

# College of Arts & Sciences Department of Biological & Environmental Sciences

17<sup>th</sup> Qatar University Life Science Symposium (QULSS 2024)

Exploring Biotechnology for a Sustainable Circular Bioeconomy

13 – 14 November 2024 Qatar University, Research Complex

**Symposium Program, Abstracts & Posters** 



















# **QULSS 2024**

Qatar University Life Sciences Symposium

# 17<sup>th</sup> EDITION

### **Exploring Biotechnology for a Sustainable Circular Bioeconomy**

A two-day symposium will be held on the 13<sup>th</sup> and 14<sup>th</sup> of November 2024 at Qatar University, organized by the Department of Biological and Environmental Sciences (College of Arts and Sciences) **Objective One:** Emphasize the potential of biotechnologies in advancing a circular bioeconomy.

**Objective Two:** Biotechnologies hold significant promise in Qatar's future, especially in the realm of research and development.

**Objective Three:** Innovative applications of biotechnologies and their integration into industrial sectors

Symposium's Date

13-14th November 2024

On November 13-14, 2024, QULSS will mark its

17 th edition

#### Symposium's Title

Exploring Biotechnology for a Sustainable Circular Bioeconomy

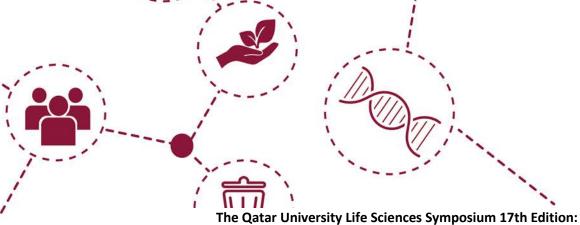
#### Symposium's Themes

- Agricultural and Food Biotechnology
- Bioremediation and Bioenergy for a Sustainable Environment
- Marine Biotechnologies and Aquaculture
- Entrepreneurship for Building Sustainable Circular Bioeconomy
- Transfer of Biotechnologies and Start-up Creation

We are looking forward to seeing you at the Symposium!

For more information, please contact the Department of Biological and Environmental Science, College of Arts and Sciences, Qatar University. P.O. Box: 2713 Doha – Qatar, Tel: 00974-4403-4534 Fax: 00974-4403-4531, <a href="http://www.qu.edu.qa/artssciences/">http://www.qu.edu.qa/artssciences/</a> Email: <a href="headdepbiological@qu.edu.qa">headdepbiological@qu.edu.qa</a>







"Exploring Biotechnology for Sustainable Circular Bioeconomy"

13-14 November 2024

9:00 am - 3:00 pm

**Qatar University, Research Complex H10-G103** 

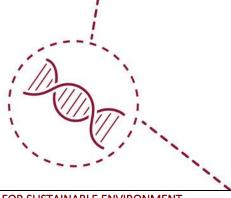
	DAY 1: Wednesday 13 <sup>th</sup> No	ovember 2024		
08.00-09.00	Registration & Reception			
OPENING CEREMONY				
09.00-09.05	- Prof Fatima Al-Kubaisi			
	Dean of the College of Arts and Sciences			
09:05-09:10	(CAS-QU)			
ļ	- Prof Mohammad Al-Ghouti			
ļ	Head of the Department of Biological and			
09:10-09:30	Environmental Sciences (CAS-QU)			
ļ	- Eng. Hamad S. Al-Shamari	Priorities of Research in Biotechnology in Qatar		
	Director of Agricultural Research Department,			
6 : 4 4 6 7	Ministry of Municipality, Qatar			
	RICULTURAL AND FOOD BIOTECHNOLOGY rof Samir Jaoua			
Moderator: Pi	TOI Salliir Jaoua			
09:30-10:10	Prof Yowahan Son	Nature-based solutions for sustainability: Focusing		
(40 min)	Division of Environmental Science and Ecological	on vegetation introduction in arid regions		
	Engineering, Korea University, South Korea			
10:10-10:40	Prof Essaid Ait Barka	Unlocking Resilient Agriculture: Exploring Beneficial		
(30 min)	Vice-President Delegated to the European	Bacteria-Plant Interactions Against Biotic and		
	Alliance INVEST, University of Reims Champagne-	Abiotic Stresses		
	Ardenne, France			
10:40-11:10	Prof Slim Tounsi	Circular Bioeconomy for Sustainable Agriculture		
(30 min)	General Director, Center of Biotechnology, Sfax	through biopesticides development		
	University Tunisia			
11:10-11:30	Dr Iman Saleh	Prosopis juliflora waste-to-value: leaf extract		
(20 min)	Department of Biological and Environmental	effectiveness against Mango post-harvest diseases		
	Sciences, College of Arts and Sciences, Qatar			
	University			
11:30-12:00	Coffee break and Refreshments			













Session 2: BIOREMEDIATION AND BIOENERGY FOR SUSTAINABLE ENVIRONMENT			
Moderator: Prof Mohammed Abu-Dieyeh			
12:00-12:40 ( <b>40 min</b> )	Prof Ibrahim Banat School of Biomedical Sciences, Faculty of Life and Health Sciences -University of Ulster, Northern Ireland, United Kingdom	Microbial Biosurfactants: Trends and Potential Application in Environmental, Agricultural, and Biomedical Industries	
12:40-13:10 (30 min)	Dr Suhur Saeed Water Management head at ExxonMobil Qatar, Qatar	Biochar and Microbes: Sustainable Technologies for Bioremediation of Industrial Effluents	
13:10-13:40 (30 min)	Prof Mohammad Trigui Head of the research Laboratory "Environmental Sciences and Sustainable Development, Sfax Preparatory Engineering Institute, Sfax University- Tunisia	Moving towards a sustainable circular bio-economy in the agriculture sector	
13:40-14:00 (20 min)	Dr Haneen Al Dous Postdoctoral Associate in Microbiology and Immunology at Weill Cornell Medicine-Qatar	Novel approach in treating industrial wastewater using metal-organic framework nanoparticles impregnated with biosurfactants	
14:00-15:00	Lunch		

DAY 2: Thursday 14 <sup>th</sup> November 2024		
Session 3. MA	RINE BIOTECHNOLOGIES AND AQUACULTURE	
Moderator: Pr	of Jassim Al-Khayat	
09:00-09:40	Prof Sergey Dobretsov	From ocean to innovation: sustainable frontiers in marine
(35 min)	UNESCO Chair in Marine Biotechnology,	biotechnology
	Centre of Excellence in Marine	
	Biotechnology, Sultan Qaboos University-	
	Sultanate of Oman)	
09:40-10:00	Dr Probir Das	The application of aquaculture wastewater-grown
(20 min)	Research Associate Professor/ Algal	microalgal biomass and catering waste as feed
	Technology Program/ Center for Sustainable	ingredients for sustainable aquaculture
	Development, Qatar University, Qatar	
10:00-10:20	Dr Victor Rosas	Replacement of by-product fishmeal with insect meal in
(20 min)	Aquaculture Nutrition Specialist,	diets for <i>Penaeus vannamei</i> : effects on growth and health
	Postdoctorate in Shrimp cultured in Bioflocs	
83	Systems, Environmental Sciences Center,	
	Qatar University	
10:20-10:45	Coffee break and Refreshments	



