory conditions. The antifungal property of Mg-PCC was evaluated at different concentrations using a soil medium. It was found that the optimum amount of 20 mg Mg-PCC per 1 g of soil inhibits fungi growth in soil media. Therefore, it can be concluded that Mg-PCC can be used as a micronutrient and good antifungal agent against *Ganoderma* sp., *Mucor fusiformis*, and *Aspergillus niger*.

Keywords: Antifungal agent, soil-borne fungi, pyrolyzed coconut coir, MgO nanoparticles

EV_023

ADSORPTION OF NICKEL IN AQUEOUS SOLUTION BY USING *Strychnos potatorum* SEED-DERIVED BIOCHARCOAL

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Water pollution is the change in water quality due to pollutants, including agricultural waste, industrial waste, and domestic waste, that negatively impact both human health and the environment. These sources discharge heavy metals into the water bodies, with industrial effluents being a major source. Nickel is one of the toxic heavy metals that has a wide range of industrial applications, such as nickel-smelting operations, battery manufacturing, nickel-plated articles, and mining. In the present study, the adsorption of Ni(II) in an aqueous solution by *Strychnos potatorum* seed-derived biocharcoal was investigated. Batch adsorption studies were conducted by varying the adsorbent dosage, shaking time, settling time, pH, and initial nickel ion concentration using 150 µm – 250 µm particle sizes. The optimum conditions for the adsorption of nickel were found at 1.000 g dosage, 40 min shaking time, 10 min settling time, and pH of 6.00 for a 50.00 cm^3 of initial nickel ion concentration of 10 mg L^{-1}. The experimental data were fitted to Langmuir and Freundlich isotherm models to evaluate model parameters. The Freundlich adsorption isotherm model was better fitted than the Langmuir isotherm model, with a regression coefficient of 0.9958, suggesting a multilayer adsorption process. The maximum adsorption capacity was obtained at 23.36 mg g^{-1}. In kinetic studies, both the pseudo-first-order model and the pseudo-second-order model were evaluated, and the pseudo-first-order model best fitted the data over the pseudo-second-order model. This study reveals that *Strychnos potatorum* seed-derived biocharcoal can be utilized efficiently to remove nickel ions from aqueous solutions. Moreover, this is a cost-effective, eco-friendly biosorbent.

Keywords: Adsorption, biocharcoal, nickel, *Strychnos potatotum*

EV_024

ECOLOGICALLY RELEVANT CONCENTRATIONS OF ARSENIC-INDUCED TOXICITIES IN ZEBRAFISH (*Danio rerio*) EMBRYOS

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Arsenic (As) is a ubiquitous heavy metal with considerable environmental concern owing to its detrimental consequences on the well-being of man and nature. The toxicities incurred by ecologically relevant concentrations of As are not well documented. Consequently, the present study intended to shed light on the As-induced toxicities at ecologically relevant concentrations using the zebrafish embryotoxicity model. Zebrafish embryos at 2 hours post-fertilization (hpf) were exposed to 2.5, 5, 10, 20, and 40 µg L^{-1} of As^{3+} for 24, 48, 72, and 96 hpf adhering to OECD guideline 236. As-induced toxicity was found to be time and concentration-dependent. The lethal concentration 50 (LC_{50}) for As^{3+} at 24 hpf was recorded as 506.761±0.212 µg L^{-1} and it was significantly reduced to 70.014±0.189 µg L^{-1} at 96 hpf. The treatment with 40 µg L^{-1} of As^{3+} resulted in increased mortality ((45.83±4.17)%; p = 0.001) and decreased hatchability (51.39±5.56; p = 0.002) compared to the control at 96 hpf. As-induced developmental toxicities were determined by exposing zebrafish embryos to a sublethal concentration of As^{3+} (7.0 µg L^{-1}). As at 7.0 µg L^{-1} was potent enough to produce distinct reductions in the total body length (p = 0.012) and eye area (p = 0.008) but did not impact the heart rate (p = 0.139) and yolk sac area (p = 0.246) of zebrafish embryos compared to the control. Furthermore, zebrafish embryos treated with 7.0 µg L^{-1} for 96 h showed no notable embryonic malformations. Overall, the present study reveals the capacity of As to induce toxicity in trace amounts. Nevertheless, thorough investigations are warranted to elucidate the underlying mechanisms of As-induced toxicities at ecologically relevant doses to implement successful environmental monitoring.

Financial assistance of the Accelerating Higher Education Expansion and Development (AHEAD) Operation Sri Lanka is acknowledged.

Keywords: Arsenic, developmental toxicities, embryonic malformations, zebrafish

EV_025

CELLULOSE FIBERS MODIFIED WITH NATURAL ANTI-BACTERIAL AGENTS FOR SINGLE-USE TEXTILE APPLICATION

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The utilisation of pineapple (*Ananas comosus*) leaf fibers (PALF) in various applications is steadily escalating because of its important features such as impressive tensile strength, biodegradability, eco-friendliness, and enhancement of sustainability and greener environment. In the current work, the antibacterial properties of PALFs were enhanced by coating essential clove oil (ECO) using polyvinyl alcohol (PVA) as the binder. Further, antibacterial properties against Gram-positive and Gram-negative bacteria have been tested in this context. PALFs were extracted using a manual method. Different concentrations of NaOH were examined to obtain the optimal surface modification to the extracted fibers. Accordingly, 9% NaOH gave the optimal surface treatment. Similarly, PVA concentration was also varied to identify the ideal ECO binding to the treated PALFs. Binding was realized through the dip coating method. Fourier transform infrared spectrometer (FTIR) characterization was used to confirm the successful coating of ECO on NaOH-treated PALFs. The disc diffusion method tested the antibacterial properties of ECO-coated PALFs. The modified fibers showed a remarkable effect against different pathogens which are *Staphylococcus aureus*, *Escherichia coli*, and *Klebsiella pneumonia*. Here, *Staphylococcus aureus* displayed the highest inhibition diameter of 34 mm when a 5% PVA solution was used. *Escherichia coli* displayed the highest inhibition diameter of 17 mm when a 3% PVA solution was used. *Klebsiella pneumonia* also displayed its highest inhibition diameter of 15 mm for a 3% PVA solution. Accordingly, it can be concluded that ECO-coated PALFs could be an ideal candidate for synthesizing single-use nonwoven and woven fabric for medical applications.

Keywords: Anti-bacterial, essential clove oil, pineapple leaf fibers, PVA, sustainability

EV_026

APPLICATIONS OF DIFFERENT MICROORGANISMS TO IMPROVE THE SOLUBILITY OF EPPAWALA ROCK PHOSPHATE

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Eppawala rock phosphate (ERP) deposit is a local resource with high phosphorus (P) content and low heavy metal concentrations. Although ERP is a good source for fertilizer production, and a few other industries, low P solubility prevents its applicability. Conventionally, ERP is solubilized by reacting ERP powder with concentrated chemicals though it is an energy-intensive and expensive method. Moreover, generation of the aggressive hydrofluoric gas during production is harmful to the environment. To overcome these issues, the applicability of microorganisms as a sustainable and green strategy to solubilize P in ERP was assessed and quantified in this research. Initially, microorganisms from the soils collected from Gannoruwa farm were introduced to the Pikovskaya agar (PVK) media and kept in an incubator at room temperature. After ten days of growth period halo zones were observed, indicating isolation of phosphorus solubilizing microorganisms (PSM). Based on morphology *Aspergillus flavus* (PSF_1), *Aspergillus niger* (PSF_2), *Penicillium* sp. (PSF_3) and *Aspergillus terreus* (PSF_4) were identified as PSM. Then, pure PSM cultures were obtained in potato dextrose agar media and incubated for four days at room temperature. Subsequently, two 10 mm diameter disks of mycelia (individual) from each PSM and 5 mm diameter disks of mycelia from all four PSM (mixture) were transferred to five conical flasks containing 100 mL of PVK broth media to obtain five different treatments. Then, the cultures were incubated in a shaker for four days (25 ^{o}C at 160 rpm). The solubilized P content in each treatment was measured at the initial stage, before keeping them in the incubator and at one-day intervals during the incubation process according to PhosVer3 ascorbic acid method using spectrophotometer (HACH 8001). Results showed that there is an increasing trend for P solubilization from the initial stage to day three for all five treatments and the values declined at the fourth day. The highest and lowest P solubility of 520 mL L^{-1} and 337.33 mL L^{-1} were observed for PSF_2 and PSF_1 respectively, while equal values of 396 mL L^{-1} were observed for PSF_4 and mixture at the fourth day of the incubation process. Therefore bioleaching or solubilizing ERP using effective PSM is a promising sustainable technology for industrial applications.

Keywords: Eppawala rock phosphate, phosphorus solubilizing microorganisms, sustainable application

EV_027

INDIVIDUAL AND INTERACTIVE TOXICITY OF CHITOSAN MEDIATED SILVER NANOPARTICLES AND CADMIUM ON GROWTH OF *Allium cepa* PLANT

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The escalating utilization of silver nanoparticles and cadmium across a wide array of applications sparked concerns about their potential environmental implications on a global scale. This study delves into the individual and interactive toxicity of chitosan-silver nanoparticles (Cs-AgNPs) and cadmium on *Allium cepa* (common onion). Cs-AgNPs were synthesized using chitosan as both a stabilizing and reducing agent. Chitosan (0.5 g) was mixed with $AgNO_3$ (2 mM, 0.5 L), followed by the addition of NaOH (1%, 1.0 mL, and 1.5 mL) after 5 and 10 minutes, respectively. The formation of NPs was indicated by the appearance of a reddish-brown color in the solution mixture and the surface plasmon resonance band at 420 nm in the UV-Visible spectrum. Transmission electron microscopic images showed spherical NPs ranging from 2 to 12 nm. The individual and combined effects of environmentally relevant concentrations of AgNPs (0.05 ppm) and Cd (0.03 ppm) on the growth and different phytochemical levels of *A. cepa* were tested during a 10-day exposure period. Total chlorophyll, phenol, flavonoid contents, root and shoot lengths, and root and shoot dry weight loss percentage were examined. The combined exposure significantly increased the total chlorophyll, phenol, and flavonoid contents compared to both individual treatments and the control group. Conversely, exposure to Cd alone decreases these levels. Root and shoot lengths were significantly reduced by the combined exposure while root and shoot weight loss percentages were not significantly affected. The findings of this study highlight that exposure to Cs-AgNPs in combination with Cd can increase the phytochemical levels in plants while displaying a negative impact on the root and shoot growth of plants, revealing a potential synergistic impact. This study emphasizes the significance of evaluating the interactive toxicity of NPs with other environmental pollutants for effective and sustainable environmental management strategies.

Keywords: *Allium cepa*, cadmium, silver nanoparticles, toxicity

EV_028

SIMULTANEOUS AND SEQUENTIAL SYNTHESIS OF RICE HUSK BIOCHAR-NANO ZERO VALENT IRON COMPOSITES: MATERIAL CHARACTERIZATION AND REMOVAL OF SELECTED NITROAROMATICS

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Nanoscale zero-valent iron (nZVI) together with a biochar (BC) support provide advantageous materials for wastewater purification *via* adsorption, reduction, complexation, and advanced oxidation mechanisms. Fabricating the materials can be carried out *via* two production routes: nZVI loaded BC subjected to sequential carbothermal reduction (BC-nZVI) and nZVI loaded biomass (BM) subjected to simultaneous pyrolysis and carbothermal reduction (BM-nZVI). Nonetheless, the physicochemical characteristics and remediation capability of the two materials have not been comparatively evaluated. The present study focuses on preparing and extensively characterizing these materials with subsequent comparative analysis of remedial action. X-ray diffraction peak pattern confirmed the formation of zero-valent iron, and the nanoscale was confirmed by transmission electron microscopy. Narrow band gap energy of 2.54 eV and photocatalytic studies showed visible activity of the materials. Synergistic adsorptive and degradative behavior of the materials towards *p*-nitroaniline (pNA) and *p*-nitrophenol (pNP) were studied by evaluating isotherm patterns at the optimum pH of 3.0, and contact time of 180 min. Langmuir capacities of BM-nZVI, BC-nZVI and BC for pNP were determined to be 89.02, 74.03, and 15.6 mg g^{-1}, respectively. Similarly, for pNA, the corresponding values were 104.2, 57.5, and 18.6 mg g^{-1}, respectively. Thermodynamic data confirmed the spontaneity of the adsorption process. Higher initial adsorption capacity was observed in BM-nZVI, while more sustainability and stability over the regeneration cycles were portrayed by BC-nZVI. Therefore, it is conclusive that loading of nZVI significantly enhances the remedial capacity of pristine BC. Furthermore, the materials produced through both simultaneous and sequential routes have signature advantages to purify nitroaromatic contaminated water in terms of initial adsorption capacity and sustainability.

Financial assistance of the Institute of Chemistry Ceylon (Grant no: 21-2) is acknowledged.

Keywords: Biochar, nanoscale zero-valent iron, p-nitroaniline, p-nitrophenol

EV_029

REMOVAL OF LEAD(II) USING PHOSPHATE-INCORPORATED AND NANO ZERO-VALENT IRON DECORATED BIOCHAR HYBRIDS

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The environmental impact of heavy metals (HM), particularly lead(II), poses significant risks to both natural ecosystems and human health. Biochar (BC) has emerged as a viable solution for the remediation of HMs. This study focuses on phosphate-incorporated BC (PBC), which has demonstrated an improvement in HM remediation capacity, especially for lead(II), attributed to the low water solubility of $Pb_3(PO_4)_2$. Despite its effectiveness, use of PBC could result in phosphate leaching which would lead to eutrophication, thereby undermining the remediation efficiency of PBC. To address this issue, the study explores the integration of nano Zero-valent iron incorporated BC (nZVI-BC) with PBC. Despite individual reports of enhanced remediation by PBC and nZVI-BC, the synergistic remediation potential of PBC and nZVI-BC, when combined into a hybrid BC, has not been fully explored. The aim of this research is filling this gap by examining the composite of PBC/nZVI-BC, revealing a new and powerful method for lead(II) removal. BC was synthesized at 500 °C *via* pyrolysis, PBC *via* a pre-modification method at the same temperature, and nZVI-BC through a post-modification carbo-thermal reduction at 1000 °C. Composites of PBC: nZVI-BC at three distinct ratios (1:1, 1:2, 2:1) on the uptake of lead(II) were studied. The findings revealed that the 2:1 exhibits the highest lead(II) remediation capacity. Moreover, Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and iron and phosphate leaching studies were carried out using pristine sawdust-BC as the control. The surface phosphate modification and the zero-valent state of the loaded iron was confirmed as per the observed FTIR and XRD peak patterns. The strategic combination of PBC with nZVI-BC, particularly at the 1:1 and 2:1, has significantly increased the immobilization of lead(II) while concurrently mitigating phosphate leaching. The study presents a novel and effectual approach to the remediation of lead(II) contaminated water, offering a promising direction for future environmental management strategies.

Keywords: Lead(II) remediation, nano zero-valent iron decorated biochar, phosphate incorporated biochar, phosphorus leaching

EV_030

BIOCHAR SURFACE FUNCTIONALITY AS AFFECTED BY ACID MODIFICATIONS: FOURIER TRANSFORM INFRARED SPECTROSCOPY-BASED PRINCIPAL COMPONENT ANALYSIS

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Biochar (BC) is a ubiquitous carbonaceous porous material that was significantly researched worldwide, due to its cost-effectiveness and unique surface properties, making it a viable option for environmental restoration and soil applications. Synthesizing engineered material through a value-addition process can facilitate highly efficient BC towards a targeted goal. The characteristics of BC can change such as the material's porosity, surface functionality, and demineralization relevant to acid treatments. The BC surface can be modified to improve its properties and distinguish it based on feedstock and modification method. One approach has been reported to observe the correlation between the type of feedstock and other physicochemical properties. Nonetheless, the surface functionality alteration's differentiation has not been adequately researched and evaluated. The study used Fourier transform infrared spectroscopic data-based principal component analysis (PCA) to differentiate modifications based on feedstock type and correlate biomass surface functionality properties with the modifications. The process involved six types of feedstocks: sawdust (SD), rice husk (RH), tea waste (TW), cow dung (CD), chicken litter (CL), and wastage sludge (WS). Observations were made on raw BC and its three modifications: HCl modification, HNO_3 modification, and H_2SO_4 modification. According to the observed PCA data, it was evident that concerning the modifications, a clear cluster differentiation existed with relevance to the lignocellulosic and non-lignocellulosic biomasses. It indicates different clustering components, except for RH, which strongly overlaps HCl-modified BC with raw BC, based on the feedstock. It was not possible to distinguish between WS and CL in terms of functional groups, even though both biomasses are non-lignocellulosic. A distinctive difference in HCl modification has been observed for lignocellulosic RH. Concerning the clear differentiation shown in the results, this model can be developed to understand how different feedstocks will respond to various modification processes.

Keywords: Acid modification, biochar, FTIR, principal component analysis, statistical correlation

EV_031

WATER DEFLUORIDATION USING MAGNETITE-IMPREGNATED COCONUT COIR-BASED ACTIVATED CARBON

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Elevated fluoride levels in drinking water can cause significant health risks including fluorosis. Hence the world health organization (WHO) has recommended a 1.5 mg L^{-1} safety limit for fluoride. However, the north-central province of Sri Lanka exhibits recorded fluoride concentrations as high as 5 mg L^{-1}. This study suggests the synthesis of magnetite-impregnated and base-activated carbon (MAC) as a remediation method. The *in situ* preparation of MAC was achieved using $FeSO_4.7H_2O$ and $FeCl_3$ in a 1:1 ratio with 15 g of coconut coir. The mixture was stirred for 1 hour at room temperature followed by the addition of 5.0 mol L^{-1} NaOH dropwise until the solution reached a pH of 10-11 and was heated at 70 °C for an hour. The resultant treated coconut coir was separated, and the oven dried at 70 °C for 12 hours. The material underwent slow pyrolysis for varying time durations (1, 2, and 3 hours) at 500 °C under N_2 environment in a muffle furnace. Post-pyrolysis the activated carbon was washed with DI water and oven dried at 70 °C for 12 hours. Sieving was done to select MAC particles ranging from 0.5 to 1.0 mm. Functional groups of MAC were studied using ATR-FTIR within the 400 - 4000 cm^{-1} range which revealed a characteristic band corresponding to the Fe-O bond (524 cm^{-1}) and the presence of C-O and C=C functional groups. The pH at the point of zero charge of MAC was obtained as 5.19. Fluoride adsorption was evaluated using a fluoride ion selective electrode demonstrating promising adsorption, particularly at lower pH values. A maximum adsorption capacity of 2.49 mg g^{-1} (96%) was observed in 2.50 ppm NaF solution at pH 2. Fast kinetics were observed for the MAC, reaching maximum adsorption within 1 minute. Furthermore, the convenient removal of MAC using a magnetic field is considered a notable advantage.

Keywords: Activated carbon, coconut coir, fluoride, magnetite, water treatment

EV_032

ANTIOXIDANT AND PHOTOCATALYTIC ACTIVITIES, AND CYTOTOXICITY OF BIOSYNTHESIZED SILVER NANOPARTICLES USING PLANT LEAF EXTRACTS OF *Camellia sinensis* VARIETIES

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Nanoparticles are particles with a size range of 1-100 nm and take the form of different shapes depending on their physical, chemical and biological characteristics. Their large surface area to volume ratio, and distinctive properties which differ greatly from their bulk counterparts, enable their application in a wide range of industries. In this study, leaf extracts of five varieties of *Camellia sinensis* (green tea, black tea, TRI 2023, TRI 3073, and TRI 4043) were used in synthesising silver nanoparticles (AgNPs) under optimum conditions of 90 °C for 45 min. Characterization carried out using UV-Vis spectrophotometry, and scanning electron microscopy confirmed that the synthesized AgNPs were spherical and about 50 nm in size. Phytochemical analysis was carried out on each water extract (WEs), and the total flavonoid content (TFC), the total phenolic content (TPC), and the total antioxidant capacity (TAC) were determined using both WEs and synthesized AgNPs. The photocatalytic activity of 267 ppm and 4000 ppm AgNPs was evaluated using methylene blue (MB) dye. The catalysis of 4-NP was measured using 4000 ppm AgNPs with the addition of sodium borohydride ($NaBH_4$) as a catalyst. A brine shrimp lethality assay was carried out using *Artemia salina*. Results showed that AgNPs had a greater antioxidant content and activity than WEs. Faster degradation of MB was seen with the addition of $NaBH_4$ under sunlight. Black tea AgNP showed successful degradation of 4-NP. Lethality assessment showed a 100% viability of *A. salina* after 24 h incubation with 2.0 mg mL^{-1} and 0.5 mg mL^{-1} concentrations of AgNPs. Thus, the study proves the ability of silver nanoparticles to be used in the removal of textile dyes and toxic by-products thereby aiding in wastewater treatment.

Keywords: *Camellia sinensis*, silver nanoparticles, total antioxidant capacity, water extracts

EV_033

BIOSORPTION OF LEAD(II) FROM AQUEOUS SOLUTION BY BANANA PEEL: OPTIMIZATION AND ADSORPTION ISOTHERM STUDY

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Lead (Pb) is one of the most toxic heavy metals found in industrial effluent, causing severe harm to the human body, particularly the liver, kidney, neurological, and reproductive systems. Among various adsorbents that have been used to remove lead from wastewater, banana peel powder (BPP), which contains various compounds, including pectin, lignin, cellulose, and hemicellulose, as well as functional groups such as carboxyl, hydroxyl, and amine, is able to adsorb a wide range of contaminants. The purpose of this study was to evaluate the optimal parameters for Pb(II) removal such as adsorbent dose, shaking duration, settling time, and solution pH at ambient temperature with a 10 ppm Pb(II) solution, by adjusting one parameter while keeping the others constant, and to investigate the adsorption equilibrium characteristics under optimized conditions. The maximum Pb(II) removal was achieved at 60 min of shaking, while the extent of removal is not significantly impacted by settling time. The optimum pH of Pb(II) removal is 4.0, and further, the adsorption capacity is slightly increased with increasing dosage. The maximum capacity of Pb(II) removal under optimized conditions is 72.3%. Adsorption of Pb(II) from solutions of a wide range of concentrations on BPP after the establishment of equilibrium was found to satisfy the requirement of the Langmuir adsorption isotherm with a higher regression coefficient (R^2 = 0.9285) value when compared to Freundlich adsorption isotherm. The results obtained suggest that the most likely mass transfer process is chemisorption, which leads to monolayer coverage. Further, the coverage of available sites is determined to be 119.2 mg g^{-1}. This study has the potential to address significant environmental concerns by providing insights into the practical application of banana peel-based adsorbents by predicting the adsorption capacity, features of the adsorption process, and equilibrium mechanism of banana peel-based adsorption in reducing heavy metal pollution in water sources.

Keywords: Banana peel, biosorbent, heavy metals, lead

EV_034

BIODEGRADATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SOIL SAMPLES FROM URBANIZED COASTAL AREAS, GARDENS, AND ROADSIDES: A GREEN APPROACH FOR BIOREMEDIATION WITH SOIL BACTERIA

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Polycyclic aromatic hydrocarbons (PAHs) are organic compounds that consist of several hundred individual homologues and isomers containing at least two or more condensed aromatic rings. They are often formed by burning carbonaceous substances, and environmental build-up has had a significant effect on pollution. As PAHs eventually accumulate in plants, they enter human systems through the food chain. Literature has documented PAHs' potential to cause genotoxic and carcinogenic effects over time. This study investigates naphthalene and phenanthrene as soil contaminants of PAHs, aiming to isolate and determine the degradation percentages of appropriate PAH-degrading bacteria. Initially, population densities were calculated and isolated morphologically different bacterial strains. Identification and the evaluation of PAH degradation potential and percentages from the selected bacterial strains were screened with plate assay and confirmed with spectrophotometric analysis. The results revealed that *Bacillus paramycoides* (SS1-SF1), *Bacillus tropicus* (SS2-SF5), *Staphylococcus saprophyticus* (SS3-SF8), *Bacillus cereus* (SS3-SF9), *Pseudomonas fulva* (SS3-D8), *Staphylococcus* (SP1-01), and *Pseudomonas* (SP3-06) bacterial strains were capable of a degradation percentage over 50%. *Staphylococcus* (SP1-01) is considered the most effective naphthalene degrader with 73.5% degradation percentage within 7 days. By-products of all the strains had greater than 80% of viability in zoo toxicity assay and it confirmed their non-toxicity. In phytotoxicity assay with *Vigna radiata*, the length from the shoot to root of the seeds within 7 days confirmed that the highest concentration of by-product had no effect on seed growth and that the by-products produced were nontoxic to the environment. Therefore, these bacterial strains can be used as efficient bioremediators which can degrade PAH pollutants through bioremediation.

