Conference Abstract Book

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Winter School on Laser Applications for One Health: Enhancing Food Security and Combating Human Diseases

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SCIENCE HORIZON AND INNOVATION
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Frontiers in Basic & Applied Sciences for Sustainability and Innovation

Integrated Solutions for Sustainable Utilization of Egypt's Water Resources

Prof. Dr. Mohamed Sultan

Professor, Geological and Environmental Sciences

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Egypt will depend on two primary freshwater sources to sustain its growing population in the 21^{st} century: the Nile River and the Nubian Sandstone Aquifer System. We apply an integrated approach that utilizes field, geochronologic, remote sensing, hydrologic modeling (continuous rainfall-runoff), and global circulation model outputs in the 21^{st} century to investigate optimum scenarios for achieving sustainable utilization of those two resources. Our results reveal (1) the intensification of flood regimes in the 21^{st} century over the Nile River source areas leading to excess runoff reaching Lake Nasser, (2) excess Lake Nasser could be diverted to the depressions south of the Tushka Lakes, where it could recharge the fossil waters of the Nubian Sandstone Aquifer System, (3) Efforts should continue to monitor leakage from the Grand Ethiopian Renaissance Dam reservoir along fault networks and regolith that reduces the runoff reaching the downstream countries.

Controlled/Living Polymerization of Glycolide: Overcoming a Long-Standing Challenge in Advanced Biomaterials by Thinking outside the Box

Prof. Nikos Hadjichristidis

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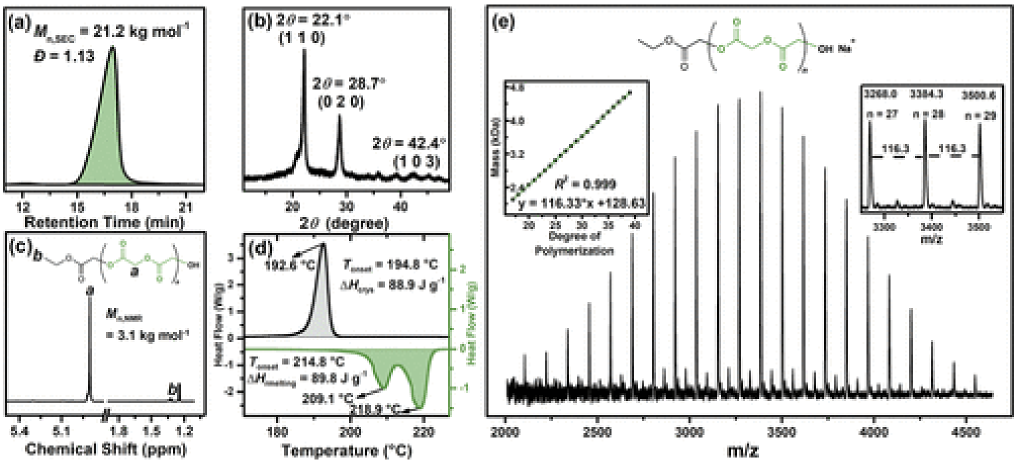
This study introduces the first efficient living/controlled ring-opening polymerization (ROP) of glycolide (GL), a commercially available bio-derived monomer, utilizing strong protic fluoroalcohols (FAs) as (co)solvents. Our findings reveal that FAs not only enhance monomer solubility but also activate both the monomer and the living chain end, as supported by density functional theory (DFT) calculations and NMR titration studies.[1] This strategy enables the synthesis of well-defined polyglycolide (PGA) and facilitates the development of novel PGA-based macromolecular architectures with distinct properties.[2] Remarkably, the resulting PGA can be chemically recycled into its monomer with high selectivity and yield, providing a sustainable alternative to conventional non-recyclable polymers. Additionally, this work advances the understanding of anionic ROP mechanisms, which have traditionally been hampered by protic impurities. Published results on methyl PGA and preliminary findings on other substituted PGA will also be presented.[3]



Molecular characterization of PGA **(a)** SEC trace, HFIP, 40 °C, PMMA standards. **(b)** WA- XRD pattern. **(c)** ^{1}NMR spectrum (600 MHz, 298 K, $CDCl_3$/HFIP). **(d)** DSC scans (10 °C min^{-1}). **(e)** MALDI-TOF MS spectrum.

References

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Bio-fluid Mechanics and its Applications

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A better understating for different biological phenomena can be achieved by studying the transport of the fluid related to the problem. The motion associated with such problems is described by the so-called governing equations, regardless of the approximation which may lead to an exact solution for these models. In most cases, a numerical technique must be employed to obtain an approximate solution. This study aims to investigate the advantage of using mixed physics-informed neural networks (MPINN) to simulate such phenomena. A hypothetical situation was considered in which an obstacle arose at the channel of the ureter during its peristaltic motion. This situation is known as a kidney stone disease. The momentum conservation governing equations is considered for the case of incompressible Newtonian fluid and the dimensionless corresponding form is introduced. The contour plots of the pressure and the velocity fields are illustrated for different stone shapes. Also, the shear stress is obtained at the surface of Lumen. Our findings show the applicability of the MPINN for obtaining reliable results for such crucial situations

The Role of AI in Medicine and Healthcare and Its Impact on Advancing a Knowledge-Based Economy

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Economy Artificial intelligence (AI) is reshaping the landscape of medicine and healthcare, driving progress that supports the growth of a knowledge-based economy. Through AI-powered tools, healthcare systems achieve greater diagnostic accuracy, personalized treatment approaches, and optimized operational workflows, leading to enhanced patient outcomes and cost-efficiency. Machine learning algorithms and advanced data analytics enable clinicians to make data-driven decisions and predict patient outcomes with high precision. AI also accelerates drug development, refines medical imaging, and enhances patient monitoring, fostering innovation and reducing the timeline for medical advancements. This integration of AI not only enhances clinical practice but also catalyzes economic development by opening new sectors, enhancing workforce skills, and promoting interdisciplinary collaboration. Consequently, the adoption of AI in healthcare serves as a pivotal factor in advancing a sustainable, knowledge-driven economy and positioning societies for future technological and healthcare leadership.

Quantum Materials under Extreme Conditions

Prof. Mahmoud Abdel-Hafiz
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Today, one of the most important research areas that attract enormous interest for humanity is the design, discovery, characterization and control of novel quantum materials. Various societal challenges such as energy, water quality, air quality, medicine and environment all need to be solved by the discovery of new compounds with dramatically improved, or even new, properties. The search and exploration for such materials requires a blending of skills and mindsets that, traditionally, have been segregated into different academic disciplines: physics, chemistry, metallurgy, materials science and engineering. Quantum materials contain several candidates, which exhibit large tunability of nontrivial electronic states by chemical doping or hydrostatic pressure. Despite extensive worldwide efforts, the synthesis of high-quality materials with well-controlled stoichiometries has shown to be a significant bottleneck in the exploration of quantum materials. I will present and discuss the basic motivations for making and studying single crystals with the highest quality, which are important due to their continuous, uniform, and highly ordered structure. Materials discussed will span superconductors, 2D magnets, transition metal dichalcogenides, topological electronic systems, and magnetic materials. I will also describe recent extreme condition experiments, including low temperature in millikelvin regime and high pressure up to 60 GPa, performed in our laboratory that address how extreme conditions can provide new insights into various fundamental problems.

Green chemistry in the undergraduate laboratory: Using research projects for teaching