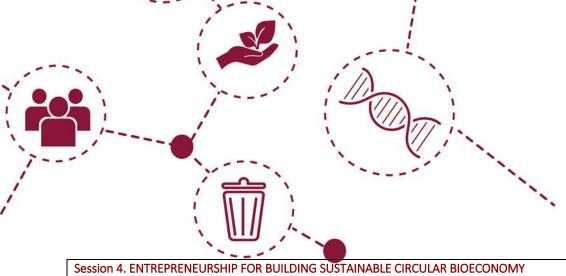
All day

Poster session











Session 4. ENTREPRENEURSHIP FOR BUILDING SUSTAINABLE CIRCULAR BIOECONOMY				
Moderator: Prof Sami Sayadi				
10:45-11:05	Dr Mohammad Ismail Ibrahim	Latest innovations in drug synthesis and production		
(20 min for	Academia Segment Manager- Middle East-			
ITS sponsor)	Merck-Kingdom of Saudi Arabia			
11:05-11:25	Dr Ashwag Binmahfooz	Gene Editing for Next Generation Food		
(20 min for	Segment Manager of Academia II Merck			
ITS sponsor)	KGaA Darmstadt Germany, Middle East-			
	Saudi Arabia			
11:25-11:50	Dr Anis Larbi	Sensitivity, accuracy, reproducibility and flexibility: key		
(25 min for	Beckman Coulter Life Sciences, France	elements of biotechnology for R&D, manufacturing and		
MedTech		QC.		
sponsor)				
11:50-12:10	Prof Ahmed Ali Khalifa	Walking the Circularity Talk: Evidence from Case studies		
(20 min)	College of Business and Economics, Qatar	and Research		
	University, Qatar			

12:10-13:00 Session 5. Biotechnologies, for transfer of technology and start-up creation (Panel discussion)

Moderator: Prof Said Elbanna, Director of Center for Entrepreneurship and Organizational Excellence, Qatar University)

Panel: Prof Ibrahim Banat; Prof Ahmed Ali Khalifa; Prof Sergey Dobretsov; Prof Samir Jaoua

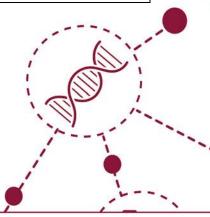
#### 13:00-13:30 Closing, gift given to the keynote speakers & awards to the winners

- **Prof Mohammad Al-Ghouti** (Head of the Department of Biological and Environmental Sciences (College of Arts and Sciences)
- **Prof Nabil Zouari** (Chair of QULSS-2024, Department of Biological and Environmental Sciences, College of Arts and Sciences)

All day	Poster session
13:30-14:00	Lunch
14:00- 17:00	Visit to Agriculture Research Station Farm



















# Department of Biological & Environmental Sciences, College of Arts & Sciences, Qatar University, Doha-Qatar

Prof. Mohammad Al-Ghouti

Prof. Nabil Zouari

Prof. Samir Jaoua

Prof. Mohammed Abu-Dieyeh

Prof. Said Sif

Dr. Hayat Al-Jabiry

Dr. Farzin Shabani

Ms. Sameera Shanawaz Shaikh

Ms. Abeer Al-Mohannadi

Ms. Fatima Ali M. A. Al-Hajri

#### Agricultural Research Station, Qatar University

Dr. Mohammed Alsafran

Center for Sustainable Development, Qatar University

Prof. Sami Sayadi

#### Welcome Message & Preface



Dear QULSS 2024 Delegate,

On behalf of the Department of Biological and Environmental Sciences, I am delighted to welcome you to the Qatar University Life Sciences Symposium 2024 (QULSS 2024). Our department stands out for its diversity, with a team of exceptional faculty and staff, high research productivity, and a robust network of stakeholders at national and international levels. With our wide-ranging undergraduate and graduate programs, we proudly position ourselves as a unique and desirable destination for both prospective students and faculty.

We offer two undergraduate programs: a BSc in Biological Sciences and a BSc in Environmental Science. The Biological Sciences Program, available to female students only, provides a solid foundation in biological sciences, equipping students to lead in emerging fields, markets, and policy discussions. The Environmental Science program is available in two concentrations: Marine Sciences and Biotechnology, both accredited by CHES (UK). At the graduate level, our MSc in Environmental Science (also CHES-accredited) can be pursued full-time or part-time, while our PhD in Biological and Environmental Sciences offers four concentrations: Cell & Molecular Biology, Environmental Science, Ecosystem & Marine Science, and Biotechnology. Additionally, a new Graduate Certificate in Environmental Sciences is designed to prepare students and professionals for further graduate studies, with the potential to join the second year of the MSc program upon meeting performance standards. Our department seeks bright, motivated, and diligent students who aspire to lead professionally or scientifically, contribute to their fields, and serve Qatar and Qatar University.

This year, QULSS celebrates its 17<sup>th</sup> anniversary, with panels addressing scientific research, collaboration, and future biological and environmental solutions. Since its inception in 2007, the symposium has served as a hub for research, dialogue, and leadership in the biological and environmental sciences at Qatar University. Over the years, the Department of Biological and Environmental Sciences has united researchers from around the world to pioneer advancements in biological and environmental science, partnering with experts from academia, government, and industry across Qatar and beyond. Below are the previous QULSSs and their themes:

- ✓ QULSS 2024: Exploring Biotechnology for a Sustainable Circular Bioeconomy
- ✓ QULSS 2023: Eco-friendly Sustainable Solutions for a Green Desert Environment
- ✓ QULSS 2022: The event was canceled because of the FIFA World Cup 2023
- ✓ **QULSS 2021**: Virtual due to Covid-19 Pandemic): Marine Resources: Conservation, Production and Sustainable Development
- ✓ QULSS 2020:(Virtual due to COVID-19 Pandemic): Epidemics and their Impacts on Environment and Society
- ✓ QULSS 2019: Plant Biotechnology and Sustainable Agriculture -Innovations towards Food Security
- ✓ **QULSS 2018:** Food Systems and Technology: Advancing Food Production

- ✓ QULSS 2017: Water Resources and Management: Future Challenges
- ✓ QULSS2016: Biodiversity, sustainability and climate change, with perspectives from Qatar
- ✓ QULSS 2015: Global change: The Arabian Gulf Ecosystem
- ✓ QULSS 2014: Molecular Cancer Research
- ✓ QULSS 2013: Environmental Health Issues in the GCC
- ✓ **QULSS 2012:** Biotechnology
- ✓ QULSS 2011: Mangrove Habitats, Functioning, Management and Sustainable Development
- ✓ **QULSS 2010:** Marine Environment and Sustainable Development
- ✓ **QULSS 2009:** Date Palm Research, Biotechnology, and Conservation Perspectives
- ✓ **QULSS 2008:** Biological Diversity of Qatar
- ✓ QULSS 2007: Diabetes: Genetics, Environmental Factors, and Therapeutic Strategies

QULSS 2024 includes a spectrum of subjects of the meetings between biotechnology and sustainability, centered on:

- Agricultural and Food Biotechnology
- Bioremediation and Bioenergy for a Sustainable Environment
- Marine Biotechnologies and Aquaculture
- Entrepreneurship for Building Sustainable Circular Bioeconomy
- Transfer of Biotechnologies and Start-up Creation

The objectives of the QULSS2024 are establishing a platform that facilitates, researchers, scientists, policymakers, and industry professionals to acquire knowledge, converse, and thus initiate partnerships. This symposium will promote innovation and sustainable development novel biotechnological solutions will be achieved by increasing the creativity and the capability to innovate among members of a certain community.