Keywords: Bioremediation, naphthalene, phenanthrene, phytotoxicity, zootoxicity

EV_035

CURCUMIN INCORPORATED NATURAL RUBBER LATEX

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Curcumin (diferuloylmethane) is a bright yellow biphenolic active compound extracted from *Curcuma longa* species, a member of the Zingiberaceae family. It has become a promising natural product owing to its biological and pharmacological activities, such as antibacterial, anti-inflammatory and antioxidant activities. Moreover, curcumin has the ability to act as a photosensitizer. However, due to its very low solubility in aqueous media, its applications have been limited. This research is to fill the gap in curcumin applications in the rubber industry by developing curcumin-natural rubber (NR) latex film using a surfactant. Curcumin was extracted from turmeric using the solvent extraction method, and it was characterized by Fourier transform infrared (FTIR) spectroscopy and UV-Visible spectroscopy. Tween 80 was used to prepare the dispersion of extracted curcumin. Tween 80 is a low-cost hydrophilic nonionic surfactant with biocompatible and biodegradable properties. The film was prepared using the solution casting method. FTIR spectra confirmed the successful incorporation of curcumin into NR latex. The developed film has shown exceptional tensile strength at 5.255 MPa compared to the cured NR latex film. The film displayed slightly increased thermal stability compared to the cured NR reference latex film. Curcumin incorporated NR latex film exhibited a lower water contact angle of 46.00° compared to the water contact angle of cured NR reference latex film, which was 76.68°, indicating the hydrophilic surface properties. Biological properties such as the non-toxicity involved with curcumin and biocompatibility of tween 80 make this approach preferable for a vast range of applications, especially in NR applications in the biomedical industry.

Keywords: Curcumin, dispersion, low aqueous solubility, Tween 80

EV_036

NATURAL RUBBER LATEX MIXED WITH JACKFRUIT LATEX AS A BIO-BASED HEAT-CURING ADHESIVE

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Rubber tree (*Hevea brasiliensis*) produces latex that contains mainly polyisoprene (30%) which gives adhesive properties to the latex. The role of an adhesive is to form a strong molecular attraction between the surfaces that need to be joined two or more surfaces together. The jackfruit (*Artocarpus heterophyllus*) tree is another tree that produces latex that contains mainly polyisoprene (0.4 - 0.7)%, resins (82.6 - 86.4)%, and lipid-derived waxy substances. The resin content in jackfruit latex (JFL) gives comparatively adhesive properties. This study aims to enhance the adhesive property of natural rubber latex (NRL) by adding JFL. NRL was obtained commercially whereas JFL was from the fruit stem. The JFL was acidic and 0.01 mol L^{-1} NaOH was added until the pH was around 10 to give a basic medium. Scanning electron microscopy analysis and Fourier transform infrared spectroscopy were also done for dried JFL films. To identify the optimum composition ratio of JFL and NRL of the adhesive peel, bond tests were carried out using a universal testing machine. By varying the NRL to JFL ratio, total solid content, dry rubber content and viscosity value variations were compared. Findings indicate that the maximum load-bearing composition of NRL and JFL was 1:1. This was modified into a heat-curing adhesive by adding a curing system. This adhesive can be used in glove industries. Therefore, experiments were conducted using three types of gloves to observe the better performance of the adhesive compared to the commercial adhesive. Adhesive shear strength test and peel bond tests were conducted on the adhesive and compared with commercial adhesive. The significance of this research is a value addition to JFL by preparing a competitive and sustainable bio-based heat-curing adhesive.

Keywords: Adhesives, adhesive shear strength, heat curing, jackfruit latex, peel bond test

EV_037

PHOTOCATALYTIC AND ANTIBACTERIAL ACTIVITIES OF CuO NANOPARTICLES SYNTHESIZED USING SEED EXTRACT OF *Persea americana*

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Plant extract-based synthesis of nanoparticles (NPs) recently emerged as an eco-friendly and cost-effective synthetic route. This study primarily focuses on synthesizing CuO NPs using avocado (*Persea americana*) seed extract. This synthesis was carried out by mixing the seed extract and the metal salt ($CuSO_4.5H_2O$) under optimized reaction conditions of metal concentration of 0.10 mol L^{-1} and plant extract-to-metal ratio of 1:7 (v/v) and pH of 12. The formation of NPs was characterized by a UV-Visible spectrometric peak at 278 nm. Fourier transform infrared analysis of the synthesized product showed a notable band at 678 cm^{-1} representing Cu—O stretching vibration mode. Powder X-ray diffraction (PXRD) analysis indicated peaks at 2θ angles of 32.23°, 35.48°, 38.50°, 49.10°, 57.73°, 61.51° and 66.54°, corresponding to the crystalline planes having the Miller indices of (110), (002), (111), (20-2), (202), (11-3), and (022), respectively (JCPDS no. 00-041-0254). PXRD data further indicated that the NPs belong to the monoclinic crystal system. The average crystalline size of these NPs calculated using Debye–Scherrer equation is ~ 5.92 nm. The photocatalytic activity of CuO NPs was studied using an aqueous solution of methylene blue (MB) dye upon exposure to direct solar irradiation. The study was carried out at optimum reaction conditions of catalytic load of 10 mg, MB concentration of 5 ppm and pH of 10, over a period of 240 min. Under these conditions, the maximum percentage of photodegradation was calculated to be 93%, which is about 31% higher than that of the control. At high concentrations, these CuO NPs showed antibacterial activity against both *Escherichia coli coli* and *Staphylococcus aureus* bacteria. Overall, this study demonstrates the feasibility of green-synthesized CuO NPs as effective photocatalysts for MB degradation and active antibacterial material against certain microbes, underscoring their potential for sustainable environmental remediation.

Keywords: CuO nanoparticles, methylene blue, *Persea americana*, photodegradation

EV_038

DEVELOPMENT OF REDUCED GRAPHENE OXIDE/CHITOSAN COMPOSITE MATERIAL FOR WATER PURIFICATION APPLICATIONS

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A reduced graphene oxide (rGO) composite reinforced with surface assimilation is an excellent material for water purification applications as it supports the adsorption of microplastics while providing a barrier for organic dyes. As a possible scaffold for water purification applications, a novel reduced graphene oxide embedded with chitosan biopolymer material (rGO-CH) was fabricated with an exceptional adsorptive capacity. Initially, the rGO-CH composite was synthesized through a biocompatible reduction technique. A graphene oxide (GO) solution of 4 mg mL^{-1} was added to the chitosan solution which was made by dissolving 2.5 g in 100 mL of 1% glacial acetic acid. The mixture was agitated while neutralizing the medium pH of about 7. Scanning electron microscopy, powder X-ray diffraction and Fourier transform infrared spectroscopy were used to characterize the synthesized composite. The removal of microplastics (MPs) from water was carried out based on the adsorption capacity of rGO-CH, using an industrial plastics sample. The MP adsorption efficiency of rGO-CH was evaluated by examining the dose of the adsorbent, duration of contact, and the concentration of microplastics solutions. The maximum adsorption capacity of rGO-CH was recorded when the adsorbent dosage was 0.025 g and with a contact time of 40 min. In contrast to rGO-CH, exclusive adsorptive capacity was recorded with GO. As a function of dye concentration, adsorbent dosage, contact time and pH, adsorption studies were conducted utilizing organic dyes such as Rhodamine B (cationic dye), and Sunset Yellow (anionic dye). The synthesized rGO-CH composite outperformed GO and chitosan in terms of dye adsorption. The optimal conditions for dye removal were observed at an adsorbent dosage ranging from 0.015 g to 0.020 g, a contact time of 30 to 40 min, and a pH range of 4.0 to 6.0. These findings will aid in refining rGO-CH for enhanced adsorption capabilities, offering valuable insights for further optimization.

Keywords: Chitosan, dye adsorption, microplastics, reduced graphene oxide, water purification

Food:

Security, Safety and Quality

FD_039

DEVELOPMENT OF A SCREENING METHOD TO DETECT MELAMINE ADULTERATION IN ANIMAL VITAMIN MIXTURE USING FOURIER TRANSFORM INFRARED SPECTROSCOPY

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Melamine is a synthetic chemical that is used for a variety of purposes, such as coatings, glues, laminates and heat-tolerant polymers, because of its physical and chemical characteristics. Melamine-contaminated animal feed leads to renal diseases and associated deaths due to melamine toxicity. Therefore, melamine content assessment is compulsory for animal feed and vitamins. This study is focused on developing a rapid, cost-effective, and field-deployable method to determine the possible melamine adulteration in vitamin-mixed animal feed using Fourier transform infrared (FTIR) spectroscopy coupled with attenuated total reflectance (ATR). Three samples were collected from three batches of the manufacturing process, and ground and sieved to overcome the scattering effect. The 18 samples prepared were spiked with melamine concentrations (w/w%) from 1.0% to 2.5×10^{-4}%. The spectral data were collected in the range of 5500-450 cm^{-1} using FTIR-ATR, and characteristic visible peaks of melamine were identified at 750-850 cm^{-1} wavelength range which was used for further statistical analysis. SIMCA 17.0.2 multivariate analysis software was used for the statistical analysis of spectral data and a chemometric model was developed with principal component analysis followed by orthogonal partial least square regression. Three preprocessing methods were deployed to find out the suitable preprocessing method with the lowest scattering effect. Standard normal variate (SNV) resulted in the separation with 99.94% total variance with six principal components. The regression model was developed with the R^2 of 0.8451, root mean square error of estimation value of 0.0117, and root mean square error of cross validation value value of 0.0013 which indicated a good fitted model. The recovery percentage of the validation set was 94.65±12.41% for the selected peak range. The limit of detection (LOD) and the limit of quantification (LOQ) of the model were 0.038 mg mL^{-1} and 0.117 mg mL^{-1}, respectively. Therefore, FTIR spectroscopy in conjunction with a chemometrics model serves as a potentially rapid, field deployable, and non-destructive method for identifying melamine in vitamin-mixed animal feed samples.

Keywords: Animal vitamin mixture, chemometric model, FTIR, melamine

FD_040

EFFECT OF CUMIN (*Cuminum cyminum*) POWDER AND CITRIC ACID INCORPORATION ON ACRYLAMIDE MITIGATION AND ANTIOXIDANT PROPERTIES IN DHAL VADE

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Acrylamide is formed during high temperature (> 120 °C) associated food processing such as deep frying, baking and roasting. Due to its potential genotoxicity, neurotoxicity and carcinogenicity in humans, acrylamide does remain a public health concern. To comply with the benchmark levels on acrylamide content in different foods, various mitigation strategies have been utilized. Incorporating antioxidants and organic acids have effectively been used in reducing the acrylamide content by interfering its formation pathways. This study focused on incorporating cumin powder (CP) and citric acid (CA) in dhal vade in order to reduce the formation of acrylamide. CP was added in 2, 3 and 4% at the expense of raw dhal content. CA was incorporated by soaking dhal in three different concentrations (0.005, 0.01 and 0.02 mol L^{-1}) instead of water. The lowest antioxidant and total phenolic content (TPC) were shown by the control sample with no CP or CA incorporation and the highest were observed with that of the highest CP or CA incorporation. This high CP or CA contents in turn indicate high TPC and antioxidant activity. The sensory analysis with 5 point hedonic scale showed 2 and 3% CP incorporation and CA pre-treatment with 0.005 M and 0.01 M as the most acceptable treated samples. Considering both antioxidant properties and sensory analysis, dhal vade with 2% and 3% CP and 0.005 mol L^{-1} and 0.01 mol L^{-1} CA were selected as the most effective incorporations that mitigated the acrylamide content by 62.00, 79.83, 40.72 and 58.55% in vade and by 23.23, 20.05, 20.59 and 33.13% in fried oil, respectively. CP has significantly reduced the peroxide production ($p < 0.05$), and pre-treating dhal with CA has significantly reduced the acid value in oil ($p < 0.05$). Therefore, incorporating CP or CA is effective in acrylamide mitigation in vade while enhancing the TPC and antioxidant properties.

Keywords: Acrylamide, antioxidant, dhal vade, total phenolic content

FD_041

EFFECT OF $KMnO_4$-IMPREGNATED ACTIVATED CARBON SACHETS ON EXTENDING STORAGE LIFE OF TOMATOES (*Solanum lycopersicum*): A COMPARATIVE STUDY AGAINST DIFFERENT MATURITY STAGES

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Tomato (*Solanum lycopersicum*) is highly perishable fruit and one of the most important agricultural crops produced in large quantities annually. Due to rapid ripening and decay of tomatoes, massive postharvest losses resulting in significant economic losses. $KMnO_4$ acts as an ethylene absorbent and activated carbon (AC) is the most versatile adsorbent. This research aimed to investigate the effect of $KMnO_4$ impregnated AC in prolonging the shelf life and reducing ripening of tomatoes against three maturity stages as green color (I), color break (II), and color turning (III). The $KMnO_4$ impregnated AC sachets were prepared by submerging AC in a saturated $KMnO_4$ solution (0.04 mol L^{-1}), centrifugation after 2 h, drying the solid portion. Then, the sachets were prepared using solid portion and tomatoes at three maturity stages were treated with these sachets. Samples were maintained at (12-13)±0.05 °C temperature and 85% relative humidity (RH) conditions for 16 days. Different postharvest related properties were evaluated using published methods. After 25 g of AC was dipped in $KMnO_4$ solution, the amount of $KMnO_4$ uptake was 5.12±0.01 g. Analysis revealed that the remaining ethylene gas concentrations in the untreated (T1) and treated (T2) were 2923.026 and 887.167 ppm, respectively. T2 group showed lower weight loss, increased pH (3.31±0.081 – 4.18±0.12) and TSS (3.43±0.306 – 4.76±0.057), and decreased acidity (0.32±0.00 – 0.87±0.03) and firmness (4.66±0.125 – 2.78±0.125 kg) compared to that of T1. At the end of the storage period, significant differences in color parameters were observed between T1 and T2 treatments in all maturity stages: I ('a' = 0.32, 6.18; 'b' = 27.94, 28.63; 'L' = 46.37, 47.97), II ('a' = 18.22, 17.35; 'b' = 24.07, 31.63; 'L' = 37.26, 39.53), and III ('a' = 18.98, 18.62; 'b' = 17.74, 20.01; 'L' = 36.5, 37.10). Lycopene content of tomatoes increased from 0.036±0.00 to 6.519±0.028 mg/100 g during storage time in T2 treatment. Ascorbic acid content decreased from 145.75±0.41 to 24.02±0.09 ppm in T2 treatment. Hence, T2 group exhibited an extended shelf life and mitigated ripening progression compared to T1 showing the potential of the $KMnO_4$ impregnated AC.

Keywords: Activated carbon, ethylene, $KMnO_4$, *Solanum lycopersicum*, storage life

FD_042

PHYSICOCHEMICAL AND NUTRITIONAL CHARACTERIZATION OF NUTRIENT RICH SNACK BAR FORMULATED WITH *Cucurbita moschata* AND LOCAL INGREDIENTS FOR SCHOOL CHILDREN

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Nutrient bars are popular all over the world due to their proven health benefits and convenience. The nutrient bar in this study was developed by mixing oats, roasted pumpkin seeds, coconut butter, treacle, mung bean flour, and corn kernels with a base of *Cucurbita moschata* (butternut squash) flour and yellow *Pouteria campechiana* (sapote fruit). The objective was to formulate and analyse the physical and nutritional attributes of snack bars with the intention of increasing the micronutrients for school children. Different formulation trials were conducted, and sensory analysis was performed using a semi trained panel. According to the results obtained, one nutrient bar formula containing yellow sapote and another that does not contain yellow sapote were selected. The texture profiles of the selected nutrient bars; hardness, adhesiveness, springiness, cohesiveness, gumminess, and chewiness were analyzed. The nutrient bar contained yellow sapote exhibited higher values in hardness (4930.00±0.03 g), cohesiveness (0.45±0.08), gumminess (2224.00±0.03 g) and chewiness (819.3±0.1 mJ). The moisture, ash, fat, crude fiber, protein, and total carbohydrate contents in the sample contained yellow sapote were (12.25±0.49)%, (2.55±0.02)%, (9.94±0.06)%, (4.65±0.06)%, (10.47±0.05)% and 64.79%, respectively on a wet basis, with a caloric content of 394.08 kcal/100 g and (13.2±0.1)% total sugars. The sample without yellow sapote contained (12.12±0.40)%, (2.21±0.01)%, (10.28±0.05)%, (4.22±0.05)%, (10.25±0.02)% and 65.14% of moisture, ash, fat, crude fiber, protein, and total carbohydrates, respectively, on wet basis with 390.5 kcal/100 g caloric content and (12.67±0.04)% total sugars. Mineral analysis showed that the sample with yellow sapote had high levels of magnesium, calcium, potassium contents. It also exhibited significantly higher levels of ($p < 0.05$) DPPH (2,2-diphenyl-1-picrylhydrazyl) and ABTS [2,2′-azino-bis(3-ethylbenzothiazoline-sulfonic acid)] inhibitory percentages, total phenol, total flavonoid, and total alkaloid contents. According to the Fourier transform infrared spectroscopic analysis, the two products indicated similar structures with similar functional groups. No preservatives were added and only after 30 days, a quality degradation was observed in both products with respect to pH, total plate count, yeast and mould count and coliforms. Results showed that the ready-to-eat nutrient bar made with yellow sapote had a high level of nutritional value, which is important for the healthy lifestyle of school children.

Keywords: *Cucurbita moschat*a, micronutrients, nutrient bar, yellow sapote

FD_043

COMPARATIVE ANALYSIS OF PHYSICOCHEMICAL, NUTRITIONAL AND FUNCTIONAL PROPERTIES OF RICE BRAN OILS FROM WHITE AND BROWN RICE BRAN IN SRI LANKA: A STUDY OF Bg 300 AND At 362

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Rice bran oil (RBO) is considered one of the healthiest edible oils in the world. Among other edible oils, RBO is unique due to its fatty acid composition, phenolic compounds (ɤ-oryzanol, ferulic acid), and vitamin E. Although RBOs have many health-promoting and nutritional properties, still it is locally underutilized. Thus, the current study was conducted to compare the main physicochemical, functional, and nutritional properties of two distinct RBOs extracted from widely grown two rice varieties; Bg 300 (white rice bran oil; WRBO) and At 362 (brown rice bran oil; BRBO) through soxhlet extraction. Saponification values in RBOs were in the range of 175 – 176 mg KOH/g. BRBO showed a higher peroxide value (3.71±0.80 milliequivalents of O_2/kg) and Iodine value (98.38±0.05 g I_2/100 g) compared to WRBO. A higher oleic acid percentage was observed in BRBO (45.34±2.65%). BRBO showed a higher smoke point (204.6±8.3 °C) compared to WRBO (198.3±4.7 °C). Total ash content (0.17± 0.01%) is higher in WRBO with a significantly higher sodium content (42.32±0.06 mg/kg) while BRBO showed a significantly higher potassium content (133.10±1.07 mg/kg). ɤ-oryzanol is one of the dominant phytochemicals that can be found in RBO with higher antioxidant activities. Compared to WRBO, a significantly higher ɤ-oryzanol percentage was found in BRBO (1.49±0.04%). The total flavonoid content (113.46±7.66 mg QE/100 g) and total phenolic content (146.52±1.46 mg GAE/100 g) of BRBO were significantly higher than that of WRBO. BRBO (1.04±0.07 mmol Trolox/g) showed a higher antioxidant activity as measured by the DPPH radical scavenging assay. Most of the nutritional and functional properties are significantly higher in BRBO extracted from At 362 with acceptable physical properties which leads to providing more health benefits for consumers. Rice bran oil extracted from an underutilized by-product of rice milling may have promising applications in the local food industry due to its high nutritional and antioxidant properties.

Keywords: Functional properties, nutritional properties, physicochemical properties, rice bran oil

FD_044

DEVELOPING WATER-SOLUBLE CURCUMIN-LOADED CARRAGEENAN NANOPARTICLES FOR INTEGRATION INTO FUNCTIONAL FOOD

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Curcumin, 1,7-bis(4-hydroxy-3-methoxy-phenyl)-1,6-heptadiene-3,5-dione, is a polyphenol found in root of turmeric (*Curcuma longa*), renowned for its strong pharmacological effects, including anti-inflammatory, antioxidant and anticancer effects. However, its effectiveness in treating cancer is hindered by its low water solubility (0.6 μg mL^{-1}) and issues with bioavailability and biocompatibility. To address these limitations, the development of encapsulating active substances in nanoscale carriers has emerged. Kappa-carrageenan, extracted from red seaweed, is a biocompatible and biodegradable polysaccharide used as a nanocarrier for curcumin. It forms stable nanoparticles (NPs), aids in controlled release, and thereby enhances curcumin's therapeutic impact on cancer cells. The key innovative aspect of this study is the development of a water-soluble jelly powder incorporating curcumin, despite curcumin's inherent low solubility in water. Jelly serves as a carrier for these NPs due to its convenience and palatability, making it an excellent choice for this study. The primary challenge faced in this study revolves around formulating a water-soluble jelly powder suitable for human consumption. The optimization of solvents to develop water-soluble curcumin-loaded carrageenan NPs involved testing various options such as distilled water, NaCl, and KCl. Throughout the experimentation, factors like resuspension in phosphate buffered saline solution and ethanol removal were meticulously examined. Each sample was duplicated and compared against a reference sample where free curcumin was added to hot distilled water. Ultimately, it was found that a 0.5 mol L^{-1} NaCl solution proved to be the most effective solvent, yielding the highest solubility in hot water. After conducting solubility tests, the optimal curcumin load was determined to be 25 mg in 800 mg of carrageenan, which was calculated by varying curcumin quantities and evaluating encapsulation efficiency. This innovative delivery system not only improves curcumin's bioavailability but also harnesses the synergistic benefits of carrageenan NPs.

Keywords: Anticancer, carrageenan, curcumin, nanoparticles

FD_045

ISOLATION OF NINHYDRIN-POSITIVE STEROIDAL SAPONINS IN PALMYRAH PRODUCTS

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Borassus flabellifer L. (Palmyrah palm) is a characteristic feature of Northern and Southern Sri Lanka. Almost all the parts of palmyrah have a greater socio-economic significance. Palmyrah produces two types of flour such as Odiyal and Pulukodiyal, and both types were employed in this study. Palmyrah fruit pulp and flour contains flabelliferins which are steroidal saponins with β-sitosterol with attached carbohydrate units. Steroidal saponins can be detected using anisaldehyde. Some -OH groups there in the carbohydrate units can be converted to -NH and -NH_2 groups due to various synthetic pathways. These N-containing flabelliferins can be detected using ninhydrin. This study presents the isolation and characterization of ninhydrin-positive steroidal saponins from Palmyrah. The crude extraction of steroidal saponins was done by solvent extraction with methanol, and the extract was concentrated using a rotary evaporator. Thin layer chromatography (TLC) was conducted using butanol:ethanol:ammonium hydroxide in different ratios and finally concluded that 7:3:5 as the solvent system for the TLC. The concentrated sample was desugared by employing a dry cellulose column. The concentrated desugared sample was subjected to column chromatography using silica gel 60-120 mesh technique with the usage of petroleum ether, dichloromethane, ethyl acetate, and methanol in different solvent ratios. Yellow and pink color bands were observed in the column chromatography experiments. Ninhydrin positive compounds were mainly observed after 1:1 ethyl acetate:methanol solvent ratio. These fractions were subjected to preparative TLC to obtain a single compound. Characterization of steroidal saponins was carried out by Fourier transform infrared spectroscopy, and analysis of the spectrum indicated O-H, C=O, and C-O stretching mainly. Several fractions in the Pulukodiyal column resulted in white crystals indicating purity within them. Several fractions in Odiyal were isolated as pure compounds. They are to be subjected to ^{1}H NMR, ^{13}C NMR in the future for further analysis and structure elucidations.