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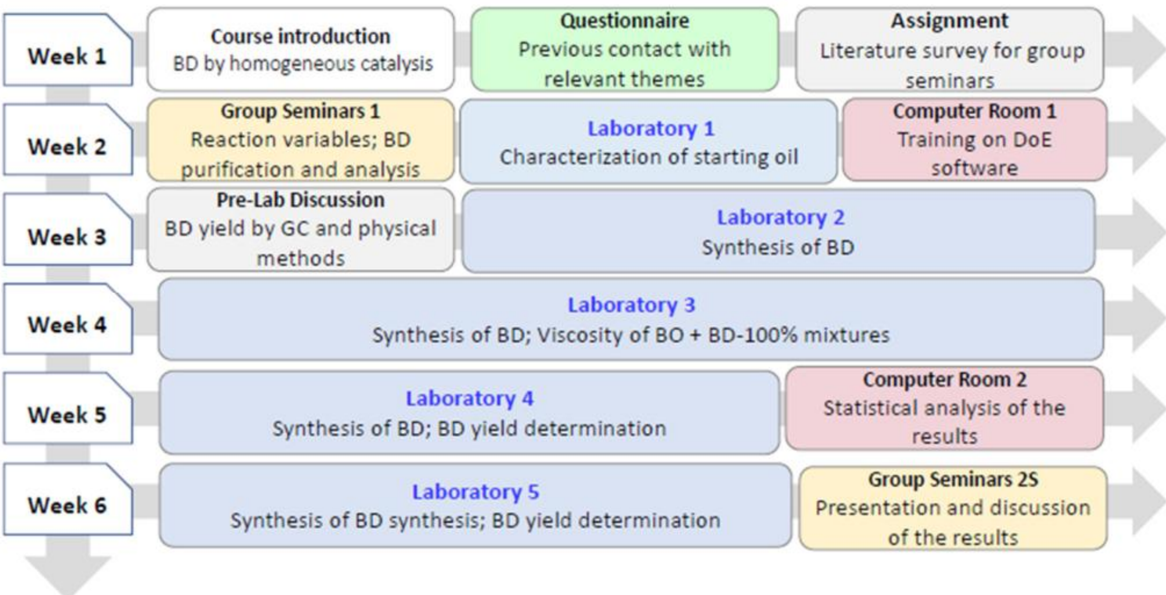
A common approach to teach the undergraduate laboratory is to give experiments designed to introduce practical skills, and to obtain results whose explanation is connected to theory. Several years ago, we started an approach where the students perform research projects, each one takes 6 weeks, 4 hr/week course periods, including pre-laboratory discussion, experimental part and discussion of the results. The subjects covered included synthesis of biodiesel (BD) from Amazon region oils; recyclable catalysts; dissolution and regeneration of biopolymers, and analysis of biofuels. Below is the flowsheet of a project on BD synthesis from babassu oil. In addition to the connection with theory, e.g., the mechanisms of the reactions of carboxylic acid derivatives, this approach allows for the introduction/application of themes that the students either do not know, or have only a little contact with. Examples are the applications of statistics in chemistry (design of experiment) and of solvatochromism for the analysis of solvents and solvent mixtures. This approach serves as a "low budget" introduction to how research is planned and done.



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Energy in the Mediterranean region: situation and prospects

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For over 35 years, OMEC has been the voice of the energy industry in the Mediterranean, bringing together leading energy companies from the North, South, and East Mediterranean. It serves as a platform for dialogue, cooperation, and the exchange of best practices, and is a recognized think tank for the Euro-Mediterranean region. OMEC aims to foster regional collaboration for a just energy transition that benefits all shores of the Mediterranean.

The presentation relies on our flagship publication, *Mediterranean Energy Perspectives (MEP)*, which outlines clear pathways to achieving net-zero by 2050, enabling governments to align environmental objectives with economic growth.

The Mediterranean region, home to 7% of the global population, accounts for 7% of world energy demand, 10% of global GDP, and only 5% of global CO_2 emissions—largely due to the EU's sustained efforts over the past two decades to reduce emissions.

It is characterized by diverse energy profiles, with northern countries more and more relying on renewable energy expansion, while southern and eastern countries still depend heavily on fossil fuels. Energy demand is steadily growing due to population increase, urbanization, and economic development, particularly in the southern Mediterranean. Significant reliance on energy imports, especially natural gas and oil, poses challenges for energy security. Renewable energy is expanding, but the transition remains uneven across the region. There is also a huge potential for energy efficiency.

As for the future, demographic shift is underway, with the South Mediterranean's population increasing while the North sees slower growth or even declines. Over the next 20 years, all population growth is expected in the South (+110 million), while the North is projected to experience a decrease of 13 million. GDP will grow on both shores, but the South's economic growth rate is expected to be twice that of the North by 2050. Despite this substantial growth, GDP per capita in the South in 2050 will still fall short of the North's current level.

On this basis, as well as the economic expected growth, MEP considers two scenarios which explore 2 different pathways for the Mediterranean energy system and its 26 member countries to 2050:

- The Reference Scenario (RS) is a Baseline Scenario (current trends), which takes into account past trends, current policies and ongoing projects. It incorporates the Nationally Determined Contributions (NDCs), but it assumes that international financing and other aids will not be enough to reach the NDCs in full. Under this scenario, the increased demand for electricity will be met with the traditional primary energy sources and with others that will be available in the future.

- The ProMED "Net-Zero Carbon" Scenario (PM) reaches the net-zero carbon emission target by 2050 through more ambitious measures for energy efficiency, significant technology development to further curb CO2 emissions, as well as increased diversification in the energy mix tailored for each country based on their national pledges. MEP lays out the foundations for a well-designed energy system that serves as a catalyst for social and economic development at local and regional levels, measuring the energy efficiency deployment and detailing the transition path away from fossil fuels to cleaner energy sources and technologies at horizon 2050. MEP also assesses the corresponding investments required for the electrification of end-use sectors and restructuring energy supply away from carbon-intensive forms of energy.

Recent Advances on Quantum Computer

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Recent advances in quantum computing have catalyzed significant progress in the field, showcasing the potential to revolutionize various domains, including cryptography, materials science, and complex system simulations. Breakthroughs in quantum algorithms, such as Shor's and Grover's, have highlighted the advantages of quantum parallelism, enabling faster problem-solving capabilities compared to classical counterparts. Furthermore, advancements in quantum hardware, including the development of superconducting qubits and trapped ion systems, have improved qubit coherence times and error rates, essential for practical applications. Collaborative efforts in quantum networking and error correction techniques are paving the way for scalable quantum systems. As the landscape evolves, interdisciplinary research continues to enhance our understanding and implementation of quantum technologies, positioning quantum computing as a transformative force in the tech industry and beyond.

Nanomedicine: Potential for Early Cancer Diagnosis and Treatment, Along with Other Biomedical Uses

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Smart nanomaterials represent a very favorable class of materials that are able to dramatically change their properties in response to specific environmental stimuli such as pH, temperature, magnetic field, light, electricity, certain chemicals, etc. Recently, the ability to manage the size in the nanoscale, shape, porosity and surface morphology of materials has created new opportunities to evade various challenges in various applications. Besides, the concurrent fast and considerable stimuli-response of these nano-structured smart nanomaterials may magnify the scope of their applications, and suggest improved performance in their uses especially in the biomedical fields. The talk will give an overview of the recent advances of smart nanomaterials, and will describe the *in-vitro* and *in-vivo* evaluation of several new series of our newly-developed smart nano and nano-in-micro systems for treatment and early diagnosis of different types of cancer.

Tool steels from industrial and research perspectives: Development of innovative and economic high-speed tool steels

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Tool steels are crucial for forming and machining materials like plastics, rubber, wood, and metals due to their durability, which relies on hardness, strength, and wear resistance. They are typically medium or high carbon steel containing carbide forming alloying elements such as molybdenum, tungsten, vanadium, and chromium to achieve a martensite hardness of 55-65 HRc. The higher carbon content combined with higher alloying elements-enhanced specific properties e.g. hardness, wear resistance and overall durability through un-dissolved carbides.

This work explores tool steel grades and their grading systems, focusing on the metallurgical concepts that affect their properties in production and heat treatment. AISI M2 high-speed tool steel is noted for its versatility in high-speed applications due to its hardness, toughness, and wears resistance. Achieving optimal properties requires precise control of cleanliness, structure, and microstructure during heat treatment for AISI M2 tool steel.

AISI M2 high-speed tool steel was produced through induction melting and electroslag refining. Various characterization techniques were conducted to investigate phase transformation, microstructure, and dilatation. The study utilized JMatPro software for phase equilibria and solidification analysis. Precipitated carbides were examined using optical microscopy and X-ray diffraction, scanning electron microscopy, and energy-dispersive X-ray techniques. Image analysis with Image J software assessed the count and size distribution of precipitated carbides and inclusions. The critical transformation temperature was measured using dilatometer. The role of precipitated carbides and microstructure on wear and hardness measurements were studied.

From Lab To Fab: Transforming nanotechnology research into industrial scales

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Nanotechnology is very promising and is considered the next industrial revolution. Innovations in nanotechnology are enhancing medicine, food, cosmetics, agriculture, environmental health, and technology and are expected to witness significant growth in their impact soon. Bringing a nanotechnology product or enterprise to the market entails many hurdles. One of the major challenges for the nanotechnology industry is the mass production of nanomaterials, as it is not easy to produce kilograms or tons of nanomaterials in a single step. This work will explain the efficient way to produce nanomaterials on a large scale for industrial applications. Identify the challenges inherent in these processes and outline a strategic framework for researchers moving from the laboratory to the industry. Nanotechnology start-up companies (as ECCM) are the only solution for the future economy, industries, and applications.