Qatar is overtaking other countries in the science and technology fields, particularly in the areas of food, agriculture, marine, and environmental technologies. A full-fledged biotechnology system is implemented to probe and innovate technologies in various sectors including food and beverage, biopharmaceuticals, and agri-tech. Quickly changing industry through research, development, and innovation is the primary sector along with that this area is growing very fast. Besides the application of biotechnologies, science studies' modus operandi is changing, introducing new capabilities to integrate financial, institutional, and industrial bodies to pursue a commercial venture as well as a societal advancement through biotechnology. QULSS2024 is the 17th anniversary, which reads the highlight key and the other upcoming biotechnologies in Qatar, on the one hand, the other new ideas via diverse sources of expertise apart from showcasing national capabilities to deal with human health and environmental sustainability.

I extend my heartfelt thanks to the scientific committee for their hard work in creating this program. Their collaborative efforts have brought together leading experts and the latest scientific insights to ensure an enriching experience over the coming two days.

We hope you enjoy your time in Doha and look forward to welcoming you back frequently.

Yours Sincerely,

Prof. Mohammad A. Al-Ghouti, PhD MSc BSc

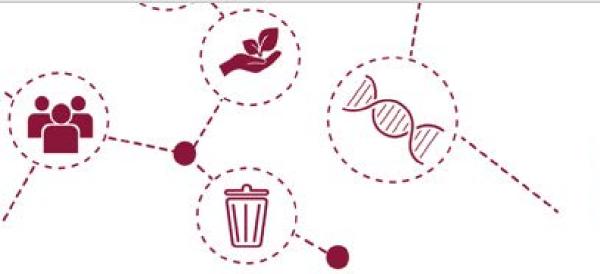
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Environmental Science Program
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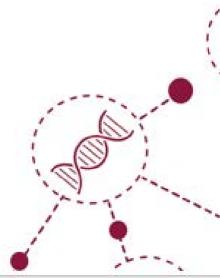




# SYMPOSIUM PRESENTERS









### NATURE-BASED SOLUTIONS FOR SUSTAINABILITY: FOCUSING ON VEGETATION INTRODUCTION IN ARID REGIONS

Prof. Yowhan Son

Division of Environmental Science and Ecological Engineering, Korea University, Seoul, Republic of Korea

#### **Abstract**

Our planet is facing challenges to achieve sustainable development by climate change, biodiversity decrease, land-use change, population increase, and other reasons. One of solutions to solve the problem is nature-based solutions (NbS). NbS are actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits. Examples of NbS include using naturally connected floodplains and riparian ecosystems, forest protection, afforestation and reforestation, deep-rooted nitrogen fixing plants, mangrove forests and well-managed and conserved grasslands. There are different types of NbS depending on the gradients of number of services and stakeholder groups and maximization of the delivery of key services. In addition, the IUCN global standard for NbS, a tool that helps plan, analyze, and evaluate NbS projects was suggested. Introducing vegetation artificially or naturally is one of the common ways to adopt NbS to restore degraded ecosystems in arid regions. Improving resilience environmentally and socio-economically after introducing vegetation are shown by the implementation of afforestation and reforestation in China, Mongolia and Kazakhstan. Interestingly significant soil physical, chemical and biological properties changed shortly after vegetation introduction. Ecosystem-based management practices should be applied to restored ecosystems. Resilience improved ecosystems provided diverse ecosystem services and lead to achieving sustainability. On the other hand, vegetation introduction using reforestation was economically viable based on the benefit and cost analysis of the Korean reforestation activities. Finally, it should be noted that stewardship on nature is secured before any types of NbS activities are considered.

#### **Biography**

Yowhan Son is a professor of Division of Environmental Science and Ecological Engineering, Korea University, Seoul, Republic of Korea since 1993. He obtained a Ph.D. in forest ecology from the University of Wisconsin-Madison. He has served as Editor-in-Chief of Forest Science and Technology, as President of the Korean Forest Society, and as Director of the Korea Office of Global Carbon Project. From 2014 to 2017 he was an Adjunct Professor of Qatar University. Currently he is a Fellow of the Korean Academy of Science and Technology and published numerous journal papers and books on carbon and nutrient cycling in terrestrial ecosystems and climate change.



# UNLOCKING RESILIENT AGRICULTURE: EXPLORING BENEFICIAL BACTERIA-PLANT INTERACTIONS AGAINST BIOTIC AND ABIOTIC STRESSES

#### **Prof. Essaid Ait Barka**

Vice-President Delegated to the European Alliance INVEST, University of Reims Champagne-Ardenne, France

#### **Abstract**

Plant diseases cause significant losses in horticulture and agricultural crops each year, costing the world economy billions of dollars. Conventional agriculture mostly uses chemical inputs to manage these illnesses in order to maintain sufficient yields. Nevertheless, many of these products are being phased out owing to safety and environmental concerns, as well as resistance developed by targeted species. Consumer concerns about environmental sustainability and food safety have increased, which has further fueled calls for conventional agriculture to use fewer pesticides. To address these issues, plant growth-promoting rhizobacteria are becoming a viable and sustainable substitute. Increased yield, improved plant development, and less vulnerability to biotic and abiotic stressors are just a few advantages of these naturally occurring soil bacteria that colonize plant roots. Additionally, these bacteria can greatly reduce the need for chemical treatments by bolstering the plant's natural defenses, providing an environmentally responsible means of promoting crop resilience and health. Here, we'll examine how the beneficial bacteria Paraburkholderia phytofirmans interacts with grapevines and how this association enhances the plants' ability to withstand a variety of stressors.

#### **Biography**

Professor Essaid Ait Barka, an expert in Plant Physiology at the University of Reims, earned his Ph.D. in 1993. His research journey includes prestigious postdoctoral appointments at Laval University in Canada and Penn State University in the United States, followed by a research professorship at the Nova Scotia Agricultural College in Canada. Prof. Ait Barka's work focuses on harnessing beneficial microorganisms as microbial inoculants to enhance plant growth and provide biological resistance to biotic and abiotic stresses. His research seeks to uncover the molecular mechanisms that govern the intricate communication between plant defense signaling pathways and beneficial microorganisms. A prolific author, Prof. Ait Barka has contributed to the field with over 130 peer-reviewed articles, 9 books, and two patents.