Keywords: Flabelliferins, Odiyal, palmyrah, Pulukodiyal

FD_046

FORMULATING HERBAL TEA BLENDS FROM *Rhizophora mucronata* HYPOCOTYL, *Sonneratia caseolaris* FRUIT, AND *Tragia plukenetti* LEAVES

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The rising popularity of herbal tea blends and the need to incorporate under-utilized food in value addition of tea products has sparked interest among producers and consumers. This study aimed to formulate three herbal tea blends using two true mangroves *Rhizophora mucronata* (Maha Kadol) hypocotyl and, *Sonneratia caseolaris* (Kirala) fruit, and medicinal plant *Tragia plukenetti* (Kahambiliya) leaves. Sensory evaluations were conducted by professional tea tasters using a nine-scale Hedonic test. The most preferred blends were identified as follows: 60% Ceylon green tea with 39% *R. mucronata*, 0.5% cardamom, and 0.5% peppermint; 70% Ceylon green tea with 15% *S. caseolaris* fruit, 10% lemongrass, and 5% peppermint; and 50% Ceylon green tea with 40% *T. plukenetti* leaves and 10% peppermint. Total antioxidant capacity (TAC), total polyphenolic content (TPC), total flavonoid content (TFC), and proximate composition were determined in all tea blends. The *S. caseolaris* blend demonstrated the highest TAC (1.47±0.06 mg TE/g DW) and TFC (232.95±2.81 mg RE/g DW) in hot water extracts. All blends showed similar TPC (mg GAE/g DW). Proximate analysis revealed the nutritional composition of each blend. The *R. mucronata* blend contained 7.66±0.40% moisture, 15.72±0.58% crude fiber, 4.00±0.06% fat, 8.44±0.07% protein, 3.54±0.05% ash, and 80.20±0.17% carbohydrates. The *S. caseolaris* blend comprised 24.53±2.01% moisture, 16.03±01.27% crude fiber, 4.00±0.13% fat, 10.17±0.25% protein, 5.33±0.03% ash, and 59.75±0.36% carbohydrates. The *T. plukenetti* blend exhibited 4.82±0.13% moisture, 10.58±0.70% crude fiber, 6.00±1.13% fat, 10.15±0.32% protein, 5.81±0.27% ash, and 79.10±0.46% carbohydrates. These results suggested that Ceylon green tea blended with the aforementioned herbs can serve as recommended value-added herbal tea beverages. The introduction of sustainable harvesting will also promote communities engaging in conservation and earning an alternative income.

Financial assistance by the United States Forest Service, facilitated through the Wildlife and Nature Protection Society, is acknowledged.

Keywords: Novel herbal tea, *Rhizophora mucronata*, *Sonneratia caseolaris*, *Tragia plukenetti*

FD_047

DEVELOPMENT OF FISH-BASED READY-TO-USE THERAPEUTIC FOOD TO PREVENT MALNUTRITION AMONG SRI LANKAN YOUNG POPULATION

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Ready-to-use therapeutic food (RUTF), a highly nutrient-dense paste made with all the nutrients a person needs, has become a lifesaving treatment for acute malnutrition. The main objective of this study was to develop a fish powder (*Leiognathus dussumieri*) incorporated RUTF, specifically a nutrient bar to prevent the malnutrition among young population in Sri Lanka. Roasted powders of red rice, soybean, Karalla fish, sesame seeds, peanut, desiccated coconut, treacle and palm oil were used as the main raw materials. The ratios were determined using sensory analysis. Chemical, physical functional properties of the formulated nutrient bars were determined using AOAC official methods and relevant reference procedures. Results showed that the nutrient bar contains (5.31±0.05)% moisture, (31.77±0.11)% total fat, (2.23±0.12)% total ash, (19.63±0.07)% crude protein, (6.22±0.11)% crude fiber, 34. 82% carbohydrates and 504 calories per 100 g. According to AAS analysis, nutrient bar consisted of 2.09±0.01 Fe, 1017.8±21.2 Ca, 3989.7±21.0 Mg, 2765.8±129.4 K, 3.36± 0.78 Zn, and 54.65±7.95 Na mg per 100 g. Nutrient bar contained 11-octadecenoic acid (oleic acid), 9,12-octadecadienoic acid (linoleic acid) as unsaturated fatty acids according to the GC–MS analysis. Nutrient bar contained 0.929±.0164 mg GAE/g total phenolic content. The IC_{50} obtained was 0.0504±0.0010 g mL^{-1} according to the DPPH assay. ABTS radical scavenging activity was (39.98±1.74)% according to the ABTS assay. The total flavonoids content was 0.208±0.004 mg QE/g according to the quercetin standard curve. TBA, peroxide tests and microbial tests confirmed that the product is safe during three months of storage at room temperature. The pH value of the nutrient bar was 7.12±0.02 and color indices of nutrient bar were L^* = 47.30±1.76, a^*= 10.70±0.76, b^* = 26.93±0.51, c^* = 28.97±0.21 and h^* = 68.27±1.75. The nutrient bar developed contained major nutrients, minerals and amino acids. Therefore, this energy-dense nutrient bar can be recommended to youths who suffer from malnutrition.

Keywords: AAS, functional properties, GC-MS, malnutrition, RUTF

FD_048

EFFECT OF NATURAL ANTIOXIDANTS EXTRACTED FROM *Emblica officinalis* SEED ON THE SENSORY PROPERTIES OF MAYONNAISE

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Plant-derived food additives have been remarkably used in the food industry. The study aimed to investigate the phenolic content and composition, antioxidant activity, and antimicrobial activity of *Emblica officinalis* seed extract (ESE), and its impact on the sensory properties of mayonnaise. The phenolic antioxidants were extracted using 100% ethyl acetate. The total phenolic content (TPC) was determined using the Folin-Ciocalteu's method and expressed as gallic acid equivalents per kilogram (g GAE kg^{-1}) sample. Gas chromatography-mass spectrometry (GC-MS) was performed to identify the phenolic compounds present in the seed extract. The antioxidant activity of the extract was evaluated at different concentrations (10, 15, 20, 25, and 30 µg mL^{-1}) using the Ferric Reducing antioxidant power (FRAP) assay and compared with synthetic antioxidants; butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA). The antibacterial activity of ESE was determined against food-borne pathogenic bacteria namely; *Staphylococcus aureus* and *Salmonella* sp. by examining the diameter of inhibition zones (mm) using the disc diffusion method. Mayonnaise, comprising sunflower oil, vinegar, sugar, and salt, was prepared, and the impact of antioxidants was evaluated by adding at 200 mg kg^{-1}. Sensory evaluation was conducted to assess sensory attributes (appearance, color, taste, odor, texture, overall acceptability) of prepared mayonnaise using 11-point hedonic scale and compared with a control sample without added antioxidants. Results showed that the TPC of ESE was 11.55±0.00 g GAE kg^{-1}. GC-MS analysis identified 1,2,3-propanetriol, 4-hydroxy-3-nitrocoumarin, and pyrogallic acid, in ESE as phenolic compounds. ESE showed the highest antioxidant activity with a reducing power of 151±2% followed by BHT (45±1%) and BHA (37±1%) at 30 µg mL^{-1}. Tested natural antioxidants showed superior inhibition against food-borne pathogenic bacteria than synthetic antioxidants, which showed no inhibitory effect. Sensory scores for all attributes of mayonnaise showed significantly higher scores ($p < 0.05$) than control and synthetic antioxidants-added samples. *E. officinalis* seed offers valuable insights into its potential as a food preservative.

Financial assistance from the University of Sri Jayewardenepura (Grant No. ASP/01/RE/TEC/2022/76) is acknowledged.

Keywords: Antimicrobial activity, antioxidant activity, *Emblica officinalis*, sensory evaluation, total phenolic content

FD_049

FORMULATION AND DEVELOPMENT OF *Centella asiatica* AND ALOE VERA INCORPORATED ICE CREAM

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Centella asiatica and aloe vera can be used as ingredients to make ice cream that gives natural colour, high nutrient value, and desired texture. Aloe vera gives mild refreshing flavor, unique taste, cooling sensation and pleasant gel-like texture to ice cream. Therefore, this study aimed to formulate and develop *C. asiatica* and aloe vera incorporated ice cream. Different treatments such as blanching, sodium metabisulfite, sodium benzoate, citric acid, low-temperature long-time pasteurization, high-temperature short-time pasteurization, and refrigeration were used for preservation of *C. asiatica* juice. The pH of each treatment was measured at day 1, 3 and 7. The results showed that blanching prevented enzymatic browning, and refrigeration was the most effective preservation method. Two formulations of ice cream were prepared and sensory, proximate, physiochemical, microbial, textural properties, and shelf-life evaluation were tested. In sensory evaluation (30 panellists), overall acceptability of *C. asiatica* ice cream with aloe vera pieces and without Aloe vera pieces were 4.900±0.305 and 3.866±0.434 scores, respectively and most accepted ice cream was used for further analysis. Moisture, ash and fat contents of ice cream was 33.83%, 3.13% and 11%, respectively. Titratable acidity, pH and total soluble solid were 0.022, 6.077 and 26.833 °Brix, respectively. The color properties were 87.130±0.007, -7.865±0.064, and 15.885±0.177, respectively for L, a, and b values (3 trials). The total plate count and yeast and mold count were zero on the first day and results were, "too few to count" after two weeks. Hardness, deformation at hardness, adhesive force, and adhesiveness were 33.60 g, 1.47 mm, 16.60 g, 0.25 mJ, respectively. The melting rate was 3.15% per minute. Organoleptic properties showed no change and microbiological characters were within the standard range. Therefore, *C. asiatica* juice can be used to give natural color to ice cream production while retaining the textural properties of ice cream.

Keywords: Aloe vera, *C. asiatica*, ice cream, preservation, refrigeration

FD_050

DEVELOPMENT OF ANTIMICROBIAL AGENTS INTERCALATED LAYERED DOUBLE HYDROXIDES INCORPORATED NANOFIBER BASED ACTIVE PACKAGING MATERIAL

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Post-harvest loss is a significant global concern, predominantly driven by biological deterioration, forcing extensive exploration of innovative solutions, such as active packaging materials. Antimicrobial agents increase the shelf-life of perishable items that are susceptible to biological deterioration. Ascorbic, citric, and salicylic acids are well-known antimicrobials. Layered double hydroxides (LDHs) are a new strategy due to their slow-releasing property. This study aims to develop a novel hybrid material by combining ascorbic-LDH, salicylic-LDH, and citric-LDH for potential active packaging material. Antimicrobials were incorporated into Mg-Al/LDH using the coprecipitation method and characterized. Loading percentages were determined, and hybrid LDH material was formulated through manual grinding. Electrospinning was employed to create hybrid LDH membranes with cellulose acetate nanofibers. Slow-releasing of antimicrobials from the membrane was tested, and its activity was evaluated by the well diffusion method. The antimicrobial activity of LDH materials was measured using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay to determine their IC_{50} values. The intensive main diffraction peak of the nitrate-LDH at d_{003}=7.96 Å was observed in powder X-ray diffraction patterns and shifts in LDHs' basal peaks indicated the increase in interlayer space, confirming the successful intercalation. Metal-oxygen bonds formation was confirmed, and other characteristic bonds were identified by Fourier transform infrared and Raman spectroscopic data, while X-ray photoelectron spectroscopy revealed details regarding molecular interactions. Scanning electron microscopic images clearly showed morphological characteristics and layered structure. Loading percentages of ascorbic-LDH, citric-LDH and salicylic-LDH were 63%, 81% and 88%, respectively. About 80%, 62% and 81% weight percentages of loadings were released after 24 hours from ascorbic-LDH, citric-LDH and salicylic-LDH, respectively. The hybrid material exhibited highest antimicrobial activity with an IC_{50} value of 132.5 μg mL^{-1}, and its synergistic action was validated by the IC_{50} values of each component which are 234.1 μg mL^{-1}, 354.5 μg mL^{-1} and 402.2 μg mL^{-1} for ascorbic-LDH, salicylic-LDH and citric-LDH, respectively. Based on these findings, the hybrid material incorporating nanofiber membrane shows promise as an active packaging material.

Keywords: Active packaging, antimicrobial agents, layered double hydroxides, synergistic activity

Medicine:

Chemistry, Pharmaceutical and Herbal Technology

MD_051

INVESTIGATION OF ANTIBACTERIAL POTENTIAL OF SEQUENTIAL EXTRACTS OF *Senna alata* AND *Datura metel* FOR SELECTED PATHOGENS

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In Ayurveda medicine, *Senna alata* (Fabaceae) and *Datura metel* (Solanaceae) are used as medicinal plants to treat skin infections. Most of those diseases are caused by microorganisms. There are very few antibiotics available for skin infections. Also, there is a huge risk of developing antibacterial resistance against the available antibiotics. Hence, the above plants were selected to investigate their antibacterial activities. The plant species were authenticated, the leaves of the plants were collected, washed, dried, powdered, and subjected to extractions. Crude extracts were prepared using 1:1 dichloromethane/methanol (v/v) binary solvent mixture for primary screening. All the crude extracts were screened against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, and *Pseudomonas aeruginosa via* agar disc diffusion assay (400 µg/disc). Both *S. alata* (8.80±0.08 mm) and *D. metel* (10.80±0.08 mm) exhibited antibacterial activity against *B. subtilis*. Therefore, those plants were sequentially extracted to observe the specific fraction/s that possess the antibacterial activity. The sequence of organic solvents aligned according to their polarity. The order of solvents used were hexane, dichloromethane, ethyl acetate and methanol. The sequential extracts of two plant species were tested against the same bacterial strains used during the primary screening *via* agar disc diffusion assay (400 µg/disc). Among those extracts, ethyl acetate extract of *S. alata* (9.90±0.08 mm), dichloromethane (9.60±0.24 mm), ethyl acetate (9.00±0.27 mm), and methanol (10.60±0.07 mm) extracts of *D. metel* displayed antibacterial activity against *B. subtilis*. The results obtained revealed that the antibacterial compounds in *S. alata* could be moderately polar. In *D. metel*, it could be in the range of slightly polar to polar. Since three sequential extracts of *D. metel* displayed antibacterial activity against *B. subtilis*, could be a potential candidate for conducting further research to investigate bioactive compounds.

Keywords: Antibacterial activity, *B. subtilis*, *D. metel*, sequential extraction

MD_052

VARIATION OF PHYTOCHEMICALS AND ANTIOXIDANT CAPACITIES ACROSS DIFFERENT PARTS OF PLANTS; *Annona muricata*, *Phyllanthus emblica*, AND *Morus alba*

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Sri Lanka, recognized as a global biodiversity hotspot, possesses a diverse range of fruits; yet a significant portion of them is underutilized. *Annona muricata*, *Phyllanthus emblica* and *Morus alba* are three such underutilized plants, despite their numerous benefits in traditional medicine. Phytochemicals are often regarded as indicators of health-promoting properties in a plant. Therefore, this research aims to estimate the phytochemical and antioxidant capacities of these selected plants and their variation across different plant parts. Crude extracts were prepared by cold maceration with 80% methanol along with continuous agitation for 48 h. The total polyphenolic content (TPC), the total flavonoid content (TFC), and the total radical scavenging activity (RSA) of the extracts were determined using the Folin Ciocalteu colorimetric assay, the aluminum chloride method, and the ABTS radical scavenging assay, respectively. Among the species, *Phyllanthus emblica* exhibited the highest mean TPC (432.00±26.31 mg GAE/g), TFC (212.61±18.71 mg QE/g), and RSA (97.58±2.78)%. Notably in all three species, the highest phenolic content was detected in the root barks. Moreover, a statistically significant positive correlation was observed between antioxidant capacity with TPC (R^2 = 0.975; p < 0.01) and TFC (R^2 = 0.925; p < 0.01), indicating potential contribution of phenolic and flavonoid compounds to the antioxidant activity. This study provides insights into the variation of phytochemical composition and antioxidant potential across different parts of the selected three underutilized plants highlighting the importance of selecting specific plant parts in optimizing their beneficial qualities. A comprehensive phenolic profiling of these plant parts may pave the path to identifying their applications in the pharmaceutical, nutraceutical, and functional food industries.

Financial support provided by the Asian Development Bank (Grant no: R2RJ4) is acknowledged.

Keywords: Total antioxidant capacity, total flavonoid content, total phenolic content, underutilized fruits

MD_053

ASSESSMENT OF *in vitro* ANTIOXIDANT ACTIVITY OF CURCUMIN RELEASED FROM CURCUMIN-LOADED ELECTROSPUN POLYCAPROLACTONE FIBERS

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Curcumin, the active ingredient of turmeric (*Curcuma longa*), has a wide range of pharmacological activities due to its unique characteristics, including antibacterial, antioxidant, anti-inflammatory, wound healing, and anticancer properties. However, its application in the medicinal industry has been restricted as it is precarious *in vivo* with very low bioavailability, and extreme light and pH sensitivity. Hence, topical administration is the best way to deliver curcumin, leading to increased bioavailability. For topical administration, nanofibers can be introduced as the best carrier to entrap curcumin and transfer it, as they can shield curcumin against bioactive degradation. This feature is mainly due to the photosensitivity ability of nanofibers. The present study is based on the cumulative release of curcumin under physiological conditions. In addition, the stability of curcumin entrapped in electrospun polycaprolactone (PCL) nanofibers was also studied using its antioxidant properties. The loading capacity of curcumin on PCL nanofibers was 25.09 mg g^{-1}. The curcumin release was examined under physiological conditions (temperature: 37 °C, pH: 7.4). The maximum release of (20.11±6.04)% was observed after 96 hours. The encapsulation efficiency of curcumin in electrospun PCL nanofibers was (64.84±13.09)%. The stability of the entrapped curcumin was investigated by assessing the antioxidant activity of the released curcumin. After 24 hours, all samples that were subjected to freeze and thaw cycles showed scavenging percentages between 86.3±6.5 and 92.2±1.7, and after 96 hours, they varied from 68.0±8.7 to 80.0±2.2. However, samples that had not gone through harsh conditions showed a scavenging percentage of 99.8±0.2 after 24 hours; but it decreased to 86.1±0.3 after 96 hours of extraction. The antioxidant property of released curcumin under physiological conditions was 33.2±8.9% after 96 hours, results of the study conclude that curcumin-loaded PCL fibers show good potential to be used in medical dressings.

Keywords: Antioxidant, curcumin, physiological, polycaprolactone

MD_054

ENHANCING THE BIOACTIVITY OF GREEN TEA (*Camellia sinensis*) USING KOTHALA HIBUTU (*Salacia reticulata*)

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This study investigates the potential synergy between two distinct botanical powerhouses: *Camellia sinensis*, the source of green tea, and *Salacia reticulata*, known as kothala hibutu. Both these plants have been celebrated for their diverse phytochemical compositions and reputed health benefits. The phytochemical analysis revealed the presence of essential compounds in both *Camellia sinensis* (green tea) and *Salacia reticulata* (Kothala Hibutu), providing a foundation for understanding their potential health benefits. Antioxidant assay showed the ability of *Salacia reticulata* to enhance the antioxidant activity of *Camellia sinensis*. Anti-inflammatory and anti-diabetic assays demonstrated the inherent properties of both plants, with kothala hibutu emerging as a potential leader in diabetes management. Furthermore, antibacterial tests emphasized the antibacterial properties of both tea samples, with a preference for Gram-positive bacteria. The types of bacterial strains used were *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. The combination of both showcased heightened antibacterial efficacy. Incorporating dried jasmine flowers in the final product added an interesting sensory dimension, with the jasmine-flavored blend emerging as the favored choice in sensory evaluation. This development is noteworthy for its potential in enhancing the acceptability of the tea and expanding its appeal to a broader audience.

Keywords: Anti-diabetic, anti-inflammatory, antioxidant, health benefits, phytochemical analysis

MD_055

NANOSILVER-INCORPORATED CARBOXYMETHYL CELLULOSE–POLYETHYLENE GLYCOL–CHITOSAN HYDROGELS AS SUPER ABSORBENT ANTIBACTERIAL WOUND DRESSINGS

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Wound healing remains a challenging issue worldwide due to its difficult-to-manage, complex nature. Nowadays, effective wound dressing approaches are gaining great importance worldwide. The biopolymer hydrogels synthesized using carboxymethyl cellulose (CMC), polyethylene glycol (PEG), and chitosan (CS) have shown great application potential as superabsorbent, antibacterial wound dressings. This study investigated the superabsorbent, anti-bacterial, and biocompatible properties of nano silver-incorporated CMC-PEG-CS hydrogels as a novel approach for wound dressing applications, as these hydrogels have not been previously reported. For this purpose, Ag nanoparticles (NPs) were synthesized using two methods: chemically using trisodium citrate (c-Ag) and green tea extract as the reducing agent in the greener method (g-Ag). CMC (4% w/v), PEG (4% w/v), and CS (2% w/v) biopolymers were mixed in distilled water in the presence of citric acid (0.96% w/v) and glycerol (3.2% v/v) crosslinkers to synthesize neat CMC-PEG-CS hydrogel blend. Then, Ag NP solutions were mixed with neat hydrogel in a 1:1 volume ratio to synthesize c-Ag-CMC-PEG-CS and g-Ag-CMC-PEG-CS hydrogels. The synthesized hydrogels were characterized using scanning electron microscopy (SEM), Fourier transform infrared spectroscopy, and X-ray diffraction. The swelling capacity of g-Ag-CMC-PEG-CS hydrogel (131%) was higher than that of c-Ag-CMC-PEG-CS hydrogel (107%) after 48 hours, indicating higher exudate absorptivity, which is further explained by the extremely porous SEM images. The g-Ag-CMC-PEG-CS hydrogel showed antibacterial activity of 7.7±1.0 mm against *Escherichia coli* and 6.3±1.0 mm against *Staphylococcus aureus* bacterial strains. In contrast, the c-Ag-CMC-PEG-CS hydrogel showed an activity of 11.3±1.0 mm against *Escherichia coli* and 9.3±1.0 mm against *Staphylococcus aureus* from the disk diffusion method. Both hydrogels showed significant survival and hatch rates from zebrafish toxicity assay, indicating biocompatibility. Thus, these Ag-incorporated CMC-PEG-CS hydrogels are promising, environmentally friendly, biocompatible, anti-bacterial superabsorbent hydrogel dressing for highly exudating wounds.

Keywords: Biopolymers, hydrogels, silver nanoparticles, wound dressing

MD_056

COMPARISON OF *in vitro* ANTIOXIDANT AND ANTI-INFLAMMATORY ACTIVITIES OF YELLOW AND PINK COLOR FLOWERS OF *Mirabilis jalapa* LINN.