Surface states engineering at the atomic scale: Lateral metallic and molecular nanoarchitectures

Prof. Dr. Zakaria M. Abd El-Fattah

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The wave-particle duality has set a solid analogue between electrons and light and brought together their corresponding physics. The electronic band theory in crystalline solids has been successfully applied to light, allowing the extensive study of photonic crystals. For photonics-based applications, microscale structures are required for which lithographic techniques are at hand. Nanostructured noble metal surfaces that host quasi-free electronic surface states are analogues of photonic systems. They are characterized by 1–3 nm Fermi wavelength, so that much finer nanostructures are required to produce surface state-based nanoelectronics. In this talk, two families of such nanostructures are considered: 2D metallic superlattices and nanoporous organic networks assembled on metal surfaces. These superstructures produce featured FS with different band topology and energy gaps. Likewise, electrons can readily be confined within the molecular nanopores leading to strongly modulated density of states. These nanopatterened surfaces are good candidates to explore relevant applications, such as electron self-collimation and negative refraction, at 1000-fold smaller scale than photonics, and are fundamentally importance for the exploration of emerging quantum phenomena.

Molecular Beam Epitaxy from Research to Mass Production

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Since the invention of the transistor by Bardeen and Brattain in late 1947, semiconductor devices have developed at an astonishing pace. Their discovery had an unprecedented impact on the electronic industry and on solid state research. Improvements in processing and lithographic techniques increased device speed and the level of integrated circuit complexity. In the 1960s, development of molecular beam epitaxy (MBE) and metal-organic vapour phase epitaxy (MOVPE) deposition paved the way, not only for heterojunction transistors, but also provided access to new device phenomena and facilitated the production of multiple layered structures with extremely fine dimensional and compositional control. The advances of these growth techniques may be gauged by the number of papers published and conferences that have taken place in the past forty years. In addition, both techniques are now commercially used to mass produce devices. However, today in industry MBE and MOCVD are the preferred techniques for electronic devices and optoelectronic devices, respectively. One of the great strengths of these epitaxial methods is their versatility. The ability to incorporate a wide variety of sources provides the flexibility needed to pursue the heteroepitaxial integration of semiconductor materials with vastly dissimilar properties, ultimately resulting in devices and circuits with broad functionality. There are already new device structures which are commercially available and many more at the advanced research stage.

Low dimensional structures form a major new branch of physics research. They are semiconductor structures which have such a small scale in one or two spatial dimensions that their electronic properties are significantly different from the same material in bulk form. These properties are changed by quantum effects. A typical example of such a structure, in which charge carries are confined to move freely in only two dimensions, is a so-called quantum well. Most physics undergraduates will have encountered the potential well as their first problem in undergraduate quantum mechanics. MBE has made it possible to produce quantum wells in practice. This sophisticated technology for the growth of high quality epitaxial layers of compound semiconductor materials on single crystal semiconductor substrates is becoming increasingly important for the development of the semiconductor electronics industry. Wider scientific interest has tended to concentrate on low temperature electronic studies of heterostructures, particularly since the award of the Nobel Prize for physics in 1985 to K. von Klitzing for his work on the quantum Hall effect.

For those not familiar with the subject it may be helpful to explain that MBE is essentially a refined form of vacuum evaporation. Elements are heated in crucibles called Knudsen cells or furnaces and directed beams of atoms or molecules are condensed onto a heated single crystal substrate where they react chemically under ultra-high vacuum (UHV) conditions. If the substrate is of the same nature as the deposited layer, the term of homoepitaxy is often used. If the single crystal formed consists of thin films of different semiconductors one on top of the other, then the process is called heteroepitaxy. The deposition rate and the temperature of the substrate must be carefully chosen and controlled. The substrate surface must be clean and as free from defects as possible. The molecular beam or flux emanating from the knudsen cell is controlled by accurate control of the temperature and the flux arriving at the sample may be regulated by appropriate shutters in front of the Knudsen cell. Several furnaces may be incorporated in the growth chamber in order to dope semiconductors or to grow compounds and alloys. For example, three of the furnaces may contain Ga, Al and As for the growth of $GaAs/Al_xGa_{1-x}As$ layers, with a Si cell for n-type doping and a Be cell for p-type doping. The special merits of this technique are that thin films can be grown with precise control over thickness, alloy composition, and doping level. Using rapidly acting mechanical shutters, the composition can be changed abruptly permitting novel structures to be prepared. A minicomputer controls the cells and substrate temperatures and the shutter operation such that any desired growth sequence may be programmed and achieved.

Using sophisticated MBE growth, lithographic and etching techniques it is possible to fabricate new forms of active devices with "tailor made" characteristics.

After a description of the technology of low dimensional structures some specific examples are cited to illustrate the main achievements of MBE both in fundamental research and manufacturing.

Emerging Trends in Semiconductors for Innovative Technologies

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The increasing global demand for innovative technologies, characterized by heightened efficiency, diminished energy consumption, and a strong commitment to environmental sustainability, has prompted an exploration of alternatives to conventional technologies. Developing new semiconducting materials with enhanced or distinct properties is imperative to the progress of contemporary technologies.

In this presentation, we will explore the latest developments in semiconductor technologies that drive innovation across various sectors. The first trend pertains to the integration of hybrid organic/inorganic structures. These structures amalgamate various semiconducting materials, incorporating quantum dots and carbon nanotubes as inorganic components alongside oligomers and polymers as organic constituents. This innovative synthesis of inorganic and organic semiconductors represents a distinctive method for creating novel semiconductor heterostructures. The objective is to exploit the unique advantages inherent to both material types, thereby facilitating the emergence of inventive applications.

The second trend centers on diluted magnetic quantum dots (DMQDs). In this context, quantum dots are combined with magnetic dopants to augment and modify the magnetic characteristics of the semiconductor matrix. This dynamic area of research is advancing rapidly in response to the growing demand for magnetic semiconductor technologies. A comprehensive understanding of these trends is critical for effectively leveraging advanced technologies such as Quantum Nanoelectronics and Spintronics.

Morphological and molecular characterization of mycotoxigenic black aspergilli isolated from raisins, onion, and fig samples

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Contamination by various *Aspergillus* species during storage and drying poses significant health risks to agricultural products such as onions, raisins, and figs. In onions, black aspergilli, particularly *Aspergillus welwitschiae*, were identified in 37 out of 40 samples from the Taif region, Saudi Arabia. Although no ochratoxins were detected, fumonisin B2 was present in 37.5% of the samples, with 18 isolates recognized as potential producers. Raisins in Jeddah, Saudi Arabia, exhibited a high mycological load, with black raisins more contaminated than white ones. *Aspergillus carbonarius* and *Aspergillus niger* were frequently isolated and recognized as potential producers of ochratoxin A (OTA), detected in 70% of raisin samples. In figs, both sun-dried and industrially processed, *Aspergillus welwitschiae* was the most abundant, especially in sun-dried figs. *Aspergillus niger* was also prominent, with significant OTA contamination in sun-dried figs compared to industrial ones. These findings underscore the importance of stringent monitoring and modern drying techniques to minimize toxin production and ensure food safety.

Solar Energy Conversion Systems: Time-resolved Spectroscopy

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Energy demands put a strain on the existing energy systems and require an optimized design for new/clean energy infrastructure. The primary concern for most scientists and technologists is the global energy supply and its impacts on our nature, economy, society, and the peace around us. Solar energy is a promising alternative energy source as the overall capacity is 104 more than the current global energy demand, if fully utilized. Solar energy can be converted into electricity *via* solar cells or into chemical energy *via* artificial photosynthesis systems "solar fuels". Solar energy harvesting is a very complicated process and to achieve high solar-to-energy conversion efficiency a wide range of tools is required to characterize these systems both optically and structurally. In my talk, I will focus on the optical characterization of (1) Light active materials for solar cell application namely, CdSe quantum dots, CdSe/ZnS core/shell quantum dots, and perovskite; (2) Active systems for solar fuels production namely, H2-evolution and CO2 reduction systems. **Time-resolved spectroscopy** is considered one of the main tools to investigate the charge carrier's dynamics and the different catalytic intermediates. During my talk, I will cover briefly the concept of transient absorption spectroscopy (TAS) and show how it is very important tool to understand/optimize different solar energy conversion systems in addition; it can serve many different research groups in UAE in different research areas such as, Physics, Chemistry, and Biology.