Beyond his research contributions, Prof. Ait Barka is engaged in University of Reims life serving as VP of the Academic Council from 2017 to 2020, and VP for International Affairs from 2018 to 2024, then Vice-President delegated to the European Alliance INVEST since 2024.

#### For more information:

https://www.researchgate.net/profile/Essaid-Ait-Barka https://scholar.google.com/citations?user=6rW6UhwAAAAJ&hl=fr&oi=sra



### CIRCULAR BIOECONOMY FOR SUSTAINABLE AGRICULTURE THROUGH BIOPESTICIDES DEVELOPMENT

**Prof. Slim Tounsi** 

General Director, Center of Biotechnology, Sfax University Tunisia

#### **Abstract**

Unlike conventional chemical pesticides, biopesticides are derived from natural materials such as microbes and plants, making them less harmful to non-target organisms and promoting biodiversity. Their integration into farming practices can reduce reliance on synthetic chemicals, decrease soil and water pollution, and lower the risk of pesticide resistance. Biopesticide production is a critical step in sustainable agriculture, yet it often incurs high costs, which can limit widespread adoption. Utilizing agricultural and industrial waste as raw materials for biopesticide production can significantly reduce these costs, aligning with circular economy principles. By repurposing waste, we not only lower production expenses but also minimize environmental impact and resource consumption. This approach enhances the economic viability of biopesticides, promotes waste valorization, and supports a more sustainable agricultural system. Ultimately, integrating waste utilization into biopesticide production fosters a circular economy by closing nutrient loops and promoting resource efficiency, ensuring that pest management solutions are both effective and environmentally friendly.

#### **Biography**

Prof. Slim Tounsi, Biology Engineering Doctor (Ph.D), now is a professor of Biology Engineering, General director of the Centre of Biotechnology of Sfax (CBS) Tunisia, President of the CBS Scientific Council, Member of Judgment Committee at the Tunisian Ministry of Higher Education and Scientific Research, Member of the Doctoral School of the Faculty of Science of Sfax, Member of International Society of Organic Agriculture Research (ISOFAR), Member of Scientific Council-Tunisia of two Tunisian institutions: Olive Tree Institute, and the Regional Research Centre in Horticulture and Organic Agriculture. He got Biology Engineering Doctor's degree (Ph.D.) at the School of Engineer of Sfax-Tunisia (2002). He is Research Advisor for Asia-Pacific (2020-2021). He got the second PhD, Biology sciences and Biotechnology at the Higher Institute of Biotechnology of Monastir-Tunisia (2006). 2002-2003: Visitor in the Laboratory of "Pathogenèse compareé" University of Paris XI France, supported by a Post-Doctoral fellow from CNRS, France. Currently Pr. Slim Tounsi' researches focus on: Study and Production of microbial and plant Biopesticides (Biofongicides, Bioinsecticides, Antibiotics) for the control of pathogens (Fungi, insect, bacteria...). He published more than 130 papers in international Journals with IF. He participated in the development of 8 national patents. He is the PI/CoPI of several Joint Research Projects (Bilateral and Multilateral: Horizon Europe, H2020, ARIMNet, ERANETMED, COST, QNRF,..). He got the regional award of innovative project/PASRI-ANPR-2014; the second award of entrepreneurship organized by Wiki Start-Up-2015, the presidential award for the best Lab in Tunisia -2018.



### PROSOPIS JULIFLORA WASTE-TO-VALUE: LEAF EXTRACT EFFECTIVENESS AGAINST MANGO POST-HARVEST DISEASES

Dr. Iman Salah

Department of Biological and Environmental Sciences, College of Arts and Sciences, Qatar University

#### **Abstract**

Over the past few decades, and due to the increase in international trades movements, a variety of plant species start growing outside their natural habitats. Invasive species, such as Prosopis juliflora, are threatening to newly invaded environment, the plant is competing with the native species causing a decline in local biodiversity. When considering invasion control, herbicides are usually used for chemical eradication however, chemical invasion control leave usually the environment with chemical residues that would have adverse effects on both human and animals health. Mechanical invasion control, beside being costly, leaves behind a large amount of waste to be handled. Therefore, control by utilization is considered in this work to turn P. juliflora from wasted to national valuable resource. Direct utilization possibilities are many in the case of this plant due to its pharmaceutical values including antimicrobial effectiveness. Prosopis juliflora phytochemicals are being explored in this work as biocontrollers against common fruits and vegetables spoiling agents, particularly mangoes. Mango (Mangifera indica) is highly internationally traded, ranking as the second most traded tropical fruit after banana. Mango with its high nutritional values is susceptible to postharvest diseases and chill injuries during storage which causes economical losses, therefore making any possible bio-controller valuable.

Prosopis juliflora leaves extracts has previously been explored as strong naturally-based antifungal agent. In this work, mango samples purchased from the local market were used to isolate two of the major fungal species that cause mango spoilage, *Alternaria alternata* and *Colletotrichum gloeosporioides*. In-vitro testing had shown significant reduction in fungal growth of both species when treated with PJ-WS-LE extract. Using fruit bioassays, applying PJ-WS-LE extract (8mg/ml) had controlled *A. alternata* growth in mango up to 80% and it also lowers by 53.4% the severity of *C. gloeosporioides*' disease in mangoes. PJ-WS-LE extract (8mg/ml) embedded in 1% chitosan maintained mango quality for 5 weeks showing the lowest weight loss among treatment groups.

The effectiveness of PJ-WS-LE extract against postharvest phytopathogens opens doors for the application of this naturally-based product as a replacement of chemical pesticides and can be economically valuable. Moreover, managing an invasive plant via utilization is an effective ecosystem tool toward management.

#### **Biography**

Iman Saleh is a Microbiology Lecturer at the Biological and Environmental Sciences Department at Qatar University, where she teaches Core curriculum courses in addition to practical sessions of various Biology courses including Microbiology. Iman has earned her Master degree from the American University of Beirut on the microbiological quality of dairy products including home-made cheese, and on the antimicrobial resistance patterns of environmental bacterial isolates. Iman has published her MS research work peer-reviewed journals. Iman has finished her PhD at the department of biological and environmental sciences at QU by Fall 2022. In addition, she has completed a joined degree in education between Qatar University and Harvard Graduate School of Education in 2024. During the last

few years she has been active in research at the department, she has published in many areas including toxicology, water treatments, microbiology and GIS. Her PhD work focused on fresh produce post-harvest fungal diseases and the development of natural bio-controller. She worked also on the development of fruits coating material and on improving storage quality parameters. Her PhD work's outcome was publications in highly indexed journals, awards at the local and international levels, in addition patent application under processing. She is currently working on active projects in the same laboratory.