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Herbal medicines have played a foundational role in traditional medical systems worldwide for centuries. Numerous phytochemicals found in plants have a wide variety of medicinal applications. Therefore, the objective of this study was to evaluate and compare the antioxidant and anti-inflammatory potential of yellow and pink color flowers of *Mirabilis jalapa* Linn, commonly known as "Four o'clock flower (Hendirikka). First, the chemical constituents of air-dried flowers were separately extracted into methanol by cold extraction. Then the 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity, the total antioxidant capacity, the total phenolic content (TPC), the total flavonoid content (TFC), and the human red blood cell (HRBC) membrane stabilization property were determined for yellow color flower extract (YCFE), whereas DPPH assay, potassium ferricyanide reducing antioxidant power (PFRAP) assay, Folin-Ciocalteau method, AlCl3 colorimetric method and the HRBC membrane stabilization assay were carried out on the pink color flower extract (PCFE). The IC_{50} values of DPPH free radical scavenging activity of YCFE and PCFE were found to be 36.11±1.11 μg mL^{-1} and 32.08±0.47 μg mL^{-1}, respectively, which were slightly higher than that of standard butylated hydroxytoluene (BHT) (IC_{50} =17.71±3.38 μg mL^{-1}). The PFRAP values of YCFE and PCFE were 465.21±5.48 and 516.67±2.38 mg BHT equivalent/g of dry weight of extract, respectively. The TPC values of YCFE and PCFE were 198.31±2.49 and 171.99±5.82 mg of gallic acid equivalent/g of the dry weight of the extract, respectively. TFC values of YCFE and PCFE were 256.08±7.50 and 241.64±10.22 mg of catechin equivalent/g of the dry weight of the extract. The results further show that the IC_{50} values of YCFE, PCFE, and the standard ortho acetylsalicylic acid for HRBC membrane stabilization assay were 509.96±42.18 μg mL^{-1}, 423.62±32.47 μg mL^{-1} and 819.59±31.08 μg mL^{-1}, respectively. The results revealed that the anti-inflammatory activities of the two extracts were greater than that of the standard ortho acetylsalicylic acid. As the findings point out that YCFE and PCFE contain chemical constituents with antioxidant potential and anti-inflammatory activity, further studies should be carried out to isolate and identify the corresponding bioactive compounds.

Financial support by the University of Kelaniya (Grant No: RP/03/02/06/01/2018) is acknowledged.

Keywords: Anti-inflammatory activity, antioxidant activity, TFC, TPC

MD_057

DETERMINATION OF ANTIBACTERIAL ACTIVITY IN STRESS INDUCED *Ophiorrhiza pumila* PLANT

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Ophiorrhiza pumila, a medicinal plant belonging to the family Rubiaceae, consists of 150 species primarily distributed throughout the Indo-Malay region. Plants of the Rubiaceae family produce various bioactive metabolites, including iridoids, indole-alkaloids, anthraquinones, terpenoids, flavonoids and phenolic compounds. These compounds are used to treat inflammation, pain, cancer, snakebite, stomatitis, ulcers, wounds, bacterial and viral infections. *O. pumila* is well-known for its high camptothecin (CPT) content, utilized in antitumor medications. However, during this study, the antibacterial activity of stress-induced *O. pumila* flowers and leaves was assessed. Salicylic acid (SA) of concentration 10 mmol L^{-1} was used as the optimum assay condition for stress induction. Crude methanol (MeOH) extracts of *O. pumila* flowers and leaves were prepared using SA treated and non-treated plants. These crude extracts were evaluated for antibacterial activity *via* disk diffusion assay against Gram positive bacteria: *Bacillus subtilis*, *Staphylococcus aureus*; Gram negative bacteria: *Pseudomonas aeruginosa*, *Escherichia coli*. Both SA-treated and non-treated flower samples exhibited antibacterial activity against Gram-positive bacteria *B. subtilis* showing inhibition zones of 12.00±0.61 mm and 10.00±0.72 mm, respectively. However, both treated and non-treated leaf extracts did not show antibacterial activity against all bacterial strains tested. The MeOH extracts of two flower samples were subjected to the minimum inhibitory concentration (MIC) assay against *B. subtilis*, and the results showed MIC values of 1.2 mg per disk for SA treated flowers, and 1.4 mg per disk for non-treated flowers. In addition, the percentage yield data suggest that the SA treatment has enhanced the production or accumulation of bioactive compounds in both leaves and flowers. Further investigation to isolate antibacterial compounds is currently underway.

Financial assistance from the National Research Council (Grant No: 19-024) is acknowledged.

Keywords: Antibacterial activity, methanol extracts, minimum inhibitory concentration (MIC), stress-induced *O. Pumila*

MD_058

PHYTOCHEMICAL SCREENING AND ANTIOXIDANT ACTIVITY OF ETHANOL EXTRACTS OF SEED, PULP AND PEEL OF *Dialium ovoideum* THWAITES

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Dialium ovoideum Thwaites, an endemic Sri Lankan wild fruit from the Fabaceae family, possesses high nutrient content. However, scientific data on its benefits still needs to be provided. Thus, this study explores the phytochemical composition and antioxidant activities of ethanol extracts from the fruit parts (seed, pulp and peel) of *D. ovoideum* Thwaites. The Soxhlet method was utilized to extract active components from the seed and peel, whereas the pulp underwent maceration at room temperature for 24 h. Ethanol was used as the solvent in both perspectives. Standard methods assessed phytochemical composition, while Folin-Ciocalteau and $AlCl_3$ colorimetric assays determined the total phenolic and flavonoid contents. The antioxidant properties of the extracts were determined by the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging and ferric-reducing power assays. Ethanol extracts from the seed, pulp, and peel possessed phenols, flavonoids, tannins, steroids, and carbohydrates. Additionally, the seed extract revealed the presence of saponins and terpenoids, the pulp extract contained terpenoids, reducing sugars and proteins, and the peel extract included saponins and reducing sugars. The ethanol extract of the seed exhibited the highest total phenolic content of 84.6±1.2 mg GAE/g, followed by that of the peel extract (27.7±0.2 mg GAE/g) and that of the pulp extract (23.5±1.4 mg GAE/g). Similarly, the highest total flavonoid content (95.1±16.9 mg QE/g) was obtained in the seed extract, while the pulp and peel extracts exhibited lower values of 18.7±11.8 mg QE/g and 9.2±5.8 mg QE/g, respectively. The ethanol extract of seed, pulp and peel displayed antioxidant activity with EC_{50} values of 145.0±35.0 μg mL^{-1}, 405.3±72.6 μg mL^{-1} and 782.0±77.3 μg mL^{-1}, respectively, compared to that of ascorbic acid (EC50 of 32.0±2.1 μg mL^{-1}) in the DPPH assay. Additionally, the extracts demonstrated significant ($p < 0.05$) reducing potential compared to that of the ascorbic acid standard. Ethanol extract of the seed of *D. ovoideum* Thwaites exhibited a strong positive correlation with antioxidant activity for total phenolic and flavonoid contents.

Keywords: Antioxidant activity, *Dialium ovoideum* Thwaites, fruit extracts, phytochemical composition

MD_059

SHRIMP SHELL CHITOSAN-nHA SCAFFOLDS: A PROMISING APPROACH FOR BONE FRACTURE HEALING

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In this study, a bone scaffold was fabricated from the co-precipitated chitosan-nano-hydroxyapatite (Chi-nHA) composite by freeze-drying method. Initially, chitosan was extracted from locally sourced shrimp shells, and chitosan-nano-hydroxyapatite composite was then synthesized by the co-precipitation method. Finally, the bone scaffold was fabricated from the composite. During the fabrication of the bone scaffold, Gelatin was used as a bonding agent to improve the mechanical and structural properties. The cross-links between the chitosan matrix and gelatin were stimulated utilizing glutaraldehyde. Scanning electron microscopic (SEM) analysis, energy dispersive X-ray spectroscopy (EDAX), X-ray diffractometry (XRD), Fourier transform infrared spectroscopy (FTIR) and thermogravimetric analysis (TGA) were employed to analyze the morphology, crystalline structure and composition in each stage. Bioactivity was tested by *in vitro* biodegradation and *in vitro* biomineralization tests. The degree of deacetylation of the extracted chitosan was 80.5 % according to the FTIR spectrum of chitosan. The SEM images demonstrated its porous structure. In the composite, nano-hydroxyapatite particles with the size of 60 – 90 nm range were distributed in the chitosan matrix. The crystallite size was calculated to be approximately 10 nm, according to the Halder-Wagner method using XRD results. EDAX results confirmed the Ca:P mass ratio of nano-hydroxyapatite. The SEM images of the prepared scaffold used for the morphological characterization of the prepared scaffold justified the porous structure. Chitosan-nano-hydroxyapatite scaffolds offer the distinct advantage of self-degradation and obviate the requirement for their removal after the regeneration process is complete. The degradation profile of the scaffold can be tailored to match the rate of bone growth, potentially reducing the risk of implant-related complications. This study presents the fabrication of a novel, cost-effective 3D bone scaffold utilizing shrimp shell-derived chitosan and nano-hydroxyapatite. The approach of the step-by-step process addresses the dual properties of ceramic nHA and polymeric chitosan for enhanced properties. This unique combination results in a 3D scaffold potentially paving the way for significant advancement in efficient bone regeneration with healthcare affordability.

Keywords: Bio composite scaffold, chitosan, gelatin, nano-hydroxyapatite

MD_060

EXPLORING THE PHARMACOLOGICAL EFFICACY OF HERBAL UNDER-EYE CREAM FORMULATED WITH *varnya gana dravya* FROM *Charaka Samhita* THROUGH ANALYTICAL TECHNIQUES

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The research delves into the intricate process of formulating a herbal under-eye cream by harnessing the potency of *varnya gana dravya* from *Charaka Samhita*, emphasizing the pivotal role of chemical analysis in gauging its effectiveness. Ayurveda champions a comprehensive approach to skincare, tackling prevalent issues such as under-eye darkness with natural remedies. The cream, meticulously crafted with *rakthachandana*, *manjistā*, and *yashtimadhu*, sourced from *Charaka Samhita's varna gana*, that including luminous complexion, minimize adverse effects, and skin rejuvenation. The methodology entails the application of traditional techniques and the selection of ingredients prized for their pharmacological properties. Chemical analysis techniques, spanning moisture content assessment, total ash value determination, acid-insoluble ash value measurement, water-soluble ash value evaluation, as well as phytochemical analysis supplemented with thin-layer chromatography (TLC) and high-performance thin-layer chromatography (HPTLC), were meticulously employed to scrutinize the composition and purity of the cream. Results unveiled a moisture content of 26.3%, a total ash value of 7.8%, an acid-insoluble ash value of 1.2%, and a water-soluble ash value of 2.05%, affirming the cream's pristine quality. Phytochemical analysis unearthed a rich array of bioactive compounds including alkaloids, flavonoids, tannins, phenols, saponins, cardiac glycosides, and terpenoids, endowing the cream with potent antibacterial, antifungal, and antioxidant properties. TLC and HPTLC corroborated these findings, cementing the presence of phytochemicals indispensable for effective skincare. These revelations underscore the cream's immense potential in alleviating under-eye concerns, underscoring the indispensable role of chemical analysis in ensuring product efficacy and safety. By amalgamating ancient wisdom with modern analytical methodologies, this research paves the way for the advancement of herbal skincare formulations anchored in Ayurvedic principles.

Keywords: Ayurvedic skin care, chemical analysis, herbal under-eye cream

MD_061

INVESTIGATING POSSIBLE ANTIPYRETIC MECHANISM OF PASPANGUWA HERBAL FORMULA *in silico*

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Understanding the antipyretic mechanism of drugs and traditional medicines has become a high priority among scientific communities. The COX-2 enzyme is a crucial target of antipyretic therapeutics, the inhibition of which could suppress the elevation of fever. In search of potential inhibitors, phytochemicals from Sri Lankan traditional medicinal plants are an invaluable source of drug leads. Therefore, this study utilized molecular docking and molecular dynamics simulation-based virtual screening to evaluate the inhibition of COX-2 by phytochemicals in five medicinal plants that formulate the traditional herbal preparation of 'Paspanguwa'. A total of forty-five phytochemicals were assessed for their pharmacokinetic properties *in silico*. The phytochemicals and the reference therapeutic drug (aspirin) were docked against the active site of target COX-2 using the Autodock Vina program. Evaluation of docking scores revealed five compounds: 6-dehydrogingerdione, α-curcumene, zingiberene, 6-shagol and esculetin as promising hits against COX-2. These five compounds exhibit low toxicity as well as high bioavailability. Upon binding to the enzyme, the five compounds interacted favorably in the active site, with binding energies of -7.3, -7.3, -7.1, -7.2 and -7.0 kcal mol^{-1}, respectively, whereas that of aspirin is -5.9 kcal mol^{-1}. From the MD simulation studies done using the software, NAMD, all complexes were found to be stable with no conformational changes during the 5 ns simulation trajectory. The ligand RMSD was less than 2.5 Å indicating the ligand bind stably to COX-2. Hence, the results of this study indicated that 6-dehydrogingerdione, α-curcumene, zingiberene, 6-shagol and esculetin have the ability to occupy the active site of COX-2, thus could act as potential inhibitors of COX-2. Hence, the resulting antipyretic activity of Paspanguwa may arise due to these binding interactions. These findings may provide new insights for developing antipyretic therapeutics against COX-2.

Keywords: Molecular docking, molecular simulation, natural products, paspanguwa

MD_062

In vitro STUDY OF ANTI-INFLAMMATORY AND ANTIOXIDANT ACTIVITIES OF ENDOPHYTIC FUNGI ISOLATED FROM *Dialium ovoideum* THWAITES LEAVES

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Endophytic fungi are mutualistic fungal communities that exit within plant tissues asymptomatically. *Dialium ovoideum* thwaites (gal siyambala) is an endemic plant in Sri Lanka that is used in Ayurvedic medicine for the treatment of skin infections. This study focuses on isolating endophytic fungi present in mature leaves of *D. ovoideum* and studying *in vitro* anti-inflammatory and antioxidant activity of their crude extracts. During the process, *D. ovoideum* leaves were cultured on PDA media and endophytic fungal colonies were obtained. After several rounds of sub-culturing followed by macroscopic and microscopic observations, four different types of fungi species (A, B, C, and D) were identified. Secondary metabolites of three of them were extracted into ethyl acetate crude extract and each of them was screened for anti-inflammatory and antioxidant activity. Egg albumin denaturation assay was conducted to assess anti-inflammatory activity using diclofenac sodium and prednisolone as standards. The crude extract of fungus B showed the highest activity among all three extracts (IC_{50} value; 0.4460±0.0636 mg mL^{-1}) yet lower activity compared to that of the standard diclofenac sodium (IC_{50} value; 0.0181±0.0898 mg mL^{-1}) and prednisolone (IC_{50} value; 0.0036±0.0487 mg mL^{-1}). Antioxidant activity was screened using DPPH radical scavenging assay where ascorbic acid was incorporated as the standard. The crude extract of fungus B showed the highest activity of the three extracts with the least IC_{50} value (0.1345±0.0611mg mL^{-1}) yet lower activity than that of the standard ascorbic acid (IC_{50} value; 0.0126±0.0128 mg mL^{-1}). All the extracts indicated a dose dependent activity. The crude fungal extracts of *D. ovoideum* contain anti-inflammatory and antioxidant activity suggesting their future potential as therapeutic agents.

Keywords: Anti-inflammatory, antioxidant, *Dialium ovoideum* thwaites, endophytic fungi

MD_063

STUDY OF ANTIOXIDANT PROPERTIES IN A COMBINATION OF TURMERIC (*Curcuma longa* L.) AND NUTMEG (*Myristica fragrans* Houtt.)

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Spices are well known for their medicinal value and are widely used in South Asian countries. They are highly used to obtain natural antioxidants in the modern scientific world, given the carcinogenic side effects associated with synthetic antioxidants. In the present study, the free radical scavenging activity and antioxidant properties of spices *Curcuma longa* L. (turmeric) and *Myristica fragrans* Houtt. (nutmeg) in combination were investigated using *in vitro* assays, including the 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity, determination of the total phenolic content using Folin-Ciocalteu reagent and the total flavonoid content using the colourimetric-$AlCl_3$ method and the ferric reducing antioxidant power (FRAP) assay. Powdered spice samples were extracted with three solvent systems including methanol, acetone, and acetone: methanol (1:1 ratio) using reflux method. The combination of spices was prepared by mixing crude extracts in equal mass ratios (1:1), and it showed greater free radical scavenging activity compared to that of acetone and methanol extracts individually. Individual extracts of turmeric and nutmeg showed 50% inhibition concentrations (157.24±1.99) mg L^{-1} and (171.29±4.03) mg L^{-1}, respectively. The combination of turmeric and nutmeg scavenged DPPH free radical with the highest efficiency showing 50% inhibition concentration (115.93±3.49) mg L^{-1}. This combination consists of (198.67±7.94) mg of pyrogallol equivalent/g of extract as the total phenolic content and (976.50±24.83) mg of quercetin equivalent/g of extract as the total flavonoid content showing higher antioxidant properties compared to individuals. Turmeric and nutmeg combination showed the FRAP value of (179.83±3.83) mg Fe^{2+} equivalent/g of extract; but this value was lower compared to the samples of individual. It can be concluded from these results that the combination of turmeric and nutmeg is a good source of natural antioxidants.

Keywords: Antioxidant activity, antioxidant properties, nutmeg, turmeric

MD_064

EVALUATION OF PHYSICOCHEMICAL PROPERTIES AND MICROBIOLOGICAL QUALITY OF *ASHŌKARŌHINĪ CHŪRNA*, A POLYHERBAL *AYURVEDA* PAEDIATRIC PREPARATION

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In *Ayurveda* literature, plant materials are known for their properties of increasing digestive fire as well as high nutritional values. According to Ayurveda paediatrics, the poly-herbal formula of *Ashōkarōhinī chūrna* is used to treat underweight children. Though the formula composition and therapeutic claims of *Ashōkarōhinī chūrna* are mentioned in the *Ayurveda* authentic text, *Ashtanga samgraha*, scientific investigations for its quality and safety evaluation are yet to be documented. This formula consists of two main ingredients, *Piper longum* Linn. and *Picrorrhiza kurroa* Royle ex Benth, which possess therapeutic and nutritional values. The present study was carried out to check whether this drug meets the standard quality parameters mentioned in the WHO guidelines for herbal medicines. Additionally, this work is an attempt to establish the quality parameters for *Ashōkarōhinī chūrna*. The physicochemical, chromatographic, and microbiological evaluations of the in-house prepared drug were performed as per the WHO guidelines. The physicochemical and microbial tests were conducted in triplicate and average results were as follows: pH (5.2), water extractable matter (27.1%), loss on drying content (11.7%), total ash content (4.2%) and acid insoluble ash (0.5%). Total bacterial count and total yeast and mould count were within WHO standard limits, while specific pathogenic bacteria (*E. coli*, *Shigella* spp., *Salmonella* spp.) were not detected in the samples tested. A thin layer chromatographic fingerprint profile was developed for the specific drug sample. These results can serve as preliminary quality standards for the selected drug formulation, indicating that the drug formulation has no significant quality issues. However, further investigations are required to assure the safety and quality of the drug. Further, these findings can be used by manufacturers as a reference for controlling the quality of *Ashōkarōhinī chūrna* formulation before its release to the market.

Keywords: Analytical studies, *ashōkarōhinī chūrna*, *ayurveda*, paediatric, underweight

MD_065

EVALUATION OF UREASE INHIBITORY ACTIVITY OF PEEL, FRUIT PULP AND LEAF EXTRACTS OF *Citrus Crenatifolia*

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Helicobacter pylori infection is known to be one of the main causes of formation of gastric ulcers and many more gastrointestinal diseases. By inhibiting the urease enzyme produced by this bacterium, an effective therapy against this infection can be developed. The current study aimed to determine the anti-urease activity of the plant *Citrus crenatifolia* which is referred to as "heen naran" in Sinhala. Citrus species are well known for their medical properties in folk medicine, owing to their diverse secondary metabolites. This research focused on evaluating the urease inhibitory activity of the fruit pulp, peel, and leaves of *Citrus crenatifolia*. The peel of the fruit of *Citrus crenatifolia* was subjected to Soxhlet extraction method using hexane, ethyl acetate and methanol as solvents, while the fruit pulp was subjected to lyophilization method to obtain the fruit extract. In addition, peels of the fruit and leaves were subjected to steam distillation to obtain the essential oil components of the plant. The maximum yield among the extracts was recorded from the fruit extract, whereas the minimum yield was obtained from the ethyl acetate extract of the peel. The highest phenolic content was found in the ethyl acetate extract of the peel of *Citrus crenatifolia* (30.958 mg GAE/g). The anti-urease activity of *Citrus crenatifolia* was evaluated using *Macrotyloma uniflorum* (Horsegram) urease using a methodology modified from the indophenol method (Berthelot reaction). The IC_{50} value obtained for the standard inhibitor, thiourea was 0.439 mg mL^{-1}. Out of the five plant extracts the lowest IC_{50} value of 0.952 mg mL^{-1} was detected for the ethyl acetate extract of peel of the fruit of *Citrus crenatifolia*, showing the highest urease inhibitory property followed by the essential oil extract from the leaf showing an IC_{50} value of 1.050 mg mL^{-1}. The results strongly suggest that the extracts from *Citrus crenatifolia* have significant potential as a therapeutic agent against *H. pylori* infection. Further studies and development of these plant extracts could lead to an effective drug with fewer complications for the eradication of *H. pylori* infection.

Keywords: *Citrus crenatifolia*, *Helicobacter pylori*, urease, urease inhibitor

MD_066

ANTIOXIDANT, ANTI-DIABETIC AND ANTI-OBESITY PROPERTIES OF LATEX OF *Garcinia quaesita*

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Garcinia quaesita which belongs to the family Clusiaceae, is an endemic plant to Sri Lanka and well known traditional Ayurvedic medicine due to its diverse biological activities including antioxidant, anti-diabetic and anti-obesity properties. Despite several studies on fruits and leaves of *Garcinia quaesita*, research on its latex remains unexplored. Hence, this study was aimed to determine the total phytochemical constituents, antioxidant, anti-diabetes and anti-obesity activities of *Garcinia quaesita* latex. The latex sample of *Garcinia quaesita* was collected and extracted into acetone. The total flavonoids content (TFC), the total phenolic-content (TPC) and the total alkaloid content (TAC) were determined using the aluminium chloride colorimetric method, the Folin-Ciocalteu reagent method and the bromocresol green (BCG) reagent method, respectively. Antioxidant capacity was determined using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and the ferric reducing antioxidant power (FRAP). The anti-diabetic and anti-obesity potentials were determined by the alpha-amylase enzyme inhibition assay and the pancreatic lipase inhibition assay, respectively. The resulted TFC, TPC and TAC values are (790.75±90.88) mg/g, (30.52±1.83) GAE mg/g and (112.71±0.01) AE mg/g, respectively. Results showed the presence of higher flavonoid content in the latex compared to other total phytochemical constituents. A strong DPPH radical scavenging ability (IC_{50} = 8.91±0.05 mg L^{-1}) was observed in the latex, compared to that of ascorbic acid (IC_{50} = 6.23±0.03 mg L^{-1}), along with considerable FRAP (0.150±0.04 mol g^{-1} dm^{-3}). Further results revealed that latex has considerable alpha-amylase inhibitory potential (IC_{50} = 38.56±3.35 mg L^{-1}) and lipase inhibition potential (IC_{50} = 36.29±1.76 mg L^{-1}) compared to their respective positive controls acarbose (8.87±0.62 mg L^{-1}) and orlistat (11.48±0.44 mg L^{-1}). Hence, it could be concluded that latex of the *Garcinia quaesita* also exhibits strong antioxidant, anti-diabetic and anti-obesity potential and future studies will be focused on isolation of active compounds.