Novel approaches for weed management by using natural substances and microorganisms

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Natural compounds and microorganisms continue to play a limited role in weed management and, despite their attractiveness and research progress, only a few of them reached the market. Very often these products have negative characteristics compared to synthetic herbicides, e.g., higher costs of production, lower effectiveness, lack of persistence, and inability to reach and/or penetrate the target weed. However, the challanging situation, due, e.g., to (a) increased demand for organic foods and agro-industrial products; (b) the ban of dangerous herbicides; (c) the increasingly high costs of developing and registering new synthetic active substances; (d) the lack of herbicides registered for minor crops; (e) the forbidden use of chemicals in some natural or humanised environments; (f) the increased awareness of environment protection; (g) the lack of weed-management practices under some conditions; (h) the need to control invasive weeds or weeds in non-agricultural environments, is giving new light and renewed interest in searching natural solutions. Moreover, the advent of new technologies, equipment, and biotechnologies not available only a few decades ago, can be extremely useful in increasing the chances of discovering biocontrol agents and natural compounds, facilitating their production and distribution, elevating their aggressiveness and effectiveness, and more precisely determining the risks of their release. Moreover, spin off companies are introducing novel technological and scientific approaches that appear very promising. The brief presentation will offer an overview of new natural compounds and microorganisms used in weed management, discussing the limits and perspectives of their application.

Nutritional improvement of wheat using TILLING, transgenesis and genome editing

Prof. Stefania Masci

Department of Agriculture and Forest Sciences (DAFNE), University of Tuscia, Italy

Wheat is a staple food for a significant portion of the global population, serving as a primary source of essential nutrients, including proteins and starch. However, its nutritional properties can be further enhanced to improve human health benefits. Both classical breeding and biotechnological approaches offer viable strategies to achieve these goals. In my presentation, the findings of our research group in the following areas will be presented: (1) the development of wheat lines with reduced levels of α-amylase/trypsin inhibitors (ATI) to mitigate wheat sensitivity; (2) the production of high-amylose wheat genotypes, which increase resistant starch content and support improved glycaemic control; (3) the enrichment of wheat with provitamin A to aid in combating vitamin A deficiency; (4) the enhancement of microelement bioavailability to address widespread micronutrient deficiencies; and (5) the development of wheat lines with a reduced potential for acrylamide formation in processed products, thereby improving food safety. These targeted improvements can contribute to a better nutrition and health, making wheat an even more valuable component of the human diet.

Plasma technologies for sustainable future

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Plasma, the fourth state of matter, has garnered significant attention in recent years for its ability to offer versatile and transformative solutions across diverse disciplines. Plasma technologies present an environmentally friendly approach with immense potential to drive sustainable innovation across numerous applications. Traditionally utilized in industrial processes such as decontaminant removal (e.g., in semiconductor manufacturing) and improved coating adhesion (e.g., in automotive industries), plasma stands out for its capability to uniformly and rapidly modify surface chemistry, topography, and wettability without altering the bulk properties of materials. Its innovative potential lies in replacing conventional surface preparation methods, often time-consuming and reliant on harsh wet chemistries, with efficient, sustainable alternatives. Plasma is also revolutionizing medicine by enabling the modification of biomaterials for enhanced biocompatibility and antibacterial properties, while use of atmospheric pressure plasma was found highly efficient in chronic wound treatment and recently also for cancer treatments. In agriculture, plasma is emerging as a key technology in sustainable practices, including boosting seed germination, improving water uptake, and decontaminating surfaces by eliminating toxins and fungi. This talk will explore the transformative potential of plasma technologies in advancing sustainability across healthcare, agriculture, and industry, showcasing their role in shaping a more efficient and resilient future.

Xtreme Horticulture for eXtreme environments

Prof. Luca Nardi
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The concept of Extreme Horticulture encompasses innovative agricultural practices tailored for both space and urban extreme environments, addressing the unique challenges posed by limited space and resources. These approaches leverage advanced technologies to optimize food production and sustainability, particularly in such constrained and harsh environments. Space farming is crucial for long-term space missions and future settlements on celestial bodies because it addresses the above-mentioned challenges through Bioregenerative Life Support Systems (BLSSs). These systems aim to create sustainable environments for astronauts by regenerating resources like air, water, and food. Urban farming, on the other hand, focuses on maximizing food production within densely populated city environments, contributing to food security and sustainability. Both forms of agriculture utilize controlled environment agriculture (CEA) precision techniques, such as LED lighting and vertical farming, to optimize growth and resource use. Technologies, such as hydroponics and aeroponics, are pivotal in these settings. They allow for precise control over growing conditions, ensuring optimal plant health and productivity and reducing soilborne diseases despite the harsh terrestrial and extraterrestrial environments. These innovations not only support space exploration but also have significant implications for sustainable practices on Earth. While space farming is primarily focused on extraterrestrial applications, its technological advancements in BLSSs can significantly influence urban agriculture, promoting sustainability and efficiency. Conversely, urban farming's socio-economic benefits highlight the potential for integrating these practices into broader urban planning strategies, enhancing community resilience and food security. In these context, the ENEA focus on Agriculture 4.0 aligns with the integration of advanced technologies to enhance agricultural productivity and sustainability. This approach leverages IoT, AI, and big data to optimize resource use, improve resilience to climate change, and reduce environmental impacts. The development of these cultivation methods and the application of the Food-Water-Energy-Ecosystems Nexus are key strategies in this transition. These efforts are complemented by innovative plant protection models and governance frameworks, aiming to foster a sustainable agro-ecological transition enhancing food security while promoting environmental stewardship on Earth and beyond.

Exploring the Potential of Phyto-Derived Agents in Photodynamic Therapy: Innovations in Cancer Treatment and Beyond

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Lung cancer is one of the most common cancers that affects both men and women and is regarded as the leading cause of cancer-related deaths, while breast cancer is the most diagnosed cancer worldwide. Green nanotechnology is a promising therapeutic option that is adopted in cancer research. *Dicoma anomala* (*D. anomala*) is an African medicinal plant used for the treatment of various medical conditions including cancer. In this study, silver nanoparticles (AgNPs) were synthesized using *D. anomala* MeOH root extract. We further evaluated the anticancer efficacy of the synthesized AgNPs as an individual treatment as well as in combination with pheophorbide a (PPBa) mediated photodynamic therapy (PDT). UV-VIS spectroscopy, high-resolution transmission electron microscopy (HR-TEM), Scanning electron microscopy (SEM), and energy dispersive X-ray spectroscopy (EDS) were used to confirm the formation of D.A AgNPs. Post 24 h treatment, A549 cells were evaluated for ATP proliferation, morphological changes supported by LIVE/DEAD assay, and caspase activities. The results revealed a dose-dependent decrease in cell proliferation in both individual and combination therapy of PPBa-mediated PDT and D.A AgNPs on A549 lung cancer cells with significant morphological changes. Additionally, the LIVE/DEAD assay displayed a significant increase in the number of dead cell populations in individual treatments (i.e., IC50’s treated A549 cells) as well as in combination therapy. In conclusion, the findings from this study demonstrated the anticancer efficacy of green synthesized AgNPs as a mono-therapeutic drug as well as in combination with a chlorophyll derivative PPBa in PDT. Taken together, the findings highlight the therapeutic potential of green nanotechnology in medicine.

Keywords: Cancer; green nanoparticles; silver nanoparticles; *Dicoma anomala*; photodynamic therapy; pheophorbide a

Advancing Regenerative Medicine: Harnessing Photo Biomodulation for Stem Cell Differentiation and 3D Tissue Models

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Adipose-derived stem cells (ADSCs) have gained prominence in regenerative medicine due to their multipotent properties and accessibility. We explored the potential of photobiomodulation (PBM) to enhance ADSC differentiation and overcome in vitro limitations. PBM has been shown to induce neuronal-like trans-differentiation in ADSCs by modulating critical signaling pathways and promoting the formation of neural embryoid bodies, providing promising applications for neuro-regenerative therapies. Investigations into osteogenic differentiation demonstrated the synergistic effects of PBM with hydrogels and differentiation inducers in three-dimensional cultures, enhancing osteoblast maturation and offering potential solutions for osteoporosis treatment. Furthermore, PBM has facilitated tenogenic differentiation, elucidating its role in supporting tendon repair and regeneration. Studies on dose– response effects reveal that optimized PBM parameters significantly influence proliferation and lineage-specific differentiation of ADSCs, whether through single or consecutive irradiation. The integration of PBM into three-dimensional culture systems has further advanced our understanding of stem cell behavior, bridging the gap between in vitro models and clinical applications. These findings collectively underscore the versatility of PBM in stem cell therapy, highlighting its capacity to; enhance ADSC differentiation into neural, osteogenic, and tenogenic lineages. By leveraging PBM's non-invasive properties, these advancements pave the way for innovative strategies in tissue engineering and personalized regenerative medicine.