## MICROBIAL BIOSURFACTANTS: TRENDS AND POTENTIAL APPLICATION IN ENVIRONMENTAL, AGRICULTURAL, AND BIOMEDICAL INDUSTRIES

Prof. Ibrahim M. Banat, BSc, PhD, DSc, FRSB

School of Biomedical Sciences, Faculty of Life and Health Sciences, Ulster University, Coleraine, Northern Ireland, United Kingdom

#### **Abstract**

Microbial biosurfactants are naturally occurring surface active molecules capable of partitioning at interphases reducing surface and interfacial tensions between different phases (gas, liquid and solid). They can also act as foaming emulsification and wetting agents that have low critical micelle concentrations and surface-tension reduction capabilities. These compounds can potentially replace chemical surfactants which typically are more recalcitrant and problematic compounds to the environment. Glycolipidic and lipopeptides biosurfactants are the most promising types including sophorolipids produced by yeasts strains such as Starmerella and Candida, rhamnolipids produced by Pseudomonas aeruginosa bacteria and other related species, mannosylerythritol lipids produced by *Pseudozyma* yeasts and surfactin produced produced by the Bacilli bacteria group. Global interest in biosurfactants has been steadily increasing during the past three decades mainly stimulated by their favorable surfactant characteristics and environmentally friendly features including sustainable production technologies, biodegradability, and lower toxicity when compared to their chemical counterparts. Their main potential applications include use in/as environmental oil cleanup agents, combating agricultural phytopathogens as biopesticide particles, dispersants and/or solubilizing molecules for hydrophobic pollutants, use as components in both domestic and industrial cleaning products, anti-microbial adjuvants and as emulsifiers or probiotic compounds in food products. In addition, several medical and pharmaceutical applications including cosmeceuticals as anti-aging, oral hygiene products, wound-healing agents and in dermatological products, have been described. This presentation will discuss biosurfactants current trends, potential future applications, and challenges in the areas of environmental, agricultural, and biomedical related industries.

#### **Biography**

Professor Ibrahim M. Banat, Professor of Microbial Biotechnology at Ulster University, UK. He has >35 years' experience in academic & research institutions in Europe and internationally. His research interests include biosurfactant, bioenergy and bio-actives, production and utilization in environmental oil pollution control and bioremediation, and microbial enhanced oil recovery. He is also recently concentrating on investigating biomedical, pharmaceutical, health and cosmetics related applications of biosurfactants.

To date Prof. Banat has >350 publications (H-Index = 102) and >47,000 citation according to Google scholar:

https://scholar.google.co.uk/citations?user=YwfP5SYAAAAJ&hl=en&oi=ao



### BIOCHAR AND MICROBES: SUSTAINABLE TECHNOLOGIES FOR BIOREMEDIATION OF INDUSTRIAL EFFLUENTS

Dr. Suhur Saeed

Water Management head at ExxonMobil Qatar, Qatar

#### **Abstract**

Bioremediation represents one of the most cost-effective, adaptable, and ecologically beneficial way to get rid of contaminants. It is a technology which can be simultaneously used with other physical and chemical treatment methods for complete management of diverse group of environmental pollutants. Combined application (biochar + microbes) can be applied successfully for reuse of wastewater and contaminated soil for environment protection and sustainable development.

Biochar is a solid carbonaceous material produced through the conversion of organic biomass using hydrothermal and thermochemical processes such as pyrolysis. Biochar surface properties, aromaticity and interactions between active functional groups on the biochar are main factors influencing removal of micropollutants. Microbial immobilization using biochar is a bioaugmentation approach that reduces the loss of functioning microorganisms while increasing bacterial resistance to actual water bodies. Biochar can be a good biofilm carrier because of its ability to support microbial life. It contains nitrogen, phosphate, and potassium as also rich in organic carbon. Microbial cells are immobilized to biochar through many methods, including adhesion or adsorption on a solid surface, encapsulation, and aggregation via flocculation and crosslinking. Because of its unique physicochemical qualities such as high porosity and wide specific surface, biochar can expedite nitrogen cycling, improve soil composting quality and promote the growth of microorganisms.

In this research, the removal of hydrocarbons in wastewater was investigated using hydrocarbon sludge-produced biochar generated using various activation agents followed by Anaerobic Digestion. The results showed a removal efficiency of hydrocarbons, 57.3% removal efficiency, with chemical oxygen demand decreasing from 89,233 mg/L to 38,000 mg/L. On the success of these initial results, the team has now developed composites of bacteria/biochar for the effective treatment of various industrial wastewaters. The bacteria used in this study were previously isolated and tested for remediation of various pollutants in wastewaters. Hence, this research confirmed that the biochar derived from oily sludge combined with microorganisms, an innovative bioaugmentation approach, is effective for wastewater treatment and reuse of highly contaminated industrial wastewater. Therefore, implementing large scale facilities that allows reuse of hydrocarbon sludge and wastewater provides a potentially meaningful circular economy pathway in oil and gas industries.





### MOVING TOWARDS A SUSTAINABLE CIRCULAR BIO-ECONOMY IN THE AGRICULTURE SECTOR

Prof. Mohammad Trigui

Head of the research Laboratory "Environmental Sciences and Sustainable Development, Sfax Preparatory Engineering Institute, Sfax University-Tunisia

#### **Abstract**

The widespread use of chemical pesticides in modern agriculture has raised significant concerns regarding their detrimental effects on human health, biodiversity, and the environment. Additionally, in arid and semi-arid regions, climate change intensifies challenges such as soil degradation, water scarcity, and increasing salinity, making soil conservation and efficient water management essential. Therefore, there is a pressing need to shift towards sustainable agricultural practices by adopting eco-friendly solutions, such as integrated pest management, organic farming, and agroecological approaches that protect biodiversity and ecosystem health. By adopting these practices, farmers can not only reduce their reliance on harmful chemicals but also enhance food security, improve soil health, and promote resilience to climate change. This shift is essential for ensuring the long-term viability of agricultural systems and safeguarding public health and the environment for future generations. Integrating circular economy principles with biotechnology offers transformative approaches to achieve this sustainability, especially in arid and semi-arid regions highly vulnerable to climate change. Circular economy in agriculture emphasizes waste reduction, resource recycling, and renewable inputs, reducing dependency on finite resources. Composting/Cocomposting is the aerobic process of degrading organic compounds using agricultural waste to create nutrient-rich soil amendments. This process enhances soil fertility and structure while reducing landfill waste. Biotechnology provides also additional solutions through plant growthpromoting (PGP) microorganisms as biofertilizers, which not only boost plant growth but also enhance resilience to drought and salinity stress, crucial for crop survival under harsh environmental conditions. Together, these approaches create a regenerative agricultural system that conserves resources, recycles waste, and fortifies soil health. Advancing biotechnological innovations and circular practices in agricultural systems offers a pathway toward a sustainable and climate-adaptive strategy for the future in arid and semi-arid regions.