Keywords: Anti-diabetic, anti-obesity, antioxidant, *Garcinia quaesita* latex

MD_067

SYNTHESIS OF ETHERIFIED DERIVATIVES OF GARCINOL AS α-AMYLASE AND α-GLUCOSIDASE INHIBITORS

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Synthesis of natural product derived compound libraries to improve their biological activity is important in modern drug discovery. Garcinol, a polyisoprenylated benzophenone, is an excellent antidiabetic secondary metabolite isolated from genus Garcinia. The current study was aimed to synthesize ether analogs of garcinol through functional group modifications and to evaluate their *in vitro* antidiabetic properties. Dried and ground fruit rinds of *Garcinia quaesita* were extracted into acetone:water (9:1) by maceration (3 x 24 hours). Garcinol was isolated from acetone:water (9:1) extract of *G. quaesita* and the structure was confirmed using NMR, mass spectroscopic, and melting point data. Two novel ether derivatives of garcinol were semi-synthesized by using ethyl iodide under mild and strong basic conditions using K_2CO_3 and NaH, respectively. Product 1 (mono etherified product) was obtained under mild basic condition, while Product 2 (tri etherified product) was obtained under strong basic condition and the products were characterized by FTIR, 1-D NMR (^{1}H-NMR and ^{13}C-NMR), 2-D NMR (HSQC and HMBC) spectroscopy and mass spectroscopy. The *in vitro* anti-diabetic properties of semi-synthesized analogs were assessed by α-amylase enzyme inhibition assay and α-glucosidase enzyme inhibition assay. Product 1 (IC_{50} = 28.45±1.17 mg L^{-1}) showed significantly higher ($p < 0.05$) α-amylase enzyme inhibitory potential, while Product 2 (IC_{50} = 210.53±3.54 mg L^{-1}) showed significantly lower ($p < 0.05$) α-amylase enzyme inhibitory activity compared to garcinol (IC_{50} = 37.81±1.48 mg L^{-1}). Product 1 (IC_{50} = 12.48±0.28 mg L^{-1}) showed no significance difference ($p > 0.05$) with garcinol (IC_{50} = 17.18± 1.53 mg L^{-1}), while product 2 (IC_{50} =131.87±9.98 mg L^{-1}) showed significantly lower activity ($p < 0.05$) compared to garcinol, in terms of α-glucosidase enzyme inhibition potential. Based on the current study, mono etherified product of garcinol has the enhanced α-amylase and α-glucosidase enzyme inhibitory potential that would be suitable for developing antidiabetic active drug leads.

Financial assistance from the National Research Council (Grant number: NRC-TO-20-19) is acknowledged.

Keywords: α-amylase, α-glucosidase, ether derivatives, garcinol

MD_068

EVALUATION OF ANTI-INFLAMMATORY AND ANTIMICROBIAL ACTIVITY OF *Solanum nigrum* LEAF AND ROOT EXTRACTS

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Herbal drugs are being used extensively to treat various widespread diseases. *Solanum nigrum* (black nightshade) is known to have medicinal properties. This study investigates the anti- inflammatory and antimicrobial activities of *Solanum nigrum* against a selected panel of bacterial and fungal pathogens. Methanolic extraction of *Solanum nigrum* leaves and roots was performed using maceration. *In vitro* anti-inflammatory activity was tested using egg albumin denaturation assay, with Diclofenac as the reference drug. Antimicrobial activity was evaluated using the well diffusion method, minimum inhibitory concentration (MIC) assay, minimum bactericidal concentration (MBC) assay, antibiofilm assay and germ tube inhibition assay. Positive controls were Gentamicin (10 mg mL^{-1}) and Fluconazole (600 µg mL^{-1}). The methanol extract of leaves significantly inhibited *Candida albicans* at all the tested concentrations (300, 150, 75, 37.5 and 18.75 mg mL^{-1}). The methanol extract of roots inhibited *Staphylococcus aureus* at 300 and 150 mg mL^{-1}, but failed to show inhibitory activity against *Escherichia coli* and *Klebsiella pneumoniae*. The MIC of *Solanum nigrum* root extract for *Staphylococcus aureus* was 37.5 mg mg^{-1}, and the MBC was 75 mg mL^{-1}. Antibiofilm activity of leaf extract was performed using crystal violet assay, and 38.56% of biofilm inhibition was observed for *Candida albicans* at 300 mg mL^{-1}. Antibiofilm activity of root extract was performed on *Staphylococcus aureus*, but it failed to inhibit biofilm formation. Germ tube inhibition assay showed only 1.78 % of germ tube formation. The results showed that *Solanum nigrum* leaf extract at a concentration range of 10-0.3125 mg mL^{-1} reduced the heat induced protein denaturation. The highest concentration (10 mg mL^{-1}) showed 90.83% of protein denaturation inhibition and the IC_{50} of *Solanum nigrum* leaf extract was 0.8812 mg mL^{-1}. Phytochemical analysis of both the leaf and root extracts showed the presence of tannins, saponins and steroids as active compounds. Root extract showed less number of phytochemicals when compared to the leaf extract. According to the findings, *Solanum nigrum* possesses anti-inflammatory and antimicrobial properties that can be further investigated for novel antimicrobial compounds.

Keywords: Antibiofilm, anti-inflammatory, phytochemicals, *Solanum nigrum*

MD_069

EVALUATION OF ANTI-UREASE ACTIVITY IN THE ROOT EXTRACT OF *Piper longum* AND THE LEAF EXTRACT OF *Cyperus rotundus*

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Helicobacter pylori is a bacterium found in the stomach that secretes bacterial urease, a major virulent factor to cause peptic ulcers. Therefore, numerous studies have been carried out to investigate the urease-inhibitory activity of herbal extracts to treat peptic ulcers through the elimination of colonization of *Helicobacter pylori*. The plants of interest in this research were *Piper longum* and *Cyperus rotundus*. Some parts of these plants are currently being used to treat peptic ulcers in traditional medicinal methods and have been strongly suggested for research. This study was focused on exploring the urease inhibitory activity in the leaf extract of *Cyperus rotundus*, and the root extract of *Piper longum*. Each herb was extracted using ethyl acetate and ethanol separately. For the root extract of *Piper longum*, sequential extraction, and Soxhlet extraction were conducted, while for the leaf extract of *Cyperus rotundus*, sequential extraction was performed. The urease inhibitory activity of these six plant extracts was evaluated using an inhibitory assay developed from Berthelot reaction. Urease enzyme was extracted from *Macrotyloma uniflorum* (Horse gram), and thiourea was used as the standard inhibitor (IC_{50} = 0.44 mg mL^{-1}). Ethanol extract of roots of *Piper longum* obtained from the Soxhlet extraction showed the highest total phenolic content (56.39 mg GAE /g) and total flavonoid content (46.22±0.005 mg QE/g) of dry weight. Among the six different extracts that showed the urease inhibitory property, the lowest IC_{50} value of 0.83 mg mL^{-1} was found for the ethanol extract of roots of *Piper longum* obtained from the Soxhlet extraction, thereby showing the highest urease inhibitory activity. These studies suggest a strong indication to use ethanol extract of roots of *Piper longum* in the treatment against the main causative of peptic ulcers and future research studies on such natural origins could be used to design and develop novel drugs with lesser toxicity.

Keywords: *Cyperus rotundus*, *Helicobacter pylori*, *Piper longum*, urease inhibitor

MD_070

ANTI-DIABETIC AND ANTI-OBESITY ACTIVITIES COMPARISON OF COMMON DIFFERENT CURRY LEAVES VARIETIES IN SRI LANKA

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Curry leaves are known to possess strong antidiabetic and anti-obesity activities and have been traditionally used for a long period of time. There are few varieties of curry leaves commonly used in Sri Lanka. Even though its medicinal values attract a common interest, the phytochemical quantification and activity of each variety are poorly explained. This study aimed at identifying the best curry leaf variety for diabetes and obesity treatments. Leaves of *Murraya koenigii* (Type 1), *Clausena indica* (Type 2), and another sub-variety of *Murraya koenigii* (Type 3), which is commonly known as "beheth karapincha" were used in this study. Authenticated, dried, and powdered leaves of each variety were sequentially extracted into hexane, ethyl acetate, and methanol solvents separately by maceration. The anti-diabetic activity of all the crude extracts was measured using α-amylase inhibitory assay, and the anti-obesity activity was determined using the pancreatic lipase inhibitory assay. Further, the HPLC profiles of all three types of curry leaves in three different extracts were also analyzed. The hexane extract of all three varieties showed better α-amylase inhibition, and the best activity was observed for the hexane extract of Type 3 (39.78 ppm). Further, ethyl acetate extracts of all three varieties also showed relatively better activity, while methanol extracts of Type 1 and Type 2 showed lower amylase inhibitory activity compared to the positive control acarbose (IC_{50} = 11.99 ppm). Nevertheless, hexane extracts of Type 1 and Type 3 showed moderate lipase inhibition activity, while the least IC_{50} was obtained for the hexane extract of Type 3 (177.82 ppm) compared to the positive control Orlistat (IC_{50} = 7.23 ppm). Comparison of HPLC profiles of all three types of curry leaves in three different extracts showed that Types 1 and 2 are not significantly different in chemical constituents, whereas Type 3 has higher phytochemical differentiation than other types. These empirical data showed that Type 3 curry leaves have better anti-diabetic and anti-obesity activities and it is different from other types in chemical profile as well.

Financial assistance from the National Research Council. (Grant No: NRC-TO-20-19) is acknowledged.

Keywords: Amylase inhibition, curry leaves, lipase inhibition, *Murraya koenigii*

MD_071

SYNTHESIS AND CHARACTERIZATION OF VISIBLE LIGHT ACTIVE Fe-DOPED ZnO NANOHYBRIDS FOR SELF-STERILIZING APPLICATIONS

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Microbial contamination in healthcare items has recently caused significant health concerns to humans, and hence, people are paying greater attention to hygiene. As a result, many antimicrobial materials are now being employed in healthcare settings. Photocatalytic sterilization of nanohybrids is viewed as a promising and growing solution to this challenge. In this study, the enhanced photocatalytic antimicrobial activity of visible light-active Fe-doped ZnO nanohybrids was studied. Fe-doped ZnO nanoparticles ($Fe_xZn_{100-x}O$) were synthesized by the coprecipitation method, incorporating various dopant ratios (x = 0, 3, 5, 7, 10), and they were characterized. The photocatalytic activity of the nanoparticles was assessed using a methylene blue dye degradation test. Free radical scavenging ability was assessed using the DPPH assay, with different catalytic concentrations, and the IC_{50} value was calculated. The antimicrobial properties of Fe-doped ZnO nanohybrids were tested by the well diffusion assay. The powder X-ray diffraction patterns exhibited a hexagonal wurtzite crystal structure revealing a decrease in particle size as the dopant concentration increased. The evaluated band gap showed a red shift upon Fe doping with the minimum band gap of 3.09 eV for Fe 5% ZnO. Fourier transform infrared spectroscopy data revealed the presence of Fe in the doped nanohybrids by showing the modes related to Fe in addition to ZnO. The morphological characteristics were examined using scanning electron microscopy. The atomic composition of nanohybrids was verified using energy-dispersive X-ray spectroscopy and X-ray photoelectron spectroscopy. The introduction of Fe as a dopant enhanced the photocatalytic activity of ZnO. Specifically, for Fe 5% ZnO, the photocatalytic activity reached a value of 84%. The Fe 5% ZnO had the greatest free radical scavenging activity with an IC_{50} value of 81.44 μg mL^{-1}, and hence, Fe-doped ZnO nanohybrids can be used as a potential self-sterilizing material in health care applications such as personal protective equipment and medical textiles.

Keywords: Antimicrobial agents, nanohybrids, photocatalyst, self-sterilization

MD_072

SYNTHESIS AND EVALUATION OF *in vitro* AND *in silico* ANTI-INFLAMMATORY ACTIVITIES OF 4-(*N*-SUBSTITUTED BENZYLIDENE)-2-PHENYLOXAZOL-5(4*H*)-ONE DERIVATIVES

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Oxazolones are a class of heterocyclic compounds that have gained significant attention in the field of research due to their diverse chemical and biological properties. Their five-membered ring contains oxygen and nitrogen atoms, providing a unique platform for the development of various functional molecules. In this study, five different 4-(*n*-substituted benzylidene)-2-phenyloxazol-5(4*H*)-ones, named as AZL-1 to AZL-5, were synthesized *via* the Erlenmeyer–Plöchl reaction using 4-hydroxy, 2-hydroxy, 3-hydroxy, 4-hydroxy-3-methoxy and 3,4-dihydroxy benzaldehydes, respectively. Structures were confirmed through Fourier transform infrared spectroscopy, high resolution mass spectrometry, and nuclear magnetic resonance spectroscopy. Docking studies between the compounds and human cyclooxygenase (COX) 1 and 2 enzymes were conducted to understand *in silico* anti-inflammatory activities. Meanwhile, *in vitro* anti-inflammatory activities of these compounds were evaluated by using the heat-induced human red blood cell (HRBC) membrane stabilization assay. The IC_{50} values were determined *via* the non-linear curve fit analysis method by using GraphPad version 9.5 software. The *in silico* study showed moderate Gold.PLP.fitness scores for all compounds including the standard, *O*-acetyl salicylic acid, showed slightly lower scores than others. Nevertheless, all of these compounds shared the characteristic affinity towards the binding cavity. The *in vitro* study exhibited inhibitory activities against HRBC membrane stabilization assay in a concentration-dependent manner. The IC_{50} values of AZL-1, AZL-2, AZL-3, AZL-4, and AZL-5 were reported as 4.65±0.22 mmol L^{-1}, 7.34±0.28 mmol L^{-1}, 5.23±0.18 mmol L^{-1}, 2.74±0.88 mmol L^{-1} and 1.96±0.09 mmol L^{-1}, respectively, while *O*-acetyl salicylic acid showed its IC_{50} value at the concentration of 6.4±0.18 mmol L^{-1}. In conclusion, all compounds synthesized are potential anti-inflammatory agents against the tested methods. Particularly, our results indicate that the number and positioning of hydroxyl groups on the benzene ring may play a role in HRBC membrane disruption.

Keywords: Anti-inflammatory, COX inhibition, HRBC membrane stabilization, oxazolones

MD_073

EVALUATION OF PHYTOCHEMICAL AND ANTIMICROBIAL PROPERTIES OF *Cyperus iria*

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Drug resistance of microorganisms is increasing at an alarming rate over the past few decades. Hence, the focus has been turned on exploring plant materials as potential alternatives. The purpose of this research was to investigate the *in vitro* antimicrobial and phytochemical properties of methanolic extracts of weed *Cyperus iria* mature leaves and roots. The extracts were prepared by sonication. Antimicrobial activity was studied by well diffusion method against bacteria; *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922), *Klebsiella pneumoniae* (ATCC 1706), *Pseudomonas aeruginosa* (ATCC 27853) and fungal cultures; *Candida albicans* (ATCC 10231), *Candida glabrata* (ATCC 90030) and *Candida tropicalis* (ATCC 13803). The minimum inhibitory concentration (MIC) and the minimum bactericidal concentration (MBC) were performed on *S. aureus*, *E. coli* and *P. aeruginosa*. Gentamicin (10 mg mL^{-1}) and Fluconazole (200 µg mL^{-1}) were used as the positive controls. The results revealed that both leaves and roots were effective against all the tested bacterial strains and S. aureus showed the highest sensitivity for both extracts (leaf: 29.0±1.4 mm, root: 33.0±1.4 mm). *E. coli* (18.5±0.7 and 20.5±0.7 mm), *P. aerugenosa* (16.0±.4 and 18.0±2.8 mm) and *K. pneumoniae* (19.5±2.1 and 20.5±3.5 mm) showed moderate results for leaves and root extracts, respectively. The tested *Candida* species were resistant to both extracts. The MICs and MBCs for leaf extract against *S. aureus* (25 mg mL^{-1}, 25 mg mL^{-1}) and *E. coli* (25 mg mL^{-1}, 200 mg mL^{-1}). The MICs and MBCs for roots were 12.5 mg mL^{-1}; 100 mg mL^{-1} for *S. aureus* and 3.1 mg mL^{-1}; 6.25 mg mL^{-1} for *P. aeruginosa*. The phytochemical analysis confirmed the presence of flavonoids, phenols, tannins, glycosides and alkaloids in both extracts, while terpenoids were present only in leaves. No steroids were detected in both. Overall results suggest the potential of *Cyperus iria* as a promising antibacterial agent.

Keywords: *Cyperus iria*, MBC, MIC, phytochemicals

MD_074

EXPLORING THE BIOACTIVITY AND CHEMICAL PROFILING OF SOME MARINE SPONGES OF SRI LANKA

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Marine sponges belonging to Phylum Porifera are sessile filter-feeders that are recognized as a rich source of bioactive compounds in the marine environment with promising biological activities due to their diverse primary and secondary chemical components. The current study aimed to evaluate the bioactivity and identify the chemical profile of the marine sponges. Ten samples were collected by scuba diving from 10-15 m depth of sea-off Kalmunei in the east coast of Sri Lanka, and extracted into a mixture of methanol and dichloromethane. Antioxidant assay was conducted using the DPPH free radical scavenging method, and the antimicrobial assay was determined by the agar disc diffusion method. Antibacterial activity was tested against *Escherichia coli* and *Staphylococcus aureus*, while antifungal activity was tested against *Candida albicans* and *Candida* spp. Ampicillin and flucanazole were used as the positive control for bacteria and fungi, respectively. Gas chromatography-mass spectrometry (GCMS) was used to determine the chemical composition profile. The highest antioxidant activity was shown by *Thorecta* sp. (K9), and the lowest antioxidant activity was shown by sample K2. The inhibition zone against *Escherichia coli* and *Staphylococcus aureus* was the highest in *Thorecta* sp. (K9), while *Candida albicans* and *Candida* spp. showed a higher inhibition zone in *Agelas* sp. (K7). Phytochemical screening discovered alkaloids, sterols, tannins, saponins and terpenoids. GCMS analysis of all ten sponge samples identified a total of 115 different compounds, of which naphthalene, thunbergol, 2,4-di-tert-butylphenol, n-hexadecanoic acid, octadecanoic acid, squalene, ɤ-sitosterol, stigmasterol, neophytadiene, 1-heptatriacotanol, heneicosane, caryophyllene, hexadecanoic acid methyl ester and 1-eicosanol were the major compounds. The overall study confirms that the marine sponges from the study site contain an extensive range of bioactive compounds with remarkable bioactivities that can be used as potential lead compounds in drug development.

Keywords: Antioxidant, antimicrobial, GCMS, marine sponges

MD_075

EVALUATION OF ANTI-INFLAMMATORY ACTIVITY OF UNDERUTILIZED FRUIT AND LEAF EXTRACTS

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Inflammation is a complex biological response crucial for the body's defence against harmful stimuli. However, chronic inflammation can lead to various diseases, including cancer, neurological disorders, and cardiovascular conditions. The purpose of the current study is to assess the anti-inflammatory properties of a few underutilized fruit and leaf extracts including lovi (*Flacourtia inermis*), veralu (*Elaeocarpus serratus*), polos/green jackfruit (*Artocarpus heterophyllus*), bilin (*Averrhoa bilimbi*), siyambala (*Tamarindus indica*) and ambarella (*Spondias dulcis*) from Sri Lanka. The fruits and leaves were subjected to extraction using water and methanol where a hot water extract and a room temperature macerated water extract were prepared along with a methanol extract. The extracts were then evaluated for their anti-inflammatory activity using established *in vitro* assays, such as human red blood cell (HRBC) membrane stabilization assay and protein denaturation assay. Preliminary results indicated variations in the anti-inflammatory activity among different fruit and leaf extracts. Best results were recorded for all three fruit and leaf extracts of polos/green jackfruit where the fruit extracts showed an inhibition of 89.19%, 90.61% and 89.25%, and the leaf extracts showed inhibition of 91.21%, 91.41% and 91.17% for hot water, macerated water, and methanol extracts, respectively, at the highest concentration tested (1 mg mL^{-1}) by the HRBC assay. When considering the protein denaturation assay results, veralu showed the best results for both fruit and leaf extracts where the fruit extracts showed an inhibition of 97.66%, and 97.24%, and the leaf extracts showed an inhibition of 94.91%, and 92.49% for the hot water and macerated extracts, respectively, at 1 mg mL^{-1}. The methanol extract of lovi exhibited the highest inhibition for the fruit extract 95.12% and leaf extract 94.06% at 1 mg mL^{-1}. This study adds important information on the possibilities of various plants as natural products of anti-inflammatory agents. According to many studies, the anti-inflammatory activity of these plants is due to bioactive compounds such as gallic acid, quercetin, and citric acid, which reduce oxidative stress and stabilize cell membranes, thus reducing inflammation. Discovering plants with potent anti-inflammatory properties could lead to new herbal supplements and nutritional strategies for treating inflammation-related diseases. However, more research is needed to fully understand their mechanisms and optimize their use for human health.

Keywords: Anti-inflammatory effects, fruit extracts, inflammation, leaf extracts, natural products

MD_076

STUDY OF SYNERGISTIC ANTIOXIDANT ACTIVITY OF LEAVES OF *Mikania cordata* (*burm.f.*) WITH COPPER OXIDE NANOPARTICLES

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Synergy is a process in which some substances cooperate to reach a combined effect that is greater than their individual effects. This is mainly due to the interactions between the substances. The synergistic effect can be observed in plants when plant components are combined with nanoparticles. In this research, the leaves of *Mikania cordata* (*burm.f.*) are combined with the copper oxide nanoparticles (CuO NPs) to examine the complementary antioxidant activity. *Mikania cordata* (*burm.f.*) leaves were sequentially extracted using hexane and methanol solvents and the resulting extract was stored for further use. The methanol extract was used to examine the antioxidant activity. The antioxidant activity observed could be attributed to the presence of flavonoid compounds previously reported in *Mikania cordata*. CuO NPs were chemically synthesized, and characterized using UV-Visible spectroscopy and Fourier transform infrared spectroscopy. The total flavonoid and phenolic contents were determined using the Folin-Ciocalteu method and the aluminium chloride colorimetric method, respectively. The antioxidant activity was evaluated using DPPH scavenging assay. The antioxidant activity of the leaf extract, and of CuO NPs was examined to determine the synergistic effect. The results show that the EC_{50} value of the methanol extract of the leaves is 978.36±0.60 μg mL^{-1}, whereas that of CuO NPs is 161.43±0.01 μg mL^{-1}. When the plant extract was combined with the CuO NPs, it showed an EC_{50} value of 662.68±0.50 μg mL^{-1}. This is a reduced EC_{50} value and a better activity as compared to that of individual plant extract. Therefore, it demonstrates a potential synergistic effect for antioxidant activity when the plant extract is combined with CuO NPs.

Keywords: Antioxidant, copper oxide nanoparticles, *Mikania cordata* (*burm.f.*), synergistic

MD_077

ANALYSIS OF PHYTOCHEMICALS AND 5-LIPOXYGENASE INHIBITION PROPERTIES OF ESSENTIAL OIL EXTRACTED FROM *Acronychia pedunculata* (L.) MIQ. (ANKENDA) LEAVES

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Deregulation of the inflammatory process may lead to severe chronic inflammation-related diseases such as rheumatoid arthritis. Arachidonate 5-lipoxygenase (A5-LOX) enzyme catalyzes the generation of leukotrienes (LTs) which have potent pro-inflammatory properties. Hence, A5-LOX inhibitors are regarded as highly significant targets in drug discovery, particularly for developing mechanism-based inhibitors to treat inflammatory diseases, especially arthritis. *Acronychia pedunculata*, a common medicinal plant in Sri Lankan traditional medicine, has been used for the treatment of joint pain, treatment of diarrhea, cough, asthma, ulcers, itchy skin, scales, pain, swellings, rheumatism and disorders with involvement of the inflammatory processes. Therefore, this study aimed to analyze the phytochemical content of the essential oil (EO) of *A. pedunculata* dry leaves using gas chromatography - mass spectrometry (GCMS) and evaluation of 5-LOX inhibition activity. *A. pedunculata* fresh leaves (intermediate maturity stage) were collected from Gampaha, Sri Lanka, air-dried at room temperature for 5 days, hydro-distilled for 5 hours at atmospheric pressure, and subjected to GCMS. Temperatures were adjusted for the injector and detector at 220 °C and 250 °C, respectively, and helium (1 mL min^{-1}) served as the carrier gas. The column TR-WAX Ultra Inert was used to analyze one microliter of essential oil samples that had been diluted with hexane. Further 5-LOX inhibition activity of leaf essential was evaluated at different concentrations of EO. Mass spectrometric analysis showed that the most abundant compounds present in the EO of dry leaves are 1R-alpha-pinene (87.78%), followed by caryophyllene (2.39%). Further, EO extract dose dependently inhibited 5-LOX having IC_{50} value of 288.42±14.77 µg mL^{-1}. This finding suggests that it holds potential for the development of herbal therapeutic targets for the treatment of anti-inflammatory drug targets.