Keywords: Adipose-derived stem cells; photobiomodulation; osteoblast; tenogenic; trans-differentiation

Circular BioEconomy: Building Africa-Europe Alliances for Sustainable Development and Innovation

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The global challenges of our time require a transformative response, addressing socio-economic inequalities and environmental degradation through a new alliance between the Global North and South. The **Circular BioEconomy** provides a framework to decouple economic growth from environmental harm, prioritizing sustainability, equity, and justice. Grounded on principles of responsible resource use, decoupling economic growth from resource consumption, and fostering behavioral change, this vision leverages advances in biotechnology, digital technologies, and bio-refining to transition to a sustainable future.

Building scientific and technological capacity is crucial for Africa's self-determination and global sustainability. Developing a **network of state-of-the-art laboratories across Africa**, in cooperation with European and international partners, will enhance research in biotechnology, environmental sustainability, and agri-food innovation. Specific research areas include studying microbial diversity in extreme environments to develop bioactive compounds, bioplastics, and biofuels. Investments in infrastructure, education, and leadership are essential to mitigate brain drain and bridge the gap between research and application.

Harnessing Africa's demographic dividend requires bold commitments to education, research, and infrastructure. Graduate and doctoral programs must prioritize critical fields like biotechnology, environmental sciences, and bioinformatics to cultivate the expertise needed for the bioeconomy transition. Investments must address the digital divide and laboratory capacity gaps to empower communities with the tools necessary for sustainable development.

The global food system, accounting for nearly one-third of greenhouse gas emissions, is a critical area for transformation. Sustainable practices, waste reduction, and valorization of by-products are key priorities. Aligning international trade agreements, adopting green technologies, and investing in logistics systems, including cold chains, can strengthen food system resilience. Capacity-building efforts should address migration dynamics as an opportunity to stabilize communities and reduce pressures on urban areas.

Collaboration between Africa and Europe is essential to advancing the Circular BioEconomy. The **ARCA4FOOD alliance** exemplifies this collaboration, uniting multidisciplinary stakeholders, including farmers, scientists, policymakers, and civil society actors, to drive sustainable innovation. ARCA4FOOD's structured, multi-annual work plan mobilizes resources and fosters partnerships to accelerate the bioeconomy transition, with a focus on territorial cohesion and equitable growth.

The Circular BioEconomy offers an unparalleled opportunity to tackle global challenges while fostering economic and social progress. Through coordinated efforts, Africa and Europe can lead the global transition to a sustainable, bio-based economy, setting a benchmark for collaborative development and innovation.

Illuminating Cancer Therapy: Advancements in Photodynamic Therapy Research and Applications

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Photodynamic therapy (PDT) and diagnosis (PDD) are highly topical research for the implementation of alternative and targeted cancer therapy. Central to efficient clinical application of PDT is the development of effective photochemotherapeutic drugs called photosensitizers (PS). PSs must not only provide sufficient killing capacity of cancer cells, but it must also easily and efficiently be absorbed by cancer cells (CC) more so than normal surrounding cells. Activation to produce significant ROS that would activate cell signaling pathways to induce apoptosis is another key characteristic of PSs. PSs with optimal activation and conjugation capabilities allowing both binding to nanoparticles (NP) and providing association with suitable, cancer specific antibodies (AB) were performed. Both CCs and cancer stem cells (CSCs) were targeted. In addition, synergistic effects of phytochemicals with potential as PSs have also been studied. Metallophthalocyanine PSs conjugated to metal-based NPs and cell specific ABs have produced an array of highly effective and efficient multicomponent drugs (MCD) for PDT and PDD. In addition, these newly synthesized MCDs not only target CCs but also CSCs which often cause recurrence and metastasis. An array of highly efficient MCDs have been synthesized and demonstrated to be highly effective in targeting CCs and CSCs and inducing cell death.

Keywords: PDT; PDD; Photosensitizers; Nanoparticles; Targeted PDT

Integrating Photo-biomodulation and Biomaterials for Advanced Diabetic Wound Healing

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Diabetic wounds, also known as diabetic foot ulcers (DFUs), present a significant global healthcare challenge due to delayed healing and a heightened risk of infection. Photobiomodulation therapy (PBM), also referred to as low-level laser therapy (LLLT), has gained recognition as a promising non-invasive approach for enhancing wound healing in diabetic patients. Biopolymers, sourced from natural materials such as polysaccharides, proteins, and nucleic acids, are highly valued for their biocompatibility, biodegradability, and capacity to replicate the extracellular matrix (ECM), making them well-suited for wound healing applications. While traditional treatments often fall short in managing these complex wounds, integrating biomaterials with photobiomodulation has demonstrated promising outcomes, offering a potential advanced solution for improving diabetic wound healing. Our research centre (LRC) on designing biopolymer-based biomaterials to augment the effectiveness of photobiomodulation (PBM) in diabetic wound healing. These biomaterials are integrated with nanoparticles, such as silver, gold, and liposomes, to enhance antibacterial properties, stimulate cellular proliferation, and regulate inflammation. An *in vitro* evaluation was conducted using human fibroblast cells (WS1) to assess the biocompatibility and wound healing potential of these biomaterials under PBM treatment (830 nm, 5 J/cm²). Preliminary results indicate significant improvements in both wound healing outcomes and antimicrobial efficacy. This research underscores the potential of biopolymer-based biomaterials as effective platforms for enhancing PBM therapy, with the aim of advancing clinical applications for chronic diabetic wounds, including diabetic foot ulcers (DFU).

Keywords

Nanoparticles, Wound Healing, Photobiomodulation, Biomaterials, Biopolymers

One Health and Climate Change: A Global Perspective

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One Health is a concept that acknowledges the interconnectedness of human health, animal health, and environmental health: is an approach that recognizes how closely human, animal, and environmental health are linked. It promotes a collaborative, multidisciplinary effort to address health issues that transcend boundaries between these three sectors. By focusing on the interdependence of these domains, *One Health* aims to create solutions that improve health outcomes for all species and the planet as a whole.

Climate change affects all three areas, requiring a unified, comprehensive approach to address these challenges: has a profound impact on human, animal, and environmental health, making the One Health approach even more crucial. Rising temperatures, changing weather patterns, and extreme weather events disrupt ecosystems, lead to the spread of diseases, and threaten food security.

- **Human Health**: Climate change exacerbates risks such as heat-related illnesses, the spread of vector-borne diseases (like malaria and dengue), poor air quality leading to respiratory conditions, and psychological impacts due to extreme weather events and displacement.
- **Animal Health**: Animals experience altered disease patterns, heat stress, habitat loss, and threats to food security. Livestock, in particular, are at risk from heat stress, while fish populations are endangered by changes in ocean conditions. Both wild and domesticated animals are affected by ecosystem disruptions.
- **Environmental Health**: Climate change accelerates the loss of biodiversity, disrupts water availability, and impacts agriculture, ultimately threatening essential ecosystem services like clean water, air, and food. These disruptions harm both human and animal health.

One Health Approach: To effectively tackle these challenges, the *One Health* framework advocates for integrated monitoring, coordinated policies, and sustainable development. Collaboration across sectors like health, agriculture, and environmental management is key to creating solutions.

Global Cooperation: Climate change is a worldwide issue requiring international collaboration. Partnerships across sectors and community involvement are essential to building resilience and promoting sustainability.

In conclusion, the ***One Health*** approach is crucial for addressing the health consequences of ***Climate Change.*** Global cooperation, sustainable practices, and coordinated policies can reduce these impacts and safeguard the health of humans, animals, and ecosystems.

The impact of various fuels on the sol-gel/auto-combustion method for synthesizing NiO nanoparticles for wastewater treatment: Electro- and photo-catalytic techniques

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In the present work, we report the synthesis of nickel oxide (NiO) nanoparticles (NPs) using a simple, low-cost, and eco-friendly sol-gel/auto combustion technique incorporating citric acid, thiourea, and glycine as component fuels. The surface morphology and structure of the investigated NiO nanomaterials were examined using scanning electron microscopy (SEM) and X-ray diffraction (XRD). Furthermore, Diffuse reflectance spectroscopy (DRS) was used to study the optical energy bandgaps. The resulting XRD and SEM data exhibited the NiO nanostructured crystalline structure and a homogeneous distribution of nanoparticles. The XRD results showed the face-centered cubic structure. The crystallinity of the nanoparticles is measured using the Scherrer formula and an average size ranging from 18.37 to 50.92 nm. Electro/photocatalyst degradation studies were carried out in the visible region using organic materials like Methylene Blue dye to improve the efficiency and effectiveness of prepared materials. Further, the sample (2-NiO) thiourea as fuel, had the highest degradation rate and the best electrocatalytic efficiency (97.6 percent) and rate constant (0.15 min^{-1}). Furthermore, we recommended thiourea as the best fuel that is utilized in the synthesis sample (2-NiO), which is the most promising material for M.B. photo/electrocatalysis due to its exceptionally high degradation rate, photo/electrocatalysis efficiency can improve wastewater treatment with their unique nanocomposite.