#### **Biography**

Dr. Mohamed TRIGUI is a Full Professor of Biochemistry and Environmental Microbiology. He obtained his Ph.D. in Microbiology, Enzyme Engineering, and Bioconversion from the University of Technology of Compiègne (UTC, France). With 20 years of experience in teaching and Research and development across France and Tunisia, Dr. Trigui specializes in Biochemistry, Enzyme Engineering, and Environmental Microbiology. He has published over 63 papers in international indexed journals across these areas of expertise. Since 2018, he has served as the Head of the Laboratory of Environmental Sciences and Sustainable Development (LASED). Dr. Mohamed TRIGUI is implicated in leading research projects, supervising graduate research (theses), and has developed eight national patents. His contributions to institutional leadership are notable, including his role as the elected Director of the Sfax Preparatory Engineering Institute in 2019 and as Head of the Department of Biology and Geology from 2011 to 2017. Additionally, he served on the IPEIS Scientific

Council from 2017 to 2020. Dr. Mohamed TRIGUI's research focus is to creating sustainable solutions for agriculture by exploring and developing natural alternatives to chemical pesticides. His work includes producing microbial and plant-based biopesticides, like biofungicides and natural antibiotics, that help to protect crops without harming the environment. He's also focused on transforming organic waste into valuable soil amendments through co-composting, a process that not only reduces waste but improves soil health and resilience against climate change. At the core of his research is the discovery and identification of bioactive compounds and beneficial microorganisms, all aimed at building healthier soils and more sustainable agricultural systems.



## NOVEL APPROACH IN TREATING INDUSTRIAL WASTEWATER USING METAL-ORGANIC FRAMEWORK NANOPARTICLES IMPREGNATED WITH BIOSURFACTANTS

#### Dr. Haneen Al Dous

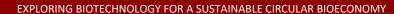
Postdoctoral Associate in Microbiology & Immunology at Weill Cornell Medicine-Oatar

#### **Abstract**

The project addresses the challenge of treating industrial wastewater using advanced nanotechnology. Two nanoparticles, ZIF-8 and iron oxide, were synthesized and coated with biosurfactants derived from hydrocarbon degrading bacteria to enhance their adsorption of organic contaminants. The modified nanoparticles demonstrated improved effectiveness in removing volatile petroleum hydrocarbons, offering potential as a sustainable, cost-effective solution for industrial wastewater treatment.

#### **Biography**

I am a postdoctoral associate in microbiology and immunology at Weill Cornell Medicine-Qatar. I completed both my master's and PhD degrees in the Biological and Environmental Science department at Qatar University, where I also earned my bachelor's degree in biomedical science. I graduated with distinction from the PhD program, focusing on bioremediation and nanotechnology applications in treating oil and gas wastewater. With over eight years of experience in microbiology, I spent four years working in clinical microbiology at Hamad Hospital and another four years conducting research in environmental microbiology at ExxonMobil Research Center. I have published several papers in the fields of bioremediation and nanotechnology. Currently, my research investigates the impact of climate change on human health, particularly infectious and vector-borne diseases. I am also exploring environmental bacteria for antibiotic discovery to address the challenge of antimicrobial resistance.





### FROM OCEAN TO INNOVATION: SUSTAINABLE FRONTIERS IN MARINE BIOTECHNOLOGY

**Prof. Sergey Dobretsov** 

UNESCO Chair in Marine Biotechnology, Center of Excellence in Marine Biotechnology, Department of Marine Science and Fisheries, Sultan Qaboos University

#### Abstract

This presentation will focus on the vast potential of marine biotechnology in fostering sustainable solutions across various industrial sectors. The talk will begin with an overview of marine biotechnology, with a significant emphasis on the process of biofouling and its innovative prevention strategies, including the development of non-toxic antifouling agents derived from marine organisms. The role of marine natural products as pharmaceuticals to address health issues such as cancer and antimicrobial resistance will also be highlighted. Additionally, the presentation will provide examples of compounds and coatings derived from shrimp waste, showcasing sustainable waste management practices that yield valuable products. Finally, the presentation will conclude with a discussion on the main challenges facing marine biotechnology today and future perspectives that could shape this dynamic field, paving the way for innovative applications that benefit both society and the environment.

#### **Biography**

Professor Sergey Dobretsov is the UNESCO Chair in Marine Biotechnology at Sultan Qaboos University, Oman, and serves on the boards of both the International Society for Marine Biotechnology and the European Society for Marine Biotechnology. Previously, he held the position of President of the European Society for Marine Biotechnology for several years. With 25 years of teaching experience, he has supervised numerous under- and postgraduate students across universities in Russia, Oman, Germany, and China. Recognized as one of the top 100,000 scientists globally by Stanford University, he has over 34 years of experience working with polar, temperate, and tropical marine communities in leading research centers. His primary research focuses on marine biotechnology, particularly in developing non-toxic antifouling solutions, studying the microbiome of marine organisms, marine natural products, and exploring microbial-host chemical interactions. He has actively participated in various international projects within these domains. Professor Sergey has published more than 160 papers in international peer-reviewed journals and authored two books, in addition to securing five international patents. He is also a member of the editorial boards for several high impact journals, including Marine Ecology Progress Series, Biofouling, International Journal of Molecular Sciences, and Frontiers in Nanotechnology.



# THE APPLICATION OF AQUACULTURE WASTEWATER-GROWN MICROALGAL BIOMASS AND CATERING WASTE AS FEED INGREDIENTS FOR SUSTAINABLE AQUACULTURE

Dr. Probir Das

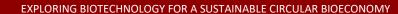
Research Associate Professor/ Algal Technology Program/ Center for Sustainable Development, Qatar University, Qatar

#### **Abstract**

Over the last decades, aquaculture has emerged as one of the major suppliers of animal protein. The massive expansion of aquaculture worldwide met the shortfall of fish production from the wild catch. However, there are several downsides to the aquaculture industry. Among these challenges, two significant issues are sustainable feed production and efficient aquaculture wastewater treatment. Fish feed often contains fish meals as a source of protein; fish meal could constitute as high as 40% of the total ingredients. Fish meal is produced from forage fish, and the production of these forage fish reached a maximum value several years back. Therefore, renewable and alternative protein sources must be developed to replace fish meal fully or partially. Marine/brackish microalgae could play a significant role in this regard, as these organisms do not require fertile land and fresh water. Similarly, leftover waste materials from the kitchen (e.g., bread, fish, meat, fruits, and vegetables, etc.) could also be processed accordingly and included in the fish feed. Furthermore, a fraction of the added feed to the fish tank is lost and ends up in the aquaculture water; microalgae could recover the nutrients from this wastewater while recycling the wastewater to the fish-rearing pond, promoting toward zero discharge from the aquaculture sector. The current study revealed that up to 40 % of the feed ingredients could be replaced by aquaculture wastewater-grown microalgae biomass and other waste materials.

#### **Biography**

Probir Das is a Research Associate Professor at the Center for Sustainable Development of Qatar University (QU). He received his Ph.D. degree in Environmental Engineering from the National University of Singapore (NUS). Dr. Das has over 18 years of experience in cost and energy-effective microalgal biomass production for various applications. Currently, he is involved in several microalgae-based projects related to the bioremediation of CO2, aquaculture wastewater treatment, biofertilizer, sustainable aquaculture, biofuel production, etc. He has over 60 international peer-reviewed publications related to high-value microalgal biomass production, bioremediation of wastewater, biofuel production, and LCA analysis. He is also a reviewer of multiple international journals.