Keywords: Anti-arachidonate 5-lipoxygenase (A5-LOX), *Acronychia pedunculata*, anti-inflammatory, essential oil

MD_078

TOTAL PHENOLIC CONTENT AND ANTIOXIDANT ACTIVITY OF *Tabernaemontana dichotama*

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Most of the non-structural phenolic compounds perform a variety of functions in plants, including acting as antioxidants. Phenolic compounds are excellent oxygen radical scavengers because the electron reduction potential of phenolic radicals is lower than the electron reduction potential of oxygen radicals. The main aim of the research was to evaluate the total phenolic content and the antioxidant activity of *Tabernaemontana dichotama*, a plant species commonly known as "divi kaduru" or "Eve's apple" collected from Gampaha District, Sri Lanka. Five extracts were prepared from different parts of the *T. Dichotama*. Extracts included methanol and ethyl acetate extracts of stem bark and seed using sequential extraction and methanol extract of stem bark using Soxhlet extraction. The total phenolic content of the extract samples was evaluated by a spectrophotometric technique using Folin-Ciocalteu reagent and expressed as gallic acid equivalents (GAE) per gram of dry weight. The antioxidant activity was determined based on the scavenging activity of the stable DPPH free radical. The total phenolic content of the extracts was obtained using the standard (R^2 = 0.9911) in the range 0.2947±0.01 mg GAE/g – 0.9112±0.12 mg GAE/g and the DPPH free radical scavenging activity; $EC_{30} \leq 1056.59$ μg mL^{-1} compared to L-ascorbic acid; EC_{30} = 35.46±0.03 μg mL^{-1}. From all the plant extracts, ethyl acetate extract of seed using sequential extraction shows the highest antioxidant activity followed by ethyl acetate extract of stem, methanol extract of stem and methanol extract of seed. These results indicate that extracts containing moderate phenolic content may provide a source of dietary antioxidants.

Keywords: Antioxidant activity, phenolic content, Soxhlet extraction, *Tabernaemontana dichotama*

MD_079

COMPUTATIONAL STUDY OF FLABELLIFERIN-II AND ITS IMPACT ON Na^+/K^+ ATPASE FUNCTION

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Flabelliferins, the bioactive constituents inherent to *Borassus flabellifer* L., demonstrate a nuanced pharmacological profile. Studies have shown Flabelliferin-II (F-II) emerges as a potent compound in palmyrah which exhibits varied bioactivities comparable to established control drugs. Within this pharmacological context, the inhibition of Sodium-Potassium Adenosine Triphosphatase (Na^+/K^+ ATPase) assumes a pivotal role. It serves as the primary target for cardiotonic derivatives, a pharmacological class of inhibitors commonly administered to patients diagnosed with heart failure. These inhibitors exert their therapeutic effects by modulating the activity of the cardiac Na^+/K^+ ATPase enzyme. Moreover, the intricate binding dynamics of ouabain, a plant-derived cardiac glycoside, within the permeation pathway of the Na^+/K^+ pump, a complex heterodimeric transmembrane protein, underscore the complexity of molecular interactions underlying this physiological modulation. Food and Drug Administration (FDA) approval for antibodies targeting heart disease cell signaling pathways is limited, despite their high costs and adverse effects. Notably, flabelliferins hold therapeutic promise. Computational studies were conducted on F-II to investigate its mechanism of action. Flabelliferin-II revealed higher binding affinity over Ouabain *via* AutoDock Vina and showed more favorable non-bonded interactions in Discovery Studio analysis. Molecular dynamic studies in AMBER 20 included comparisons using the root mean square deviation, radius of gyration, and defined secondary structure of protein plots of protein and protein-ligand complex. Overall, these findings conclude that F-II, the active compound of palmyrah, is a highly promising candidate for inhibiting the enzyme, Na^+/K^+ ATPase. This computational study demonstrates the superior effectiveness of F-II over comparator medication in carrying out their bioactivity, thus suggesting their potential utilization in the pharmaceutical industry.

Keywords: Flabelliferin-II, Na^+/K^+ ATPase, palmyrah, pharmacological

MD_080

METHOD DEVELOPMENT AND VALIDATION OF VITAMIN C AND LOSARTAN POTASSIUM PHARMACEUTICAL TABLETS USING ZERO DIMENSION (0-D) UV-VISIBLE SPECTROPHOTOMETRY

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It is important to have simple but accurate and fast analytical procedures to determine the active pharmaceutical ingredient (APIs) concentrations in drug substances as the deviation from the labeled amount might negatively affect the patients. The goal of this study is to develop procedures to determine the API concentrations of vitamin C (ascorbic acid - AA) and losartan potassium (LP) using ultraviolet-visible (UV-Vis) spectrophotometry. The methods have been developed according to the International Conference on Harmonization (ICH) guidelines and validated using the acceptance criteria of linearity, range, accuracy, precision, limit of detection (LOD), limit of quantitation (LOQ), and stability. The wavelength corresponding to AA and LP tablets' maximum absorbance (λ_{max}) was measured and used for the rest of the study from the UV-Vis spectra. A five-point calibration curve was prepared within a concentration range of 6 -18 ppm and 3 - 9 ppm for AA and LP, respectively, with a correlation coefficient (R^2) of 0.998. All validated parameters met the acceptance criteria outlined in the ICH guidelines. Test sample analysis was carried out using brands purchased from different areas in Sri Lanka. The developed analytical methods showed that the actual concentrations of APIs of AA ranged from 412.18 to 453.50 mg per 500 mg tablet, 81.07 to 106.06 mg per 100 mg tablet, and 190.47 mg per 250 mg tablet, whereas 44.34 to 55.90 mg per 50 mg tablet for LP. The studies revealed that AA remains stable at room temperature for up to 3 days and in refrigerator conditions for up to 7 days, while LP exhibits stability for up to 21 days under both conditions. The study concluded that the developed analytical procedure can be used to quantitatively analyze the API for AA and LP drug substances at room temperature or refrigerated conditions.

Keywords: Active pharmaceutical ingredient, losartan potassium, ultraviolet-visible (UV-Vis) spectrophotometry, vitamin C

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MD_081

COMPARATIVE STUDY OF ANTIMICROBIAL AND ANTIOXIDANT PROPERTIES OF *Psidium guajava* L. (GUAVA) AND *Annona muricata* L. (SOURSOP) LEAVES

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Psidium guajava L. (guava) and *Annona muricata* L. (soursop) are two famous fruit-bearing trees native to Sri Lanka. These trees are renowned for their medicinal applications in traditional Sri Lankan folk medicine. However, less scientific data are available on these plant species in Sri Lanka. Therefore, this study aimed to compare the phytochemical screening, anti-microbial, and antioxidant properties of guava and soursop leaves to identify the potential species for pharmaceutical applications. Methanolic extracts of guava and soursop were investigated for antimicrobial activity using the agar dilution method against five microorganisms; two Gram-positive bacteria, i.e., *Staphylococcus aureus*, *Enterococcus* sp., two Gram-negative bacteria, i.e., *Escherichia coli* and *Pseudomonas aeruginosa* and one unicellular fungus, i.e., *Candida albicans* and the minimum inhibitory concentration (MIC) was determined. The antioxidant activities of plant extracts were measured using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) method. Ascorbic acid was used as a standard in this assay. Screening of phytochemicals was done using standard protocols. The results revealed that different plant extracts showed inhibitory activity against different test microorganisms. Methanolic extract of guava showed significant inhibitory activity against *Staphylococcus aureus* and *Candida albicans*, with a MIC value of 2560 ppm. Methanolic extract of soursop showed inhibitory activity against all five microorganisms with a MIC value of 20,480 ppm. The methanolic extracts of guava and soursop exhibited strong antioxidant activity, with IC_{50} values of (5.27±0.01) ppm and (35.74±0.01) ppm, respectively. It was observed that methanolic extracts of both plants contain saponins, tannins, terpenoids and glycosides. Additionally, the methanolic extract of guava contains flavonoids as well. The outcome of the study suggests that the methanolic extract of guava is the better extract with respect to the mentioned properties. In conclusion, the antimicrobial and antioxidant activities of these plant leaf extracts showed potential applications in the healthcare industry.

Keywords: Antimicrobial, antioxidant, guava, soursop

MD_082

GREEN SYNTHESIS AND CHARACTERIZATION OF NANO-HYDROXYAPATITE *via* WET CHEMICAL METHOD USING *Centella asiatica* EXTRACT FOR BIOMEDICAL APPLICATIONS

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Hydroxyapatite (HA), $Ca_{10}(PO_4)_6(OH)_2$, is an inorganic compound with significant biomedical applications. Nano-hydroxyapatite (NHA) has gained attention due to its impactful physicochemical properties in various biomedical applications, such as bone grafting and drug delivery, in comparison to macro-hydroxyapatite. Different methods are employed to synthesize NHA to control particle size and shape. The use of plant extracts with surfactant properties as green templates in the synthesis of NHA is being explored. This study focuses on the synthesis and characterization of NHA using a green wet chemical method with *Centella asiatica* (CA) aerial extract for biomedical applications. NHA was synthesized using $Ca(OH)_2$, KH_2PO_4 with varying amounts of the extract. Characterization involved powder X-ray diffraction (PXRD), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared (FTIR) spectroscopy, and scanning electron microscopy (SEM). The PXRD patterns matched with the standard HA peak patterns without impurities. The aspect ratio of HA was lower than 1, while CA-mediated samples showed ratios higher than 1. The average width of prepared particles ranged from 26-34 nm. FTIR spectroscopic analysis indicated that compounds from the extract were involved in the synthesis process. According to XPS analysis, carbon, oxygen, calcium and phosphorus were the main chemical constituents, and the Ca:P ratios were around the standard value of 1.67. SEM images showed rod-shaped and needle-shaped particles, and the particle size changed with increasing extract concentration. This study concluded that NHA can be successfully synthesized using a wet chemical one-pot method with CA extract as a green template. The sizes and shapes of NHA were altered without compromising the purity of HA when using CA extract, and the different sizes and shapes of NHA can be utilized in various biomedical applications.

Keywords: *Centella asiatica*, green template, nano-hydroxyapatite, wet chemical method

MD_083

PHYTOCHEMICAL ANALYSIS OF LEAF EXTRACTS FROM FIVE SELECTED CITRUS PLANT SPECIES IN THE NORTH CENTRAL PROVINCE OF SRI LANKA

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Citrus which belongs to the family Rutaceae is one of the most commonly cultivated crop species available in the world. Fruit species, such as oranges, lemons, lime and pomelo, fall into this category. The inherent properties of these fruits useful in fields of medicine, cosmetics, and other forms are mainly due to the available phytochemicals. Different parts of citrus plants have distinct compositions of the phytochemicals. This study mainly focuses on five selected citrus plants grown in the north central province of Sri Lanka; *Citrus maxima*, *Citrus sinensis*, *Citrus aurantifolia*, *Citrus hystrix* and *Atalantia ceylanica*, and intends to analyze the total phenolic content (TPC) and the total flavonoid content (TFC) of the selected fruits alongside with the effect of polarity of selected solvent on the quantity of phytochemicals extracted. When considering the quantity of total phenolics and total flavonoids extracted, *Citrus sinensis* showed the highest quantity of TPC and TFC at mean values of 42.27±1.48 GAE (gallic acid equivalent)/g and 131.39±20.87 QE (Quercetin equivalent)/g, respectively. In assessing the impact of solvent choice on phytochemical content, ethyl acetate emerged as the most effective, yielding the maximum amount of TPC and TFC of 33.531±6.889 mg mL^{-1} GAE and QE of 78.934±7.850 mg mL^{-1}, respectively. In contrast, hexane extraction yielded significantly lower amounts of extracted compounds with 16.213±4.113 mg mL^{-1} GAE of TPC and 36.263±2.067 mg mL^{-1} QE of TFC. The study highlighted the significance of selecting the appropriate solvent for extracting phenolic compounds from plant materials. Additionally, it highlights *Citrus sinensis* leaf extracts as particularly rich sources of TPC and TFC among the tested citrus plants.

Keywords: Citrus, polarity, total flavonoid content, total phenolic content

MD_084

PHYTOCHEMICAL PROFILING AND BIOCHEMICAL ACTIVITIES OF ENDEMIC MEDICINAL PLANTS *Diplodiscus verrucosus* AND *Dimorphocalyx glabellus*

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Diplodiscus verrucosus (dikwenna) and *Dimorphocalyx glabellus* (weliwenna), plants are endemic to Sri Lanka. Despite their endemic status, there is a lack of information within Ayurveda medicine for both species. This study aims to investigate the biochemical activities and conduct phytochemical profiling of these plants. An antioxidant assay, the free radical scavenging method revealed significant antioxidant activity in *D. verrucosus* leaves (90.63%), and *D. glabellus* roots (94.24%), with the roots of *D. glabellus* exhibiting the highest activity. The antimicrobial assay demonstrated that *D. verrucosus* leaf extraction exhibited maximal antibacterial efficacy against *Staphylococcus aureus,* with an inhibition zone of 20.00±0.27 mm. *D. glabellus* showcased superior antibacterial effectiveness against *E. coli* with an inhibition zone of 15.10±0.07 mm. In both assessments, Ampicillin 10,000 ppm employed as the control, demonstrated an average inhibition zone of 20.00±0.01 mm. The results indicated that root extracts from both plants exhibited significantly higher zones of inhibition (15.5±0.08 mm) against *Candida albicans*, while the leaf extracts from both plants showed high inhibition zones (16.70±0.07 mm) against *Candida* spp. In comparison, Fluconazole 10,000 ppm (standard), showed an average inhibition zone of 19.60±0.01 mm. Phytochemical screening indicated the presence of alkaloids, flavonoids, phenols, steroids, and tannins in both plants. Gas chromatography-mass spectrometry (GCMS) analysis identified a total of 83 compounds in *D.verrucosus*, including β-caryophyllene (7.09%), germacrene (0.99%), humulene (2.29%), linalool (0.37%), neophytodiene (1.14%), and *D. glabellus* revealed 78 compounds with significant concentrations of squalene (1.44%), phytol (4.64%), neophytodien (6.51%), hexadecenoic acid (12.57%), tocopherol (8.89%), and stigmasterol (2.28%). The research concludes that both plants demonstrate promising herbal properties. However, *Diplodiscus verrucosus* showed superior performance in antioxidant, and antimicrobial activities compared to *Dimorphocalyx glabellus*. This finding emphasizes that these endemic plant species have the potential for antimicrobial activity and usage as product development in natural healthcare solutions.

Keywords: Antioxidant, anti-microbial, GCMS, phytochemicals

MD_085

DEVELOPMENT OF A LARVICIDAL AGENT AGAINST *Aedes* SPP. MOSQUITO LARVAE BY ENCAPSULATING MIXED CRUDE EXTRACT OF *Capsicum frutescens* (KOCHCHI) AND *Allium sativum* (GARLIC) INTO CHITOSAN NANOPARTICLES

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A vector-borne disease dengue, which is primarily transmitted by *Aedes* mosquitoes, is currently an increasing global public health threat which affects more than 2.5 billion people worldwide. In Sri Lanka, the disease has a seasonal transmission. Since there is no specific cure or vaccination for dengue, prevention is the primary control measure. However, synthetic larvicides bring about unfavorable side effects on humans, other non-target organisms, and the environment. Hence the aim of this study is to explore plant-based larvicides as a non-toxic, environmentally friendly, and cost-effective option. In this study, larvicidal properties of three different Sri Lankan kochchi (*Capsicum frutescens*) varieties (Variety 1, Variety 2 and Variety 3) were examined. Washed and ground plant materials were extracted into the three solvent systems of water (maceration 24 x 3), hot water (reflux for 3 h) and water-acetone mixture (maceration 24 x 3). Larvicidal activity of each crude extract was evaluated through larvicidal assay by exposing 20 mosquito larvae of third and fourth instar to varying concentrations of each extract for 24 h. The most active kochchi variety was combined with garlic, and the larvicidal bioassays were used to evaluate the effectiveness of the mixed extract. Mixed extract was encapsulated in chitosan nanoparticles which were synthesized using the modified ionotropic gelation method. The percentage encapsulation efficiency was calculated with the help of UV-Visible spectroscopy. Larvicidal bio assays results showed that kochchi Variety 1 exhibited the highest larvicidal effect and cold water proved to be the most effective solvent system. The calculated LC_{50} values for capsicum extract, garlic extract, and combined extract were 3384 ppm, 4940 ppm and 2614 ppm, respectively, showing that the combined extract has the highest larvicidal activity. Particle size analysis showed that the chitosan nanoparticles were in the 100 nm size. Fourier transform infrared spectroscopic data of nanoparticles before and after encapsulation confirmed the proper encapsulation of the active compounds. These empirical results revealed that that mixture of kochchi Variety 1 and garlic could be developed as a larviciding agent and future studies are focused on larvicidal activities of the encapsulated nanoparticles.

Keywords: *Aedes* spp. larvae, *Allium sativum*, *Capsicum frutescens*, lavicidal activities, larvicidal nanoparticles

MD_086

ENHANCING ORAL ULCER TREATMENT EFFICACY IN THE DENTAL DRUG INDUSTRY THROUGH ELECTROSPUN FIBER MATS

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In the dental drug industry, isopropyl alcohol (IP) is frequently used as a solvent. However, due to its remarkable electrospinability, poly(vinyl alcohol) (PVA) can be used as a potentially effective treatment for oral ulcers. Conventional oral ulcer remedies frequently face difficulties since the medications quickly dissolve in saliva and have a limited shelf life. Drug-incorporated electrospun fiber mats provide a novel solution to this problem by enabling prolonged drug release that is not compromised by saliva dilution. The ideal circumstances for creating electrospun fiber mats filled with medicinal substances to cure oral ulcers are examined in this work. Continuous fine fibers without beads could be obtained at a total PVA polymer concentration of 7% (w/v) for H_2O:IP ratio 1:1, 15 cm distance between the tip and the collector, 15 kV applied voltage, 700 rpm of drum speed, and 0.5 mL h^{-1} of flow rate were found to be the ideal electrospinning settings at room temperature. These optimized settings allow the synthesis of high-performance H_2O:IP nanofibers with an average diameter of 129.20 nm. The selected solvent mixture shows compatibility with medications that treat oral ulcers by using IP as a solvent. Through the use of this technique, the electrospun fiber mats can overcome the problem of quick saliva dilution and release medications over an extended period of time. This work demonstrates how oral ulcer medication treatments can be administered more effectively by using electrospun fiber mats as a substrate.

Keywords: Dental drug industry, electrospun fiber mats, oral ulcers

MD_087

ANALYSIS OF DIFFERENT CINNAMON VARIETIES PRESENT IN LOCAL AYURVEDIC MEDICINAL PRODUCT DHATHRYARISHTAM

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Cinnamon is one of the most important spices daily used by people worldwide. Eight species of cinnamon are grown in Sri Lanka; *Cinnamomum verum* (Sri Gemunu or Sri Wijaya), *Cinnamomum dubium*, *Cinnamomum citriodorum*, *Cinnamomum rivulorum*, *Cinnamomum sinharajense*, *Cinnamomum capparu-corende*, *Cinnamomum ovalifolium*, *Cinnamomum litseaefolium*. Dhathryarishtam, an Ayurvedic medicinal product, offers potential benefits for liver and heart ailments. However, the absence of a specified cinnamon variety poses a notable concern. This study aims to address this ambiguity by employing gas chromatography - mass spectrometric (GCMS) analysis to determine the specific cinnamon variant in Dhathryarishtam. GCMS fingerprinting analysis was carried out to investigate the presence of the chemical compounds following National Institute of Standards and Technology (NIST 3.0) libraries, considering a minimum of 60% similarity index as significant. GCMS analysis of methanol and ethanol extracts of Dhathryarishtam identified only cinnamaldehyde. Sri Gemunu bark oil and Sri Wijaya bark oil contain cinnamaldehyde, while Sri Gemunu leaf oil and Sri Wijaya leaf oil contain eugenol. *C. dubium* leaf oil contains both cinnamaldehyde and eugenol. *C. sinharajaense* leaf oil contains eugenol. The chromatograms of methanol extracts of Dhathryarishtam, and Sri Gemunu and Sri Wijaya bark oils exhibit five common peaks indicating the presence of cinnamaldehyde, dodecanoic acid, methyl tetradecanoate, hexadecenoic acid and octadecenoic acid. However, the chromatograms of ethanol extracts, having three overlapping peaks, are indicative of the presence of cinnamaldehyde, hexadecenoic acid and octadecenoic acid. This suggests a high likelihood that Dhathryarishtam contains the same cinnamon species present in the bark oils of Sri Gemunu and Sri Wijaya.

Keywords: Cinnamon, dhathryarishtam, Sri Gemunu species, Sri Wijaya species

MD_088

INVESTIGATION OF EFFECTS ON LIVER ENZYMES BY SELECTED POTENTIAL FACTORS CAUSING CHRONIC KIDNEY DISEASE OF UNKNOWN ETIOLOGY IN SRI LANKA

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The exact causes of chronic kidney disease of unknown etiology (CKDu) remain unclear. Research explores potential links to environmental factors, such as agrochemicals and heavy metals. CKDu and liver diseases often share common risk factors. Liver enzymes are vital for drug metabolism and detoxifying environmental toxins. Inhibitory factors can disrupt these functions. Some factors associated with CKDu may also influence liver enzymes. This study aimed to assess the compatibility of liver enzymes with potential factors causing CKDu to prevent undesired complications. The selected factors, including cadmium (ranging from 3 μg L^{-1} to 15 μg L^{-1}), arsenic (10 μg L^{-1} to 50 μg L^{-1}), glyphosate (50 μg L^{-1} to 250 μg L^{-1}), 2-methyl-4-chlorophenoxyacetic acid (MCPA) (0.1 μg L-1 to 0.5 μg L^{-1}), profenofos (75 ng L^{-1} to 375 ng L^{-1}), and mancozeb (40 μg L^{-1} to 200 μg L^{-1}), were prominent contributors to CKDu in Sri Lanka. These concentrations were chosen to reflect those typically found in water sources in the affected areas. Liver enzymes (AST and ALT) were extracted from a goat liver sample, mixed separately with prepared compounds/ions solutions in a series of concentrations, and served as test samples. Spectroscopic methods were employed to assess enzyme activities, and the Kruskal-Wallis test in SPSS 25.0 was used for statistical analysis to compare mean values between test and control samples. Results revealed no significant differences in mean AST and ALT values compared to controls for all factors, except arsenic, which exhibited a significant difference ($p < 0.05$) in AST values, particularly at the highest concentration (50 μg L^{-1}). No significant difference was observed for ALT values at any concentration. In conclusion, the study demonstrated that the selected CKDu-inducing factors did not significantly affect AST and ALT enzymes at concentrations found in normal water sources, except for arsenic, emphasizing the importance of analyzing liver enzyme activity in the context of CKDu. Future research may extend to enzyme kinetics and reaction mechanisms with specific factors like arsenic. The findings contribute to understanding the complex interplay between environmental factors, kidney diseases, and liver function.