***Keywords*:** NiO nanoparticles, Sol-gel/auto combustion, Methylene blue dye (MB), Bandgap analysis, electro, and photo/electrocatalytic activity.

A novel of pyrazolo[1,5-a]pyrimidine derivatives as a new class of antiinflammatory agents targeting COX-2 and LOX-5 with *in-silico* ADMET and molecular docking simulation

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Inflammations indicate the progression of various biological complications and are mediated by the cyclooxygenase and lipoxygenase pathways, which facilitate the release of arachidonic acid metabolites. In this study, a new series of pyrazolo[1,5-*a*]pyrimidine was designed and synthesized based on the reaction of 5-aminopyrazole with *α-β*-unsaturated carbonyl or nitrile reagents. The structure of the designed derivatives was confirmed using spectroscopic data, including (IR, H/C NMR) and elemental analyses. Firstly, the *in-silico* virtual screen was carried out inside more than one crystal structure (PDB: 3LN1 and 3MQE), and the results demonstrated a binding affinity comparable to that of the cocrystallized ligand in both cases, suggesting that the designed derivatives may similarly interact with the pocket. Additionally, the synthesized derivatives were screened *in vitro* for their inhibition of COX-2 activity, with results demonstrating moderate to favorable IC50 values in nanomoles when compared to celecoxib, which served as a positive control. The structure-activity relationship (SAR) study was analyzed to elucidate the influence of various substituents on the pyrazolo[1,5-*a*]pyrimidine nucleus. Furthermore, the most potent compound was evaluated against LOX-5, revealing an IC50 value of 2.3 ± 0.10 μM in comparison to zileuton (IC50 = 1.50 ± 0.10 μM), suggesting that this compound exhibits its anti-inflammatory effects through dual inhibition. The drug-likeness, physicochemical properties, and toxicity prediction were also assessed, with findings indicating promising oral bioavailability and a nontoxic profile. Molecular docking simulations within the active sites of COX-2 and LOX-5 demonstrated various types of interactions, yielding strong binding affinities.

Dual Optical Sensing of Methylene Blue in Aqueous Solutions Using Ce-BTC@MCC Composite

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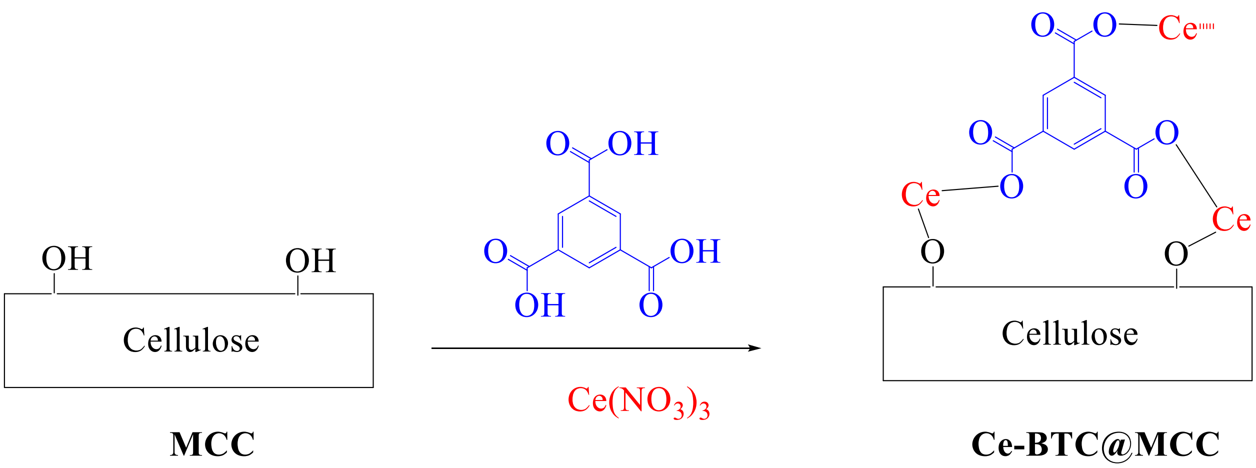
Methylene blue (MB), a non-biodegradable and potentially carcinogenic dye, poses significant risks to human health and environmental safety. The detection and quantification of MB in water are crucial for monitoring water quality. This study presents a novel dual optical sensing approach using a cerium-based metal-organic framework anchored to microcrystalline cellulose (Scheme 1), Ce-BTC@MCC, synthesized and characterized through FTIR, SEM, EDX, XRD, and EBT techniques. The dual sensing is based on two modalities: (1) the utilization of Ce-BTC@MCC composite powder and (2) an optical sensing film composed of Ce-BTC@MCC integrated with carboxylate-poly(vinyl chloride). Fluorescence emission at 677 nm (excitation at 611 nm) was employed for MB quantification. The developed optical sensing methods demonstrate high selectivity, reversibility, very low detection limit and high selectivity. Linear detection ranges of 10–200 ppb for the powder-based mode and 25–200 ppb for the film-based mode, with detection limits of 2.73 ppb and 4.03 ppb, respectively. Both modes exhibited high selectivity towards MB in the presence of commonly coexisting industrial dyes such as Congo Red, Indigo Carmine, Malachite Green, Bromophenol Blue, Methyl Orange, and Rhodamine B. Validation through spiking studies in tap and wastewater samples yielded recovery rates between 91.1% and 106.8%, confirming the robustness and applicability of the proposed methods.
These findings highlight the potential of Ce-BTC@MCC-based dual optical sensing systems for real-time monitoring of MB in environmental water sources.



Scheme 1. The formation mechanism of Ce-BTC@MCC composite

Development of a Mn-Mo@Sulfur-Doped Carbon Xerogel Sensor for Sensitive Lamotrigine Detection: Characterizations and Applications

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A novel low-cost voltammetric sensor based on the modification of a glassy carbon electrode (GCE) with sulfur-doped carbon xerogel/manganese/molybdenum (Mn-Mo@SCX/GCE) was developed for the determination of lamotrigine (LTG) in its pure form, pharmaceutical preparations, and real samples. The prepared nanocomposite was characterized using HRTEM, SEM, and XRD. The performance of the developed sensor for electrocatalytic oxidation of LTG was investigated using cyclic voltammetry (CV), differential pulse voltammetry (DPV), and electrochemical impedance spectroscopy. The obtained data revealed that Mn-Mo@SCX/GCE increased the anodic peak of LTG compared to the pristine GCE. The impact of different parameters was studied, e.g., nanocomposite amount, surface area, scan rate, pH, and accumulation time. A linear calibration was obtained for LTG in the range of 20 nM - 43.04 µM with a correlation coefficient of 0.982. The limit of detection (LOD) and limit of quantification (LOQ) were calculated to be 15 pM and 47 pM, respectively. The analytical method validation parameters were investigated, and the developed sensor showed good accuracy, selectivity, excellent repeatability and reproducibility, and high sensitivity. Finally, the proposed analytical method was successfully applied for the quantification of LTG in its dosage forms as well as human serum and urine samples with high recovery results.

Unveiling the Hidden Threats in Fish Imported Feed: Contamination and Its Effects on Aquaculture in Egypt

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The Egyptian fish industry relies on local and imported feed ingredients, such engredients are susceptible to fungal contamination during transportation, processing, and most probably during storage. Prolonged storage increases the risk of natural toxin exposure, leading to higher fish mortality and a noticeable reduction in production. This study assessed both quality and safety of processed fish feed in Egypt, with a special focus on fungal contamination. Feed samples from three governorates: Cairo, Dakahlia, and Kafr El Sheikh were analyzed. Fusarium species, Aspergillus flavus, and Aspergillus parasiticus were identified using standard identification keys, and toxins were quantified via spectrophotonetric analyses.

Results revealed 29 different fungal isolates, included four toxigenic species, where fungal counts ranged from 2.2×10^2 to 6.07×10^4 CFU/g. Aflatoxigenic Aspergilli constituted 34.6% of the identified toxigenic isolates. Fish fed diets containing 2.884–11.546 µg/kg afla B1 exhibited severe gill damage, including epithelial hyperplasia and lamellar degeneration. Diets with 6.066–11.546 µg/kg afla B1 caused hepatocyte degeneration in the liver, while kidneys remained unaffected. Despite feed samples meeting permissible aflatoxin limits in Egypt, adverse health effects on fish were observed.