### BY-PRODUCT FISHMEAL REPLACEMENT BY INSECT MEAL IN DIETS FOR *PENAEUS VANNAMEI*: EFFECTS IN GROWTH AND HEALTH

#### Dr. Victor T Rosas

Aquaculture Nutrition Specialist, Postdoctorate in Shrimp cultured in Bioflocs Systems, Environmental Sciences Center, Qatar University

#### **Abstract**

High pressure on the use of fishmeal (FM) in aquaculture farming has led to the search for alternative sources to replace FM. By-product FM and insect meal (IM) are two proteic sources that could serve as alternatives to FM in shrimp diets. In the present study, five isoproteic (38% protein) and isolipidic (9%) diets were formulated for Penaeus vannamei, in which byproduct FM was gradually replaced (0%, 25%, 50%, 75%, and 100%) by a mix of black soldier fly (BSF) larvae meal and soybean concentrate. The diets were tested in triplicate for 56 days at a density of 250 shrimps/m2. Each experimental diet was offered three times a day. At the end of the experimental period, growth parameters and hepatopancreas status were evaluated. The counting of hepatopancreas tubule cells was performed for all treatments. Results indicate that neither by-product FM nor BSF meal alone supported acceptable growth. However, a mixture with up to 50% replacement showed improved growth parameters. especially final weight and total biomass. This effect is related to nutritional deficiencies in the IM and FM, which can be compensated for when combined. Additionally, the hepatopancreas cell analysis revealed that 50% replacement led to larger blister cells (B-cells) and more reserve cells (R-cells), while complete FM replacement resulted in a higher count of embryonic cells (E-cells) in the tubular midgut. The results indicate that both by-products FM and IM can be alternative sources to fishmeal, and it is possible to produce it in Qatar, which will lead to reduced waste production as well, and can become interesting ingredients for aquaculture farming.

#### **Biography**

Dr. Rosas holds a master's and a doctorate in aquaculture and has over fifteen years of experience in aquaculture production and nutrition. He completed a postdoctoral research program focused on biofloc systems. Dr. Rosas is currently a visiting professor at the Federal University of Rio Grande. Currently, he is working as a researcher on food security projects, specifically exploring the use of insect meal as a protein source for shrimp farming in Qatar.

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#### LATEST INNOVATIONS IN DRUG SYNTHESIS AND PRODUCTION

#### Dr. Mohammad Ismail Ibrahim

Academia Segment Manager- Middle East-Merck-Kingdom of Saudi Arabia

#### **Abstract**

Drug discovery is a lengthy and costly process where it normally takes a range of 11-13 years for a final drug to be approved and released in the market. During this journey, pharmacology, toxicity profile, clinical and preclinical studies take place. <sup>1,2</sup> With the rise of artificial intelligence (AI), machine learning and computer-aided drug design (CADD), it appears that these developments have advanced and expedited the process of hits identification and discovery of lead compounds for the drug to go through the discovery phases. <sup>1,2</sup>

AIDDISON™ Empowers medicinal chemists by streamlining the entire drug discovery process. Leveraging generative AI and advanced CADD methods, AIDDISON™ integrates ligand-based and structure-based approaches into a single, easy-to-use platform. it provides all the tools needed to move from idea to actionable insight with greater efficiency and confidence.<sup>3</sup>

SYNTHIA™ Retrosynthesis Software is expert-coded by chemists and engineered by computer scientists, it enables scientists to quickly find and easily navigate innovative and novel pathways for novel and published target molecules.⁴

In addition to in-silico development, some important in-vitro screening methods have made it possible to screen up to billions of molecules against a drug target in a single afternoon.<sup>5</sup>

#### References

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- 6. https://www.sigmaaldrich.com/SA/en/product/sial/dyna002?msockid=096fe5c0be1b63c422d8f1f8bff462f8

#### **Biography**

A chemist with PhD degree in organic chemistry, with research interests and publication record in:

- Organic synthesis of bioactive natural compounds.
- Materials engineering and bionanocomposites.

Currently working for Merck KGaA as Academia Segment Manager-Middle East, with responsibility to enhance collaboration with the research and academic communities in the middle east region. Worked before as:

- Division manager -Mass Spec & Nanotechnology (Naizak Global Engineering Systems)-KSA
- Chemist (Royal Scientific Society)-Jordan
- Teacher assistant (Jordan Univ. Of Science & Technology)-Jordan

#### GENE EDITING FOR NEXT GENERATION FOOD

#### Dr. Ashwag Binmahfooz

Segment Manager of Academia II Merck KGaA Darmstadt Germany, Middle East- Saudi Arabia

#### **Abstract**

Gene editing is emerging as a vital tool in the quest to enhance food quality and tackle the challenges posed by climate change. By precisely modifying the genetic makeup of plants and animals, scientists can develop varieties and species that are more resilient to environmental stresses.

Furthermore, gene editing can reduce the reliance on chemical pesticides and fertilizers, promoting sustainable agricultural practices. Through these advancements, gene editing holds the promise of transforming our food systems, ensuring food security, and mitigating the adverse effects of climate change. At Merck we are happy to support researchers in the Middle East and all over the world with our gene editing tools and solutions and help them revolutionize agriculture.

#### Biography

A Life science manager based in Saudi Arabia. Driven by strong passion for biotechnology, I hold a Professional Science master's in biotechnology from California State University, and a Bachelor's in Biology from King Abdulaziz University. Currently, I work as a Segment Manager at Merck KGaA, where develop business strategies and collaborate with prominent Institutions like KAUST to foster growth in biotechnology across the gulf region.



# SENSITIVITY, ACCURACY, REPRODUCIBILITY, AND FLEXIBILITY: KEY ELEMENTS OF BIOTECHNOLOGY FOR R&D, MANUFACTURING, AND QC

Dr. Anis Larbi

Medical and Scientific Affairs, Beckman Coulter Life Sciences

#### **Abstract**

Our knowledge of biology, geology, chemistry, and other aspects of life has been accelerated and deepened by technology. Numerous technological developments have made it possible to make discoveries that improve human longevity and overall quality of life. There are still obstacles in the way of maintaining our capacity to live long and with high standards, namely the preservation and adaptation of our ecosystem. This talk will highlight how technological advancements (i) benefit research ecosystems, (ii) improve the quality and precision of science, (iii) make it possible to comprehend the emergence and evolution of pathogens, and (iv) support essential aspects of our lives (contaminants, food and beverage, agriculture, soil and sea, waste management). Practical examples of how biotechnology allowed for a departure from the status quo will be used to contextualize these. This presentation will end with a viewpoint on possible other uses of these biotechnologies.