Keywords: Chronic kidney disease of unknown etiology (CKDu), CKDu factors, liver enzymes, enzyme compatibility

Waste:

Management, Value Addition and Circular Economy

WA_089

COMPARISON OF ADSORPTION EFFICIENCIES OF ACID-MODIFIED BANANA PSEUDO STEM BIOMASS ON METHYLENE BLUE AND RHODAMINE B

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Adsorption techniques can be used to remove dyes that are hard to degrade biologically from contaminated water. Agricultural waste products that are readily biodegradable have often been tested for this removal process as they can be made into adsorbents at a low cost of production. In this research study, the removal of methylene blue (MB) and rhodamin B (RhB) from water samples using banana pseudo-stem biomass (BPSB) that was dried and modified by hydrochloric acid and nitric acid was studied. The batch sorption studies were done by changing operating variables, such as the dye concentration, contact time, pH, temperature of the dye solution and the amount of BPSB. The results show that MB dye has the highest adsorption capacity at the pH of 7, temperature of 40 °C, amounts of acid-modified BPSB (both modifications results in the same capacity) of 0.30 g, contact time of 2.0 h, and the dye concentration of 500 ppm. RhB has the highest adsorption capacity at the temperature of 40 °C, amount of acid-modified BPSB (both modifications lead to the same results) of 0.30 g, contact time of 2.0 h, and the dye concentration of 300 ppm. However, the change of adsorption capacity with pH is insignificant for RhB because the pH for the maximum adsorption capacity cannot be found. The kinetics study matched well with the pseudo-second order, while the thermodynamic study matched well with the Langmuir adsorption isotherm, Freundlich adsorption isotherm, and the Temkin adsorption isotherm.

Keywords: Adsorption, agricultural waste, kinetics, low-cost adsorbent

WA_090

VALUE ADDITION TO WASTE NYLON FISHING NETS BY INCORPORATING SHORT-FIBERS IN NATURAL RUBBER VULCANIZATES

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Waste nylon fishing nets (WNF) adversely affect the lives of marine organisms by trapping them in discarded nets and dysfunctioning their digestive systems by microplastics produced. The most used strategy to mitigate this environmental issue is to reuse or recycle WNF. Even though many recycling attempts have been reported, the incorporation of WNF in rubber compounds has not been investigated extensively. This research thus aimed to enhance physical properties of natural rubber vulcanizates by incorporating WNF, thereby adding value to it. Short fibers varying the lengths of 2 mm, 3 mm, 5 mm, and 7 mm were employed in making passenger car tire sidewall compounds. Corresponding to each fiber length, three different series of triplicated samples were prepared by varying fiber loading of 2 phr (parts per hundred), 4 phr and 6 phr. The samples were vulcanized at 150 °C and their rheological properties, dynamic viscoelastic properties, and physico-mechanical properties of vulcanizates were subsequently investigated. The cure and dynamic viscoelastic properties changed significantly with WNF fiber loading, while physico-mechanical properties varied with both fiber length and loading. Specifically, the samples having 2 mm WNF at 2 phr fiber loading exhibited notably similar results in rheological characteristics and dynamic viscoelastic properties compared to those of the control sample. All WNF rubber vulcanizates showed anisotropy in tear strength values. In particular, the sample having 2 mm WNF fibers at 2 phr exhibited an improvement of (15.82±1.05)% in tear strength along the longitudinal direction and an improvement of (5.81±1.91)% along the transverse direction compared to that of the control sample. The other physico-mechanical properties, such as hardness, abrasion volume loss, resilience and tensile strength, remained within a comparable range. These findings suggest the potential of using WNF fibers as filler in rubber products and solving environmental issues caused by WNF.

Keywords: Anisotropy, physico-mechanical properties, rheological properties, waste fishing nets

WA_091

OPTIMIZATION OF RICE HUSK-DERIVED ACTIVATED CARBON FOR EFFICIENT METHYLENE BLUE ADSORPTION: KINETICS AND EQUILIBRIUM STUDIES

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Synthetic dyes are indispensable in various industries, yet their toxicity necessitates efficient wastewater treatment. Activated carbon (AC) plays a crucial role in this regard. This study aimed to optimize AC from rice husk through method optimization and to investigate its methylene blue (MB) adsorption potential. Method optimization for AC synthesis involved varying parameters: HCl concentrations (5, 15, 30% v/v), soaking times (12, 24, 48 h), activation temperatures (400, 600, 800 °C), and activation times (60, 120, 180 min). Then, yield was calculated for each sample. AC samples prepared were introduced into MB solution and agitated for 60 min. Post-centrifugation, dye concentration in the supernatant was measured at 15 min intervals using a UV-Vis spectrophotometer at 664 nm, enabling the determination of MB removal percentages. The optimal method involved treating rice husk with HCl (5% v/v) for 24 h, followed by washing with DI water, drying, and pyrolysis at 400 °C for 2 h. This AC variant exhibited the highest MB removal. The surface morphology and the elemental composition of this AC variant was examined by scanning electron microscopy and energy dispersive spectroscopy and Fourier transform infrared spectroscopy. In batch adsorption, the effects of experimental parameters, such as initial MB concentration, adsorbent dose, pH and shaking time, on MB adsorption to AC were evaluated at room temperature. Results indicated the highest MB removal percentage with AC (0.05 g), concentration of MB (5 mg L^{-1}), pH (7), and shaking time (60 min). Further, the equilibrium adsorption data were analyzed by the Langmuir and the Freundlich isotherm models. Among the two isotherms, the Langmuir isotherm (R^2 = 0.9981) is better fitted with data having a maximum adsorption capacity (Q_{max}) of 20.88 mg g^{-1}. Adsorption kinetics analysis suggests that the pseudo-second order model best fits the data, indicating a chemical sorption mechanism governing the adsorption process. Based on the results, it can be concluded that AC is an efficient and cost-effective adsorbent for dye removal from industrial wastewater.

Keywords: Activated carbon, methylene blue, rice husk, wastewater

WA_092

PURIFICATION OF CRUDE GLYCEROL FROM BIODIESEL PRODUCTION AND DEVELOPMENT OF A COST-EFFECTIVE CAR WASH

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Sustainable utilization of resources and the concept of zero waste are much spoken in the present-day world. Crude glycerol, a leading byproduct of biodiesel production, constitutes about 30% of the reaction's output. However, the glycerin produced in this manner cannot be used for industrial purposes due to impurities. Therefore, purification needs to be done, and in the present research, an effort has been made to purify glycerol. Purified glycerol can be used as a value-added industrial product, such as car wash and other industrial detergents. Crude glycerol purification is normally done by several methods namely, ion exchange, activated carbon adsorption, membrane separation, and acidification followed by the distillation process. For the present study, acidification followed by the distillation process was undertaken due to a smaller number of steps and cost-effectiveness in small-scale industries. In the study, 500 g crude glycerol was placed in a beaker, and 10 mL of phosphoric acid was added. The mixture was heated on a magnetic stirrer at 50 °C for 1.0 h at 200 rpm. The pH was adjusted between 6-7 during which impurities settled down. Distillation was then carried out at 100 °C for 2-3 h to remove water. The physico-chemical parameters of the purified glycerin such as pH, viscosity, refractive index, and density were evaluated. Results were 6-7, 16335 cp, 1.449, and 0.96 g mL^{-1}, respectively. GC-MS investigation of the purified glycerin revealed that it contained 38.82% glycerin and 61.18% esters. Further purification was done with normal hexane to remove esters. A value-added car wash formulation was developed and its pH, foaming quality, and cleaning ability were evaluated. In conclusion, the novel purification process is inexpensive, and the resulting value-added product is cost-effective compared to market available products.

Keywords: Acidification, carwash, crude glycerol, purification, value addition

WA_093

BIOGENIC ZnO NANOPARTICLES SYNTHESIZED FROM PURPLE YAM PEEL AS A POTENTIAL PHOTOCATALYSTS FOR THE DEGRADATION OF PIGMENT DYE

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Synthesizing nanoparticles (NPs) from waste materials offers a sustainable remedy, repurposing abandoned resources into valuable sources. Employing these eco-friendly NPs not only reduces environmental burdens associated with waste disposal, but also enhances resource efficiency and conservation efforts. This study focuses on the synthesis of zinc oxide NPs (ZnO NPs) derived from purple yam peel (YP), with a specific focus on evaluating their photocatalytic efficacy against IC orange pigment dye (PD), a commonly employed industrial dye. The optimal conditions for synthesizing ZnO NPs with enhanced yields involved variation of parameters, including ion precursor concentration, the ratio of plant extract to ion solution, pH, irradiation methods, and incubation time. The NPs synthesized were characterized using UV-Vis spectroscopy, Fourier transform infrared spectroscopy (FTIR), Scanning Electron Microscopy (SEM), transmission electron microscopy (TEM), energy dispersive X-ray spectroscopy (EDS), and X-ray diffraction (XRD). Surface plasmon resonance peaks between 350 and 370 nm preliminary confirmed the formation of ZnO NPs. FTIR analysis indicated the stretching mode of the Zn-O bond in the range of 500-700 cm^{-1}. SEM analysis elucidated the spherical morphology of the NPs, while TEM analysis revealed a particle size of 82.4 nm. XRD analysis substantiated the presence of a hexagonal crystalline structure, whereas EDS analysis validated the elemental composition, identifying Zn and O as the predominant chemical constituents. Under the optimized operational parameters encompassing pH, catalytic load, and dye concentration, the ZnO NPs synthesized using YP exhibited remarkable photo degradation efficiency, achieving a notable 89.05% degradation of the dye within 420 minutes. Thus, the findings of this study unveil the promising potential of ZnO NPs synthesized with YP as a sustainable solution for advancing textile and wastewater remediation.

Keywords: Photocatalytic activity, pigment dye, purple yam, ZnO NPs

WA_094

COMPARATIVE ANALYSIS OF VARIOUS PHOTOCATALYSTS AND EFFECT OF DIFFERENT PARAMETERS ON PHOTOCATALYTIC DEGRADATION OF BRILLIANT BLUE DYE

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Contamination of water bodies by industrial dyes has gained considerable attention nowadays due to its adverse effects on human health and the aquatic ecosystem. The current study mainly focuses on comparing the effect of different types of photocatalysts including chemically synthesized TiO_2, MnO_2 (commercially available), TiO_2-p25 nanoparticles (NPs), calcinated Ag-TiO_2 particles, and non-calcinated Ag-TiO_2 particles to effectively remove an industrial dye, brilliant blue, from contaminated water through solar irradiated photocatalytic degradation. Sol-gel method was used for the synthesis of TiO_2 particles and Ag-TiO_2 particles. A part of the synthesized particles was subjected to calcination. The study revealed that the dye degradation efficiencies of photocatalysts were Ag-TiO_2 (without calcination) > TiO_2-p25 NPs > calcinated Ag-TiO_2 > MnO_2 > synthesized TiO_2 particles. Using Ag-TiO_2 (without calcination) different parameters including pH of the medium, the mass of catalysts (10 - 50 mg) and the concentration of brilliant blue (5 - 25 ppm) were varied for the determination of the photocatalytic degradation efficiency of brilliant blue. Under pH 2, 20 mg of Ag-TiO_2 synthesized particles (without calcination) showed the highest photocatalytic degradation efficiency of 99.9% for 5 ppm brilliant blue dye. The photocatalytic degradation is increased with decreasing particle size. Further, Ag doped TiO_2 exhibited higher photodegradation ability. The current study shows that non-calcined Ag-TiO_2 particles exhibit a higher degradation ability and could be used effectively for the degradation of industrial dyes.

Keywords: Calcinated Ag-TiO_2 particles, degradation efficiency, photocatalytic degradation, sol-gel method

WA_095

MECHANICAL AND THERMAL CHARACTERIZATION OF *Corypha umbraculifera* PETIOLE FIBERS FOR POTENTIAL USE AS A NOVEL TEXTILE FIBER

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Driven by the rising demand for sustainable textiles, this study investigates the potential of *Corypha umbraculifera* petiole fibers as an alternative novel bio-based textile fiber. The mechanical and thermal characterization identified their suitability for diverse textile uses. High cellulose content (66.37%) found in the chemical analysis suggests good potential for fiber strength, further supported by the measured mechanical properties, tensile strength of 178.02±28.60 MPa, and Young's modulus of 39.14±5.97 GPa. The analysis identified *Corypha umbraculifera* petiole fibers with extraordinary lengths (1.5 - 3.0 m) and diameters of 0.23±0.01 mm. These exceptional qualities position them as a strong contender for use in filament yarns, and their favorable linear density of 3.78 dtex indicates their suitability for producing lightweight textiles. With the measured high moisture regain of 9.80%, the fibers will offer comfortable wear and the ability to accept dyes and chemicals readily. The water contact angle of 72.90±0.32° indicates its hydrophilic nature, and Fourier transform infrared spectroscopy analysis was performed to identify the functional groups. The fibers exhibit remarkable thermal stability, which is evident from their high onset degradation temperature of 263.6 °C measured by thermogravimetric analysis. This property makes them ideal for withstanding the high temperatures encountered during textile processing. The X-ray diffraction analysis indicates a crystallinity index of 43.6% and crystallite size of 3.89 nm, contributing to the fiber's durability. The microfibril angle of 18.32±1.28° also influences the fiber's axial strength. Scanning electron microscopic analysis revealed the presence of hollow centers within the fiber structure, suggesting good moisture absorption capabilities to exhibit wicking properties. The characterization suggests *Corypha umbraculifera* petiole fibers, with exceptional properties and functionalities, hold promise as a bio-based textile alternative.

Keywords: *Corypha umbraculifera*, mechanical characterization, textile fiber, thermal characterization

WA_096

NOVEL BIOCHAR PRODUCTION FROM INSOLUBLE DAIRY WASTE

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Sustainable management of dairy waste (DW) is a global concern with significant economic, environmental, and social implications. DW contains water, lipids, proteins, lactose, etc. Therefore, DW consists of two distinct fractions, soluble fraction and insoluble fraction. Sustainable disposal of insoluble dairy waste is crucial for the dairy industry. Synthesis of a novel biochar (BC) material; dairy waste biochar (DW-BC) is an effective method for solid waste management of biomasses and a value addition method. Due to the high porous nature of BC and the presence of higher content of phosphate and other micronutrients in DW, the DW-BC can be used as a soil amendment to enhance the soil texture and quality and as an adsorbate for water remediation. During the study, waste yogurt was used as the DW biomass. DW-BC materials were synthesized at 300 °C and 500 °C to produce DW-BC300 and DW-BC500. Ferrous oxide incorporated BC materials were prepared at the above two temperatures to produce FeDW-BC300 and FeDW-BC500, respectively. BET analysis of BC materials confirms the porous nature, the scanning electron microscopy confirms the rich surface morphology and Fourier transform infrared spectroscopic data show the presence of surface functional groups on the materials. Highest affinity of 20.28 mg g^{-1} was shown by FeDW-BC300 for Cr^{3+} and there is a significant adsorption capacity for Cu^{2+} and Pb^{2+}. FeDW-BC300 has a higher affinity of 20.02 mg g^{-1} and 12.07 mg g^{-1}, respectively, towards para-nitrophenol and para-nitroaniline. To the best of our knowledge, this BC material was prepared for the first time from DW biomass; yogurt.

Financial support from the Institute of Chemistry Ceylon is acknowledged.

Keywords: Biochar, dairy waste, waste management, water remediation

WA_097

PLASMA FUNCTIONALIZED COCONUT-COIR BIOCHAR FOR Cd(II) AND Pb(II) REMOVAL FROM AQUEOUS SOLUTION

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Lead (Pb) and cadmium (Cd) are common heavy metals in wastewater discharged from industries. Plasma functionalization is a promising avenue for enhancing the adsorption capabilities of carbon materials, particularly in the context of heavy metal removal from aqueous solutions. This study focuses on the development of plasma-functionalized coconut-coir biochar (PFCB) as a sustainable and eco-friendly material for the removal of Pb(II) and Cd(II) from wastewater. Herein, PFCB was synthesized utilizing atmospheric-air plasma (AP) without using any chemical or solvent. Coconut-coir biochar (CB) was prepared using coconut coir dust *via* pyrolysis at different temperatures (300 °C, 500 °C, and 700 °C) for 1 h, 2 h and 3 h residence periods. Resultant CB was subjected to AP treatment for 30 min to obtain PFCB, which was characterized using Fourier transform infrared spectroscopy (FTIR), point of zero charge (PZC), and methylene blue number. The PZC of PFCB was found to be at pH 7. The FTIR data implies the presence of epoxy, carbonyl, and amino functional groups in PFCB. Batch sorption studies were conducted for Cd(II) and Pb(II) and quantitative analyses were carried out using a flame atomic absorption spectrometer. The pH of the solution, concentration, and contact time for removal of Pb(II) and Cd(II) were optimized using standard solutions of 250 ppm Cd(II) and 500 ppm Pb(II) solutions, respectively. At an optimal pH of 7, PFCB shows a maximum Cd(II) adsorption capacity of 96.00 mg g^{-1} from 250 ppm Cd(II) solution and a maximum Pb(II) adsorption capacity of 175.00 mg g^{-1} from a Pb(II) solution of 500 ppm, at optimal pH 5 within one minute. In contrast, non-functionalized, CB exhibited significantly lower removal capacity of 46.7 mg g^{-1} for Cd(II) and 38.19 mg g^{-1} for Pb(II), under similar conditions. Compared to that, both adsorptions exhibited fast kinetics ensuring maximum adsorption efficiency. These findings underscore the potential of PFCB as an efficient adsorbent for the remediation of Pb(II) and Cd(II) in wastewater, offering a sustainable solution for environmental pollution.

Keywords: Adsorption, biochar, cadmium, lead, plasma functionalization

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WA_098

Centella asiatica EXTRACT-DERIVED Co_3O_4 NANOPARTICLES ON PHOTOCATALYTIC DEGRADATION OF TEXTILE DYES AND ANTIBACTERIAL ACTIVITIES

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Recently, a growing interest was focused on synthesizing nanoparticles (NPs) using plant extracts. The present study aims to develop an eco-friendly method to synthesize NPs of Co_3O_4 using plant extracts of *Centella asiatica* (Gotukola) stems. This synthesis was carried out under optimum reaction conditions of 0.10 mol L^{-1} Co^{2+}(aq), 1:8 (v/v) plant extract to metal salt ratio, and pH of 12. The UV-Visible spectroscopic analysis revealed a prominent peak at 362 nm, indicating the formation of NPs. The Fourier transform infrared spectrum revealed distinctive peaks at 575 cm^{-1}, 3250 cm^{-1} and 1061 cm^{-1} indicating the stretching of Co—O, O—H and C—O functional groups, respectively. The powder X-ray diffraction pattern shows peaks at 2θ angles of 31.38°, 36.95°, 44.88°, 59.46° and 65.32°, resembling the crystallographic planes having Miller indices of (220), (311), (400), (511) and (440), respectively. According to the crystallographic data, the product is in face-centered cubic phase with the average crystallite size ranging from 33.70 nm to 66.11 nm. The fact that the final product has +2 and +3 oxidation states indicates that an oxidation reaction has occurred during the formation of NPs, possibly due to air oxidation of some Co^{2+} ions. The photodegradation ability of synthesized NPs on methylene blue (MB) dye was studied under the optimized conditions of catalytic load of 2 mg, pH of 10, and MB dye concentration of 5 ppm. The percentage photodegradation was calculated by measuring the absorption of the reaction mixture at λ_{max} of 664.2 nm over a period of 240 min at 40 min intervals. Under these conditions, NPs synthesized showed a remarkable photodegradation ability of 95.46%, which is about 33% higher than that of the control. With regard to antibacterial activity, NPs of Co_3O_4 exhibit greater inhibition against *Escherichia coli* compared to that of *Staphylococcus aureus*. Overall, this study shows that green synthesized Co_3O_4 NPs have the potential of remediating environmental pollution caused by certain textile dyes and microbes.

Keywords: Antibacterial activity, *Centella asiatica*, Co_3O_4 nanoparticles, methylene blue, photodegradation

WA_099

DETERMINATION OF QUALITY OF MUNICIPAL SOLID WASTE-BASED COMPOST AS A FERTILIZER SOURCE

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Municipal solid waste (MSW) is a growing problem in urban areas of Sri Lanka, and this issue is rising due to the absence of proper solid waste management systems in the country. MSW substances currently lack proper quality and are highly susceptible to contamination with hazardous material due to non-segregation of waste. This study explores the quality of MSW compost obtained from five composting facilities of local government authorities in Sri Lanka. The final compost product was obtained from a heap of compost before packaging in all five cases. The main objectives of this study are general, physical and nutrient requirements along with contamination of heavy metals. Air-dried and oven-dried samples were used for moisture and mass loss on ignition measurements. Both pH and conductivity readings were obtained in aqueous extracts and 0.01 mol L^{-1} $CaCl_2$ extracts. The same $CaCl_2$ extracts were used for nitrite-N and orthophosphate-P analysis while 2 mol L^{-1} KCl extracts were used for ammonium-N analysis. Total Kjeldahl nitrogen (TKN) was studied by acid digestion and using a semi automatic Kjeldahl distiller. Chemical oxygen demand (COD) was studied by two separate methods namely, the COD reactor method and the open reflux method. In the case of heavy metal contents, acid digestion and atomic absorption spectrophotometry were used to study the contents of Cd, Cr, Ni, Zn and Pb. The experimental results confirmed that all samples satisfactorily meet the general, physical and nutrient requirements according to SLS 1634:2019 standard. However, many compost samples contain undesirable amounts of heavy metals. Usage of hazardous municipal solid waste-based compost without proper quality control will result in disastrous adverse effects on the environment. Thus, strict quality control of compost made of municipal solid waste is mandatory. This study could be extended further to investigate microplastics, and hazardous organic chemicals.

Keywords: Compost, municipal solid waste, SLSI specifications, toxic contaminants

WA_100

BATCH STUDIES FOR REMOVAL OF CATIONS FROM A MIXTURE USING COCONUT SHELL CHARCOAL, RICE HUSK AND BURNT BRICK CLAY PARTICLES

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The release of heavy metal ions into wastewater resulting from human and industrial activities has become an increasing concern among the public. This study explores the possibility of removing heavy metal ions from synthetic wastewater using three types of processed waste material that are readily available: coconut shell charcoal (CC), heat-treated rice husk (RH) and burnt brick clay particles (BP). Batch studies separately conducted on CC, RH and BP using Pb(II) solution of 10.0 mg L^{-1} as a representative for the cation mixture lead to the optimum values of 0.500 g dosage (range: 0.010 – 1.750 g), 90.0 min shaking time (range: 5 – 120 min), 60.0 min settling time (range: 5 – 60 min) and ambient pH of 5.1 (range: 2.00 – 8.00) at which the extents of removal are determined to be 93.74%, 92.88% and 96.37%, respectively, demonstrating excellent removal ability for Pb(II). Subsequently, a mixture of CC, RH and BP adsorbents of equal masses, when exposed to a synthetic wastewater solution prepared with Al(III), Ca(II), Cd(II), Cr(III), Cu(II), Fe(II), Mg(II), Ni(II), Pb(II) and Zn(II), lead to different adsorption characteristics depending on the type of the metal ion. The removal percentages are very high for Al, Cr and Pb, while moderate or low removal are for Cd, Cu, Fe, Ni and Zn. On the other hand, Ca and Mg are leached out indicating that ion-exchange contributes to the mass transfer. These results suggest that the mixture of CC, RH and BP adsorbents would be a strong candidate for the removal of toxic heavy metal ions from a solution mixture. Although Ca and Mg are leached out during the metal ion removal process, it would not pose a great problem as they are relatively harmless. It can thus be concluded that this study provides insights into addressing heavy metal waste in effluents, and will lead to the development of an efficient treatment system using readily available materials for industrial effluents containing toxic metal ions.