Additionally, two mycotoxins, Beauvericin (15.776 µg/L) and Diacetoxyscirpenol (<3.037 µg/L), were produced by Fusarium oxysporum. These findings highlight the potential contamination of fish feeds by mycotoxins, emphasizing the need for regular monitoring of feed ingredients, particularly imported ones through hygienic practices during processing and storage. The study highlights the risks of contaminated feed ingredients and underscores the importance of using effective mycotoxin adsorbents to safeguard fish health and performance. The increased awareness of mycotoxin issues in aquaculture is essential to mitigate their impact on fish and address potential consumer health risks due to toxin residues in fish tissues.

Solutions to Enhance Wheat Grain Quality using Mycorrhizal formulations for Water-Stressed Calcareous Soils

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Arbuscular mycorrhizal fungi (AMF) are increasingly recognized for their role in enhancing food security by improving crop yield and quality. This study investigated the impact of native AMF, formulated with alginate and biochar carriers, on the yield and quality of wheat (Triticum aestivum L.) grown under water-deficient conditions. A field experiment at Mariout Research Station, Alexandria, Egypt, evaluated the effects of two AMF species—Acaulospora spinosa (PP789659) and Glomus ambisporum (PP812667)—on wheat grain yield, protein content, and mineral concentrations in calcareous soil under three irrigation intervals (W1, W2, and W3 corresponding to 1, 2, and 3 weeks, respectively). The mycorrhiza-biochar formula demonstrated the highest efficacy, increasing protein content by 25%, 22%, and 39% and grain yield by 15.9%, 16.1%, and 42.3% under W1, W2, and W3, respectively ($p < 0.05$). AMF treatments significantly enhanced the concentrations of P, K, and Zn in wheat grains, with the mycorrhiza-biochar formula particularly increasing Zn and Fe bioavailability compared to uninoculated controls. These findings highlight the potential of AMF inoculation to improve protein content, mineral enrichment, and the bioavailability of essential micronutrients in wheat grains cultivated in calcareous soils.

Keywords:

Arbuscular mycorrhizal fungi (AMF); Acaulospora spinosa; Glomus ambisporum; Formula solution; Biochar and Alginate; Calcareous soils.

Impact of total phenolic compounds on ecological and health risks of water and sediments from Timsah Lake, Suez Canal, Egypt

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This study aimed to measure spatial and temporal distributions of total phenolic compounds and their ecological and health hazards using UV-vis spectrophotometers as a low-cost, fast, simple method in water and sediments collected from Timsah Lake, Suez Canal, Egypt, 2022. Also, assessing highly adaptive fungal species associated with contamination is designed. Due to human and environmental activities and industrial waste discharges, Timsah Lake is increasingly threatened by all kinds of pollutants. The results indicated that the seasonal concentration means of the phenolic compounds were winter (0.229) > spring (0.161) > summer (0.124) > autumn (0.131) mg/l and winter (3.08) > summer (2.66) mg/g in water and sediment samples, respectively. The result has shown that the phenol concentrations in all stations were more than 0.005 and 0.1 mg/l for Egyptian National Standards and World Health Organization (WHO) for drinking water but less than the limits of 1 mg/l for wastewater. Notably, the fungi recorded the highest counts during spring, totaling 397 colonies/100 ml of water and 842 colonies/gram of sediment. Four isolates of fungi were identified and deposited in the GenBank database by *Aspergillus terreus*, *Aspergillus terreus*, *Penicillium roqueforti*, *and Penicillium rubens* under accession numbers OR401933, OR402837, OR402878, and OR424729, respectively. Moreover, ecological risk (RQ) for the total phenolic compounds was > 1 in all investigated stations for water and sediments. The hazard quotient is HQ < 1 in all seasons in water and sediments except winter. The hazard index (HI) in water and sediments for children is higher than for adults. It can be concluded that the low-cost, fast, simple method for determining phenolic content in water and sediment samples, using UV-vis spectrophotometry, was useful for predicting the reactivates of a wide variety of phenol and their derivatives. Furthermore, it can be concluded that Periodic assessments of water quality and strict regulations are necessary to safeguard this vital resource from pollution and ensure the well-being of future generations. Finally, policymakers and water treatment specialists might use the information from this research to reduce these chemical pollutants in Egypt.

Keywords

Phenolic compounds · Water · Sediment · Ecological risks · Health risks, Timsah, Suez Canal, Egypt.

EFFECTS OF RED-BILLED QUELEA INVASION ON AGRICULTURAL PRODUCTION IN DANGE-SHUNI LGA, SOKOTO STATE NIGERIA

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Red-billed Quelea is a small Sub-Saharan African bird which is also regarded as the most abundant and destructive bird species in the world. These birds are long-distance migrants whose migration is determined by suitable breeding conditions that are influenced by rainfall patterns. In northern Nigeria, Red-billed Quelea birds are abundant especially in Sokoto, Kebbi, Zamfara, and Katsina States. Dange-shuni LGA of Sokoto state has been one of the major areas suffering from Quelea bird attacks. For instance, in August 2022, there were serious attacks of Quelea birds in Dange-Shuni LGA; where crops worth millions of Naira destroyed. Despite the government and farmer's efforts to reduce the menace of the bird, Red-billed Quelea devastation of crops continues to be one of the major challenges that militating food security in the area. This research seeks to assess the effect of the Red-billed Quelea invasion on agricultural production in the area. Data were collected from sample of 360 respondents in eight purposively selected villages using questionnaire, which was selected based on the severity of the incident. The result were analyzed using descriptive statistics, qualitative analysis and the inferential statistics (paired sample t-test). Moreover, Key Informant Interview (KII) was conducted for more information on governmental efforts and planning towards ending the menace of the Quelea bird in the state. The stakeholders were interviewed included staff from the Ministry of Agriculture, and some leaders from the All Farmers Association (AFAN), Sokoto state chapter. However, possible recommendation will be made based on the empirical findings.

Synthesis, characterization, antioxidant and anti-inflammatory studies of modern synthetic tetra phenyl porphyrin derivatives

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Embarking on the frontier of molecular innovation, this study focuses on the synthesis and characterization of a new class of porphyrin derivatives—specifically, the 5, 10, 15, 20-tetrakis (3-bromopropoxyphenyl) porphyrins. Through meticulous synthetic methodologies, these novel derivatives are crafted, strategically incorporating bromopropoxyphenyl moieties at distinct positions within the porphyrin framework. This research aims to unravel the structural intricacies and explore the potential applications of these compounds through a detailed characterization utilizing advanced analytical techniques. 5, 10, 15, 20, tetrakis (4-hydroxyphenyl) porphyrin was synthesized by treating pyrrole and *p*-hydroxylbenzaldehyde.5,10,15,20,Tetrakis-(4-hydroxyphenyl)was converted into 5, 10, 15, 20, tetrakis (4-bromoalkoxyphenyl) porphyrin. 5,10,15, 20-Tetrakis -(4-bromoalkoxyphenyl) porphyrin was treated with Isopropyl phenol, para-Aminophenol, hydroquinone, 2-Naphthol, 1-Naphthol and Hydroquinone and different derivatives of ether linked were obtained the synthesized compounds were analyzed using contemporary spectroscopic techniques like UV-Vis, NMR and Mass spectrometry The synthesized compounds were also tested for their biological activities like antioxidant and anti-inflammatory

Smart nanotechnology and repurposing tactics for fostering therapeutic and cosmeceutical activity of an anti-androgenic drug

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Drug repurposing strategy has become a cutting-edge viable strategy that works on overcoming the tedious, long-term, expensive drug discovery process. Synchronizing this tactic with nanotechnology as one of the most advanced drug delivery techniques has combined tremendous advantages in this study. The anti-androgenic drug spironolactone (SP) was loaded on two biodegradable nanofiber scaffolds. This fabrication process aimed to maximize SP repurposed dermatological uses, avoiding its severe systemic side effects and increasing rosacea and acne patient compliance. The scalable cost-effective electrospinning method was used in the formulation of NFs while Polyvinylpyrrolidone (PVP) and Polycaprolactone (PCL) were used as fabricating polymers. Scanning electron microscopy showed that SP-PVP NFs and SP-PCL NFs have smooth homogenous surfaces with a diameter size of about 426.6 nm and 500 nm respectively. The entrapment efficiency for SP-PVP NFs is 96.34%± 1.2 and its loading capacity of 11.89% ± 0.15. The mechanical properties and solid state of NF scaffolds were evaluated and the obtained values showed the durability of the prepared scaffolds. *Ex vivo* studies showed that SP percentage retained in the skin after applying NFs was higher than pure SP gel. Stability and *in vivo* safety results showed that the produced nanofibers are stable and safe. SP-PVP NFs and SPPCL NFs anti-rosacea and anti-acne pharmacological effects were evaluated via two different *in vivo* models. The obtained results showed a significant boost in SP-repurposed dermatological activity. It was concluded that SP-loaded nanofibers are safe promising carriers and can maximize several repurposed dermatological uses of SP.