Keywords: Adsorption, cation mixture, heavy metal, industrial effluent

WA_101

UTILIZATION OF WASTE ENGINE OIL TO IMPROVE THE PROPERTIES OF ACTIVATED CARBON DERIVED FROM TEXTILE DYEING SLUDGE

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Textile sludge, a prominent hazardous waste and a major contributor to environmental pollution, demands effective treatment strategies. This study delves into the challenge of textile sludge management, particularly focusing on Sri Lanka's prevalent method of incineration for waste reduction. However, this method possesses limitations. The objective is to develop a comprehensive solution by harnessing the potential of textile sludge and waste engine oil (WEO) for producing activated carbon (AC) with enhanced properties. The core aim of this study is to explore the application of the AC produced in wastewater purification through adsorption *via* a systematic series of steps. The collection and detailed characterization of raw materials, textile sludge, and WEO are the initial steps. By mixing these materials in varying ratios, pyrolysis was taken place in a controlled environment, while meticulously recording the temperature profiles and residue formation. The char obtained was subsequently subjected to an activation process. Following thorough characterization, the properties and adsorption capacity of AC were assessed, optimized, and compared under various conditions. Synthesized wastewater treatment experiments were performed, and pollutant removal efficiency was evaluated. The results revealed that the ratios of 1:1 and 2:1 of sludge to WEO yield AC with significant adsorption capacity, indicating sustainable wastewater treatment. This method is novel since it eliminates the need for an inherent or dedicated activating agent, as the activation process is driven by the volatile organic compounds emitted from WEO during pyrolysis at low temperatures. Additionally, the utilization of WEO increases the carbon content in the biochar, addressing the high ash content in typical textile dye sludge-derived AC. This study fulfills a crucial gap by addressing textile sludge and WEO as promising resources for sustainable AC production by mitigating environmental risks posed by these byproducts.

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Keywords: Activated carbon, sustainable manufacturing, textile sludge, waste engine oil

WA_102

GREEN SYNTHESIZED NiO NANOPARTICLES ON METHYLENE BLUE DYE DEGRADATION AND ANTIMICROBIAL ACTIVITIES

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In the field of nanotechnology, materials are designed with at least one dimension in the nanometer scale in order to improve their physical and chemical properties. In this study, NiO nanoparticles (NPs) were successfully synthesized using *Brassica oleracea* (cabbage) leaf extract *via* green method by optimizing reaction conditions of metal-to-plant extract ratio of 3:1, Ni(II) concentration of 5 ppm and pH of 12. UV-Visible spectrometric analysis showed a peak at 383 nm indicating the formation of NPs under applied reaction conditions. The Fourier transform infrared spectrum exhibits an intense peak at 617 cm^{-1} suggesting the Ni—O stretching vibration. Powder X-ray diffraction (PXRD) pattern shows three peaks at 2θ of 37.20°, 43.46° and 62.82°, which are in agreement with the Miller indices of (111), (200) and (220) of NiO NPs, respectively (JCPDS 01-089-5881). PXRD data further indicate that the NPs synthesized are in cubic crystal structure with the space group of Fd-3m, and the Debye-Scherrer equation leads to the average crystallite size in the range of 2 - 8 nm. The antibacterial activity of NiO NPs measured using the diameter of the inhibition zone according to the well diffusion method against *Staphylococcus aureus* and *Escherichia coli* bacteria indicates a zone diameter of 16 mm for *E.coli* and 14 mm for *S. aureus*, implicating the effectiveness of the NPs as antimicrobial agents. The catalytic activity of synthesized NPs under direct sun irradiation determined by evaluating the photodegradation of methylene blue (MB) dye under optimized conditions of catalytic load of 5 mg, MB concentration of 5 ppm, and pH of 10. This results in the maximum photocatalytic activity of 86%, which is 35% higher than that of the control. Overall, this study shows that the green synthesized NiO NPs have the potential to be used to minimize environmental pollution caused by certain textile pollutants and microbes.

Keywords: *Brassica oleracea*, catalyst, green synthesis, NiO nanoparticle

WA_103

MODELING AN AMORPHOUS BIOCHAR STRUCTURE USING MOLECULAR DYNAMICS SIMULATION

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Biochar (BC) is a highly porous carbonaceous material commonly produced by the thermal decomposition of lignocellulosic material. It is an excellent, low-cost adsorbent and is of great interest in the remediation of pollutants from water. The surface properties of BC can be modified to enhance the efficiency of the adsorption of specific compounds. However, experimental studies into the adsorbate-adsorbent interactions remain tedious, expensive, and time-consuming. Although several *in silico* studies have been carried out into these interactions, these studies use graphitic models and single molecules *in lieu* of BC, which are not accurate representations of BC, which is amorphous. There are no accurate and validated *in silico* models of amorphous BC. In this work, an amorphous BC model was developed by the pyrolysis quenching of a graphite system through a classical molecular dynamics simulation using a ReaxFF interatomic potential in large-scale atomic/molecular massively parallel simulator (LAMMPS) software. The resulting structure was then validated visually and by analyzing the model's calculated Fourier transform infrared (FTIR) spectrum. At the same time, the amorphicity was established by a 3D radial distribution function of the carbon skeleton. Fourier transformed the dipole auto-correlation function calculated using LAMMPS to obtain the FTIR spectrum. The calculated spectrum of the BC model was compared with similarly calculated spectra of several common moieties found in BC. The *in silico* BC model was deemed to be an accurate representation of amorphous BC. The amorphous BC structure we developed in this study is a very close representation of the BC found in nature; hence, the adsorption studies that were subsequently carried out are also more accurate than existing studies on the adsorption of various chemical species onto BC.

Keywords: Biochar, *in silico*, molecular dynamics, LAAMPS, simulation

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SB_104

SUPPRESSION OF WATERBORNE PATHOGENS IN EFFLUENTS USING AGRO-WASTE-DERIVED FUNCTIONALIZED CELLULOSE NANOCRYSTALS

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Confining exposure to waterborne pathogens and water-related disease outbreaks protects public health. This study pursued fabrication of cellulose nanocrystals (CNCs) incorporated with biogenic metal/metal oxide nanocomposite (NC) nanofiltration media to prepare pathogen-removing filters. Pineapple (*Murusi*) waste was utilized to synthesize CNCs and Ag/Ag_2O/ZnO NCs and evaluate their capacity to suppress pathogen proliferation in wastewater. Different parameters, irradiation methods, precursor concentration, plant extract-to-precursor ratio, pH, and incubation time, were varied to obtain higher NC yields with smaller sizes. UV-Visible (UV-Vis) spectroscopy, Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and X-ray diffraction (XRD) were used to characterize the NCs, while FTIR and thermogravimetric analysis (TGA) were used for the CNCs. To fabricate CNCs with Ag/Ag_2O/ZnO NCs, a 50 g sample of CNC was employed along with varying amounts of NCs. Nanofiltration columns were prepared by varying the ratio of CNC:Ag/Ag_2O/ZnO NCs (10000:1, 5000:1, 2500:1). *Salmonella Shigella* Agar (SSA) medium was used to determine the inhibition of Salmonella typhi in water medium. UV-vis spectroscopy revealed Ag/Ag_2O/ZnO NCs formation by displaying a peak around 350-450 nm. FTIR confirmed pure CNCs and phytochemical role in Ag/Ag_2O/ZnO NC formation. SEM depicted spherical Ag/Ag_2O on narcis-like ZnO, confirming the successful synthesis of NCs. TEM showed an 11.4 nm average particle size, while XRD indicated hexagonal wurtzite ZnO and face-centered Ag/Ag_2O. Ag/Ag_2O/ZnO/CNC composite showed potent antibacterial efficacy, whereas cellulose fibers did not display, while CNCs filtered up to 160 mL before saturation. The 10,000:1 column lost bacterial removal capacity after 880 mL; the 5,000:1 column started declining at 1.12 L, and the 2500:1 column lost efficacy at 1.2 L throughput. This study revealed that the MC mediated NC-incorporated CNC membranes could be viably utilized for suppression of waterborne pathogens in wastewater.

Keywords: Ag/Ag_2O/ZnO NCs, cellulose nanocrystals, green synthesis, pineapple waste, waterborne pathogens

SB_105

GREEN SYNTHESIS OF ZINC OXIDE NANOPARTICLES USING *Mangifera indica* SEED KERNEL EXTRACT AND THEIR PHOTOCATALYTIC ACTIVITY

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The utilization of plant-mediated synthesis to produce nanoparticles (NPs) has gained significant interest due to its eco-friendly and sustainable nature. The present study reports the biosynthesis of zinc oxide (ZnO) NPs using an aqueous extract of *Mangifera indica* seed kernel. The green synthesis of ZnO NPs was achieved by mixing 50.0 mL of aqueous zinc nitrate solution with seed kernel extract under optimized conditions of precursor metal concentration (0.010 mol L^{-1}), plant extract volume (5.0 mL), and pH (12.0). The formation and characterization of NPs were performed using various techniques, such as ultraviolet-visible (UV-Vis) spectroscopy, X-ray diffraction (XRD), and Fourier transform infrared (FTIR) spectroscopy. UV-Vis spectral analysis revealed sharp surface plasmon resonance at 330–340 nm, while FTIR analysis indicated the presence of phenolic compounds, flavonoids and alkaloids in the plant extract. This observation was accountable for the capping and stabilization of ZnO NPs *via* phytochemicals. Topographical images displayed flower-like ZnO NPs composed of clusters of individual nanocrystals. XRD data revealed characteristic peaks matching the Miller indices of crystalline planes of wurtzite, a mineral of hexagonal ZnO NPs with an average crystallite size of 12.98 nm. The synthesized NPs were evaluated for their photocatalytic activity in the degradation of methylene blue (MB) dye (λ_{max} = 664.2 nm), while optimizing parameters such as catalytic load (5.0 mg), pH (6.0), MB dye concentration (5.0 ppm), and irradiation time (3.0 h). The photocatalytic degradation efficiency reached a maximum of 72.3% under 180 min of solar irradiation. This dye degradation ability of NPs highlights their potential for wastewater treatment and environmental remediation applications.

Keywords: Green synthesis, *Mangifera indica*, photocatalysis, zinc oxide nanoparticles

SB_106

INCORPORATION OF NATURAL INEXPENSIVE FILLER-CELLULOSE NANOCRYSTALS INTO POLYCARBONATE MATRIX AS A GREEN TECHNOLOGY APPROACH

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With its important mechanical properties, polycarbonate is a widely used polymer in industry. To further enhance its properties, different reinforcement agents have been employed. Cellulose nanocrystals (CNC) have been identified as a promising agent due to its exceptional reinforcing capabilities and eco-friendly nature. The research work is mainly focused on the enhancement of mechanical properties of polycarbonate (PC) by incorporating CNC as a reinforcement agent. The nanocomposite synthesis involved the formation of hydrogen bonds between the carbonyl group of polycarbonates and the hydroxyl group of cellulose nanocrystals. The process was initiated by utilizing commercially available cotton balls upon sulfuric acid hydrolyzation. Fourier transform infrared spectroscopy, light microscopy, scanning electron microscopy, dynamic light scattering, thermogravimetric analysis, and powder X-ray diffraction were used as characterization techniques to confirm CNC-PC nanocomposite formations. Synthesized CNC particles were within the range of 30-1000 nm with a recovery rate of approximately 41%. The large-scale synthesis was successfully obtained under optimized conditions. CNC-PC nanocomposite was prepared with varying filler loadings from 0 to 3%. Tensile, flexural, hardness and impact testing were conducted on the CNC-PC nanocomposites compared to the pristine polycarbonate. The results confirmed the increase of flexural strength by 70.31%, impact strength by 7.26% and shore D hardness by 6.38%. The enhancement of these properties has also been attributed to the formation of strong interactions between the CNC and polycarbonate. The results confirm the potential of using CNC as an effective reinforcement agent for polycarbonate with enhanced mechanical properties for sustainable and green technology applications in the polymer industry.

Keywords: Cellulose nanocrystals, nanocomposites, polycarbonate, reinforcement agent, sustainable

SB_107

ASSESSMENT OF THE VIABILITY OF *Tithonia diversifolia* SEED OIL AS A BIODIESEL FEEDSTOCK *via* TRANSESTERIFICATION

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Tithonia diversifolia (TD), commonly known as Mexican sunflower or wild sunflower, is a native to Mexico and Central America. However, this plant is considered invasive in various countries and regions where it has been introduced including Sri Lanka, India, Kenya, Australia, Nigeria, and Southeast Asia. TD seeds yield 27-30% of oil when extracted using *n*-hexane as a solvent through the Soxhlet extraction method. The acid value, saponification value, and the molar mass of the TD seed oil were found to be 7.02 mg KOH g^{-1}, 216.81 mg KOH g^{-1} and 802.26 g mol^{-1}, respectively. Preceding the transesterification process, a pre-esterification step was undertaken on TD seed oil using methanol with sulfuric acid as the catalyst. To achieve a reduction in the acid value of the oil to below 1%, the application of 1.00 g of methanol and 0.018 g of sulfuric acid for every 10.00 g of oil with methanol was implemented. The optimum conditions for the transesterification were investigated by varying the parameters; temperature (28.0 - 70.0) °C, methanol:oil molar ratio (3:1 - 12:1), and catalytic potassium hydroxide concentration (0.5 - 1.5)%. TD oil solidifies below 37.0 °C, hindering transesterification, and causing oil to adhere undissolved to flask walls until temperatures exceed 37.0 °C. The optimal triglyceride conversion of 91% was achieved at 60 °C in the presence of 1% potassium hydroxide as the catalyst when the methanol:oil ratio was kept at 10:1. Biodiesel properties including flash point, fire point, density, cloud point, pour point and kinematic viscosity at 40 °C of TD biodiesel were characterized according to the ASTM standards, and the results obtained were 170.0 °C, 180.0 °C, 872 kg m^{-3}, 12.0 °C, 7.0 °C, and 5.4 mm^2 s^{-1}, respectively. TD biodiesel demonstrates favorable properties within the standard range as per ASTM standards, positioning it as a promising biodiesel feedstock.

Keywords: Biodiesel, pre-esterification, *Tithonia diversifolia*, transesterification

SB_108

In silico INVESTIGATION ON DESIGNING NEW SYNTHETIC LINAMARIN ANALOGS ANTICANCER DRUG

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The metabolic breakdown of linamarin by beta-glucosidase produces hydrogen cyanide, which can result in the death of cancer cells. However, linamarin is not readily hydrolyzed in the human body. This study focused on designing synthetically viable new linamarin analogs with a better hydrolyzing rate than linamarin. Linamarin's cyanogenesis consists of an enzymatic step of glycosidic bond cleavage and a spontaneous breakdown of cyanohydrins. In this study, Koshland's double displacement retaining enzymatic mechanism was followed by the hydrolyzing mechanism of linamarin and its analogs. Geometry optimization of stationary states of the reaction path (minima and transition states) was performed using density functional theory at B3LYP/6-31G (d) level while single point energies of the optimized geometries were obtained ωB97X-D/6-311+G (d). The barrier height of the rate-determining step of the linamarin and its analogs were calculated. All calculations were done in polarizable continuum model (PCM) solvent media. The energies of the spontaneous decomposition of the cyanohydrins were evaluated using the same level of theory. Linamarase, which is responsible for hydrolyzing linamarin, is not present in human cells. Therefore, a suitable crystal structure of a human enzyme that can hydrolyze cyanogenic glucosides was investigated by conducting a BLAST search using the UniProt server and NCBI website, and subsequent ligands were docked to obtain the binding energies. Results revealed that the proposed analogs have much lower barrier height than linamarin in the rate-determining step. Energy calculations reconfirmed that the decomposition of all cyanohydrins is highly spontaneous. The human cytosolic beta-glucosidase (PDB ID:2JEF) which has the highest similarity to linamarase was used for docking studies. It revealed that the binding energies of the analogs were much lower than linamarin. In conclusion, the study reveals that the proposed linamarin analogs could be developed as better drug candidates for cancer therapy in the future.

Keywords: Cyanogenic glucosides, DFT, linamarin, linamarin analogs

SB_109

BIOREMEDIATION OF CHROMIUM BY HEAVY METAL-RESISTANT BACTERIA FROM TANNERY EFFLUENT

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The rapid expansion of industrial activities has led to a significant increase in the discharge of heavy metal-containing industrial waste, particularly impacting soil and water ecosystems. Among these heavy metals, hexavalent chromium, extensively used in the tanning industry, poses severe health risks due to its toxicity and ability to permeate cell membranes. Conventional physicochemical methods for heavy metal remediation often prove ineffective at low concentrations, prompting the exploration of alternative approaches such as bioremediation using microorganisms. Five bacterial species isolated from tannery effluent, namely A, C, 2, 3 and 6, exhibited multi-metal resistance capacity for chromium and lead, but in this study, the main focus is on chromium remediation. The results indicate that bacterial species A exhibited the highest removal efficiency of Cr(VI) among the five isolated species. Moreover, biodegradation efficiency increases with decreasing pH, reaching optimal removal at pH 6.0, due to electrostatic interactions between positively charged biosorbents and $Cr_2O_7^{2-}$ ions at low pH range, whereas with increasing concentration of Cr(VI) solution, biodegradable efficiency decreased with optimal removal (36.96±1.02)% observed at 5 ppm concentration. The growth curve analysis suggested the potential benefits of Cr(VI) in enhancing bacterial growth and reaching a minimum inhibitory concentration of 400 ppm. The Freundlich isotherm model provided the best fit to the experimental data, indicating multilayer biosorption of Cr(VI). Furthermore, the role of extracellular polymeric substances in metal adsorption, particularly through proton exchange mechanisms, was analyzed through Fourier transform infrared spectroscopic data. Overall, this study underscores the potential of bacterial species A for effective remediation of heavy metal pollution, especially at low concentrations, offering a sustainable solution to environmental contamination.

Keywords: Bioremediation, biosorption, heavy metals, microorganisms, tanning industry

SB_110

DEVELOPING A NATURAL FOOD PRESERVATIVE FROM CINNAMON (*Cinnamomum zeylanicum*) OIL NANOEMULSION

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This research explores the potential of cinnamon oil extracted from *Cinnamomum zeylanicum*, a native plant of Sri Lanka, as a natural food preservative. Despite well-documented *in vitro* antimicrobial properties, real-world studies on its efficacy are scarce. Practical challenges, such as limited water solubility, intense aroma and flavor, impede its integration into food products. However, innovative encapsulation methods, such as nanoemulsions, offer a solution to these obstacles. A novel plant-based cinnamon oil nanoemulsion (CONE), composed of soy protein isolate, soy lecithin and sunflower oil, was developed and evaluated for its preservative effectiveness. In creating an oil-in-water nanoemulsion, soy protein encapsulates cinnamon oil particles, with soy lecithin serving as the emulsifying agent and sunflower oil acting as the ripening inhibitor. Comprehensive assessments included antioxidant, anti-inflammatory, and antibacterial assays, along with practical food assessments and sensory evaluations. Rooted in cinnamon's acknowledged antimicrobial properties, this study aims to provide a practical, plant-based alternative for the food industry. Results indicate that CONE emerges as a revolutionary, 100% plant-based natural food preservative, demonstrating antibacterial, antioxidant, and anti-inflammatory attributes. It displayed inhibitory action against four bacterial strains associated with food spoilage or toxicity: *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. Practical food assays and sensory evaluations affirm its preservative capabilities while maintaining organoleptic qualities of foodstuff, including color, texture and aroma. Additionally, CONE exhibits stability over six months under refrigeration, suggesting potential as a convenient household product. This research not only validates CONE's efficacy but also unveils opportunities for further exploration and optimization, paving the way for promising avenues in future product development.

Keywords: Cinnamon oil nanoemulsions, nanoencapsulation, natural food preservatives

SB_111

MODIFICATION OF SURFACE HYDROPHOBICITY OF PAPER *via* GAMMA RADIATION INDUCED GRAFT COPOLYMERIZATION

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As hydrolysis plays a critical role in deterioration of paper, modification of surface hydrophobicity is a major concern in conservation and packaging point of view. The present study was designed to enhance the surface hydrophobicity of paper using inexpensive and readily available commercial alkyd resin and it employed gamma radiation to proceed with the graft copolymerization reaction. Naturally aged paper samples were treated with mixtures of alkyd resin and methyl methacrylate and mixtures of alkyd resin and styrene, followed by irradiation with 15 kGy dose. Fourier transform infrared (FTIR) spectroscopic analysis, scanning electron microscopic (SEM) analysis and thermal analysis were performed to determine the success of the reaction. Surface hydrophobicity was determined by contact angle measurements (at 10 minutes delay) and by the total immersion method. All the analytical results were evaluated comparative to the reference (chemically untreated and unirradiated paper). In comparison to the reference, appearance of new IR peaks, corresponding to the alkyd resin indicated the success of the graft copolymerization. Surface morphological modifications were detected in the micrographs, whereas the enhanced thermal stability and multi-step decomposition were observed in thermogravimetric analysis. During contact angle measurements, water droplets on the reference got absorbed within the delayed time, while water droplets retained for modified samples. As per the results of the total immersion experiments, absorbed water content for unmodified paper saturated around 110% while absorbed water content for modified papers were significantly lower (below 100% during the experiment duration) and hence a clear indication of enhanced water resistivity. In conclusion, FTIR, SEM and thermal analysis results were evident of success of the graft copolymerization reaction, while the effective modification of surface hydrophobicity of paper was confirmed by contact angle and total immersion experiments.

Financial assistance provided by the International Atomic Energy Agency (Technical Cooperation Project RAS1027) is acknowledged.

Keywords: Alkyd resin, gamma radiation, graft copolymerization, hydrophobicity, paper

SB_112

MULTIMETALLIC SILICA NANOHYBRIDS INCORPORATED NANOFIBER MEMBRANE FOR POTENTIAL SYNERGISTIC ANTIBACTERIAL APPLICATIONS

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Numerous obstacles that have arisen in modern life have been successfully surmounted by nanotechnology. One of the foremost problems for the public health is bacterial infections. They highlighted the lack of efficacy of traditional therapies, high rates of morbidity and mortality, resistance to antibiotics, and other issues that prompted the emergence of novel, inexpensive antibacterial materials. The synergistic antibacterial activity of metal nanoparticle conjugates is a blooming strategy. In this study, Ag, Cu, and Co were doped separately into silica nanoparticles by sol-gel method. The synthesized monometallic nanohybrids were combined by mechano-chemical grinding in equal proportions to formulate bi- and multi-metallic nanohybrids. They were characterized structurally by Fourier transform infrared (FTIR) spectroscopy, Raman spectroscopy, X-ray diffraction (XRD) and X-ray photoelectron spectroscopy (XPS). Transmission electron microscopy (TEM) images were used to characterize the morphology of nanohybrids. The doped percentages of each metal into the silanol network were determined using atomic absorption spectroscopy (AAS). To assess the activity and confirm antibacterial synergy, the minimum inhibitory concentration (MIC) from 12.25 to 1560.00 μg mL^{-1}, minimum bactericidal concentration (MBC) from 197.00 to 3125.00 μg mL^{-1}, and IC_{50} values (from 30.56 to 1683.00 μg mL^{-1}) were evaluated and confirmed the best antibacterial synergy by multimetallic silica nanohybrid, that demonstrated the toxicity level (LD_{50}) of 6.25 mg mL^{-1}. It was then incorporated into a cellulose acetate nanofiber membrane by electrospinning and characterized by FTIR, XRD, Raman spectroscopy and TEM. Disc diffusion assay was conducted against American type culture collection (ATCC) cultures of three Gram-positive and three-Gram negative bacteria to further confirm the antibacterial synergy. The highest synergistic radical scavenging performance of multimetallic nanohybrid incorporated nanofiber membrane (91.77±0.88)% was established by the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) assay. Finally, it was demonstrated that the multimetallic silica nanohybrids incorporated nanofiber membrane possesses a substantial potential as an emerging, broad-spectrum bacterial coverage and cost-effective antibacterial membrane that can be employed in biomedical applications.

Keywords: Antibacterial synergy, electrospinning, multimetallic silica nanohybrids, nanofiber membrane

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