Synthesis of new quaternized chitosan Schiff bases and their N-alkyl derivatives as antimicrobial and anti-biofilm retardants in membrane technology

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New quaternized salicylidene chitosan Schiff bases (QSCSBs) and their N-octyl derivatives (OQCs) have been synthesized and characterized, aiming to develop innovative antimicrobial and anti-biofilm agents. This research holds immense potential, as these compounds could be utilized as anti-biofouling additives in membrane technology in the future. The synthesis involved the modification of low molecularweight-chitosan (LMC) through simultaneous Schiff base formation and quaternization processes to create QSCSBs. Subsequently, QSCSBs were catalytically reduced to form quaternized N-benzyl chitosan (QBCs) intermediates, which then underwent nucleophilic substitution reactions affording N-octyl quaternized chitosans (OQCs). Characterization techniques such as elemental, spectral, and microscopic analyses were used to confirm the successful synthesis of these materials. As membrane technology relies on surface charge, QSCSBs and OQCs with large zeta potentials could be used as positively charged additives. Moreover, SEM image revealed the regular distribution of pores and voids across the additives' surfaces raises intriguing questions about their implications for membrane perfor mance. Meanwhile, the superior antibacterial and antibiofilm potential of these materials, particularly QSCSB2 and OQC2, indicate that the utilization of these compounds as anti-biofouling additives in membrane technology could significantly improve the performance and longevity of membranes used in various applications such as water treatment and desalination.

Different concentrations of silver nanoparticles trigger growth, yield, and quality of strawberry (*Fragaria ananassa* L.) fruits

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The application of nanoparticles (NPs) in horticultural crops is in a tremendous increase. NPs help in the overcoming of stresses with positive impacts on plant growth and development. Silver NPs (AgNPs) have numerous pre- and post-harvest applications in agriculture. This study aimed to evaluate the effect of AgNPs application (0, 50, 100, 150, 200 ppm) at three spray intervals (5, 10, 15 days) on the morphological and compositional traits, and defense system of strawberry. Results showed that AgNPs application enhanced the growth, yield, quality and nutritional as-pects of strawberry grown under field conditions. Shoot fresh weight and leaf number/plant were enhanced at 100 ppm AgNPs; whereas, shoot dry weight, root fresh and dry weights were significantly improved with 50 ppm AgNPs. A stunted growth of strawberry plants was record-ed at 200 ppm AgNPs. Moreover, a 15 day-spray interval was found optimum for the improve-ment of major morphological traits. Fruit size, yield, total soluble solids (TSS), acidity, and an-tioxidant capacity were improved at 50 and 100 ppm AgNPs. The activation of plant defense sys-tem i.e., SOD, POD, CAT, total soluble protein, and ascorbic acid was improved under AgNPs foliar application. The activation of stress indicating marker MDA outlined a high defense response of strawberry at 150 ppm AgNPs. Conclusively, AgNPs application at 50, 100, and 150 ppm can be considered effective for sustainable strawberry production.

Keywords: Abiotic stress, Enzymatic activity, *Fragaria ananassa*, Growth, Morphological traits, Plant adaptive response, Yield.

Resonant-State Expansion for Non-Relativistic Wave Equation in One Dimension

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The resonant state expansion (RSE), a rigorous perturbation theory recently developed in electrodynamics, is here applied to non-relativistic wave equation in one dimension. The resonant state (RSs) of a symmetric double quantum well structure superimposed by a combination of delta functions was first calculated. These RSs are then taken as an unperturbed basis for the calculation of RSE. The resonant state expansion is first verified for triple quantum well systems, showing convergence to the available analytic solution as the number of basis resonant states increases. The method is then applied to more complicated systems such as multiple quantum well and barrier structures. Results are compared with the Eigen solution in triple quantum wells and infinite periodic potentials, revealing the nature of the resonant states in the studied systems.

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Exploring the implications of Ternary Jeffrey Nanofluid on Pulsating Flow and Heat Transfer through unsymmetrical Corrugated Micro Conduit

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Pulsatile flow occurs in medical devices, impacting heat transfer and fluid behavior. It has practical significance in several disciplines, including thermodynamic devices. Pulses in flow and pressure influence pipe systems, reciprocating pumps, and compressors. Motivated by this, we simulated corrugated microchannel with Jeffery fluid flow enhanced by tri-nanoparticles to investigate this type of flow in detail. The model assumed that, in addition to external temperature influences, conduit walls experience electric and magnetic fields, governed by momentum and heat equations, along with electric potential and pulsing pressure equations. Using the perturbation method and Mathematica software, we derived semi-analytical solutions for the governing partial differential equations in their complex form. nanoparticle-enhanced blood exhibits improved thermal performance compared to pure fluid, with the type and concentration of nanoparticles (Fe_3O_4, Au, SWCNTs) significantly impacting heat dissipation and temperature distribution within the microfluidic conduit. Higher nanoparticle concentrations increase liquid viscosity, reducing velocity inside the conduit; however, a magnetic field can reverse this effect. This study underscores the application of pulsatile flow in heart pumps, where optimizing thermal characteristics can enhance device efficiency and patient outcomes.

Role of lncRNAs in Breast Cancer Development and Progression: A Molecular Insight

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Breast cancer is the most prevalent cancer among women worldwide, emphasizing the need for novel prognostic markers and therapeutic targets to improve patient survival and quality of life. Long noncoding RNAs (lncRNAs) have been shown to regulate gene expression and are involved in various cancerrelated processes. This study aimed to investigate the role of 10 specific lncRNAs in the development and progression of breast cancer. Expression levels of these lncRNAs were analyzed in RNA extracted from tissue samples of 80 breast cancer patients and 20 healthy controls using quantitative real-time PCR (qRTPCR). The correlation between lncRNA expression and clinicopathological characteristics was assessed using linear regression.

The results revealed significant upregulation of **GAS-5**, **XIST**, **MALAT1**, **UCA-1**, and **HOTAIR** in breast cancer tissues compared to controls. In contrast, **HIF-1**, **RIST**, **PTC**, **ANRIL**, and **Linc-00086** did not show significant changes in expression. Further analysis revealed that **MALAT1** and **XIST** were associated with the **luminal B subtype**, while **HOTAIR** and **UCA-1** were linked to **triplenegative breast cancer (TNBC)**.

These findings underscore the critical role of specific lncRNAs in breast cancer progression and subtyping, suggesting their potential as diagnostic, prognostic, and therapeutic targets. However, further research is needed to elucidate their precise molecular mechanisms and clinical applications. This study paves the way for using lncRNAs as biomarkers for breast cancer management and highlights their promise in personalized medicine.

Impact of GSPP certification on the phytosanitary quality of tomato seedlings in the nursery

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Tomato production and commercialization represent one of the main sectors of the national economy. Unfortunately, this crop is hindered by bacterial canker, a bacterial disease caused by *Clavibacter michiganensis* subsp. *michiganensis* (*Cmm*), which causes significant damage. For decades, several research efforts have been carried out to control this pathogen, particularly through chemical and biological control methods. However, these methods serve as preventive measures for tomato plants.

Since 2009, the GSPP (Good Seed and Plant Practices) prevention system has been implemented among seed producers and nurseries (plant producers). This system is based on strict hygiene measures. GSPP is an international transparent system for managing and preventing risks associated with *Clavibacter* in tomato cultivation. In order to evaluate the effectiveness of this system on tomato plants, we conducted isolation tests for *Cmm* on selective and semi-selective culture media, followed by molecular testing.

This study demonstrated that the rigorous application of good seed and plant practices standards and implementation of strict sanitary measures significantly reduce the risk of contamination of grafted tomato seedlings by *Clavibacter michiganensis* subsp. *michiganensis* in a commercial tomato nursery.

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Structural, Optical, and Antifungal Effect of Zinc Oxide Nanoparticles Prepared by Ball Milling Route

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This research is focused on the preparation of zinc-oxide nanoparticles (ZnO-NPs) via ball milling with various particle sizes by changing the time of milling and studying its characterization by employing xray diffraction technique (XRD), Fourier Transform Infrared spectroscopy (FT-IR), Atomic force microscopy (AFM) and Raman spectroscopy. The morphology and size of ZnO nanoparticles were determined by Transmission Electron Microscope (TEM), zeta potential, and dynamic light scattering (DLS), and determine the absorption, absorption index, reflectance, and energy gap by spectrophotometer. The properties of the antifungal effect on Sclerotinia sclerotiorum fungi were studied.

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