#### **Biography**

Anis Larbi started his academic career in Germany and then Singapore (A\*STAR Institutes) after earning his PhD in Immunology from Sherbrooke University in Canada. He has conducted numerous clinical research studies and possesses a strong expertise in human immunobiology, particularly in relation to aging. He has worked with multinational corporations like Sanofi, Merck MSD, Nestle, and Abbott. He was also a member of the A\*STAR immunomonitoring platform. From 2020 to 2023, he was named a Highly Cited Researcher and published over 210 peer-reviewed articles (H-index = 86). He is an adjunct professor at the University of Sherbrooke's Faculty of Medicine. He joined the Medical and Scientific Affairs division of Beckman Coulter Life Sciences in 2020.



### WALKING THE CIRCULARITY TALK: EVIDENCE FROM CASE STUDIES AND RESEARCH

Prof. Ahmed Khalifa

College of Business and Economics, Qatar University

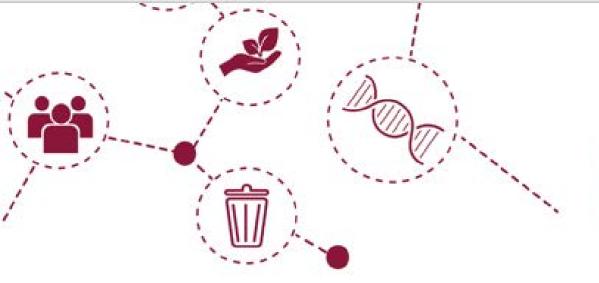
#### **Abstract**

Our research explores pathways to a circular economy for sustainable development, focusing on Qatar and broader global contexts. The QNV2030's goal of sustainable economic development necessitates entrepreneurial and economic diversification, fostering a circular economy through diversification and leveraging opportunities in the energy transition and waste management. Achieving net-zero emissions by 2050 requires tackling both energy and non-energy related GHG emissions via CE transition. Our systematic review identifies technology, finance, ecosystem factors, and behavioral changes as key accelerators. Additionally, our comparative analysis across nations reveals that while command-and-control regulations and market-based mechanisms (carbon taxes, emissions trading) offer varying levels of success in promoting CE principles, information-disclosure strategies are essential for consumer empowerment. From public policy prospective, our studies demonstrate the significant impact of carbon pricing policies, particularly emission trading systems, in reducing carbon emissions globally. Additionally, allocating the carbon permits requires specific scientific approach to guarantee efficacy and the transparency across the economic agents

#### **Biography**

Professor Khalifa's dedication to Economics, sustainability and climate change research has been a guiding force throughout his career. He has played a pivotal role in fostering collaboration between the College of Business and Economics, the College of Engineering, and the College of Arts and Science at Qatar University. This collaborative approach has yielded invaluable insights and innovative solutions to address the complex challenges posed by climate change and sustainable development within business schools such as establishing H2hub for sustainable energy, high impact research grants (#404), Carbon Capture and utilization cluster (NPRP12C-0821-190017), Water conservation (NPRP10-0131-170-300) and electricity conservation (NPRP9-232-5-026). Ahmed Khalifa's academic journey has been marked by continuous growth and unwavering dedication through high impact journal publications, several patents within his field and self-developing technology in different economic sectors. Khalifa graduate from Colorado State University in 2009 and before joining Qatar University in 2013, he served as an assistant professor at both Bloomsburg University of Pennsylvania and the King Fahd University of Petroleum and Minerals. For more information about Ahmed, please scan:



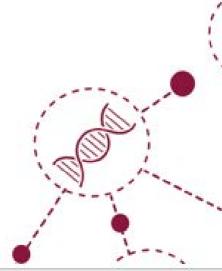




# POSTER ABSTRACTS







#### Understanding the biodiversity of bacterial adaptation in hypersaline evaporitic environments of Qatar Sabkhas

Zouari, Nabil<sup>1</sup> and Al Disi, Zulfa<sup>1</sup>

<sup>1</sup>Environmental Sciences Program, Department of Biological and Environmental Sciences, College of Arts and Sciences-Qatar University

Email: nabil.zouari@qu.edu.qa, zaldisi@qu.edu.qa

Little is known about the roles of extremophiles and of bacteria tolerating harsh conditions in ecosystems, including climate regulation. Recent works showed that their contribution to the production of greenhouse gases, as well as to the major carbon, nitrogen and nitrate cycles is far from negligible. Often, the genome contains more than 90% of genes coding for proteins with unknown functions in extremophiles. Some tolerant bacteria are also abundant at harsh conditions. For what reasons? Their biological macromolecules known to be extracellular must necessarily adapt to the physico-chemical conditions, to the particular nutritional and energy resources of these extreme environments. Their stability and functionality are crucial to the survival of such microorganisms. These constraints can lead to the emergence of new metabolic pathways using substrates and cofactors different from those used by "conventional" organisms. Over the past 30 years, we have witnessed the discovery of an extraordinary diversity of microorganisms inhabiting environments previously thought to be hostile to life. Today, we know that microbial life extends on Earth wherever we find water in a liquid state (appropriate water activity (aw)), from the polar ice caps to underwater hydrothermal springs, in deserts, in hypersaline lakes or soda, in acidic waters, inside the earth's crust, and also Sabkhas. In all types of adaptations associated with microbial life in "extreme" conditions, changes in protein structures profoundly alter the biochemistry and physiology of biological systems. At the geological scale, large-scale climatic variations have established extreme conditions on the surface of the planet. It is also for this reason that the notion of extremophilia must be put into perspective.

In the frame of our research projects, halophilic bacteria (moderate and extreme) have been isolated from hypersaline evaporitic environments of Qatar Sabkhas. The taxonomic biodiversity of microorganisms found in these environments is essentially linked to their characteristics: bacteria which are aerobic, halophilic and heterotrophic. We showed, using proteins profiles analyses, that they are endowed with metabolic and physiological activity involved in transformation and degradation of organic pollutants but in forming many types of minerals. Primely, these microbial species exhibited the capability to induce and or mediate carbonate minerals formation including the formation of high magnesium carbonate that are considered as precursor to dolomite formation. The most representatives are aerobic bacteria essentially belonging phylogenetically to the genera, *Bacillus, Virgibacillus, Pseudomonas*, and *Halobacillus*. The molecular (ribotyping 16S rRNA and MALDI TOF) identification but especially their protein profiles (MALDI TOF MS and PCA) used for the phylogenetic comparison showed that many adaptation routes were implemented by these strains. To confirm their biodiversity, their functionality was also studied, in term of capacity to form minerals with different compositions and with potential to incorporate metals in minerals.

### Upcycling shrimp and fish waste as feed sources for housefly (Musca domestica) larvae meal for aquaculture feeds

Britz, Larissa M.K.<sup>1</sup>; Rosas, Victor T.<sup>1</sup>; Haga, Yutaka<sup>2</sup>; Vethamony, Ponnumony<sup>1</sup> and Al-Khayat, Jassim A<sup>1\*</sup>.

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#### **Abstract**

Due to decrease in marine fish stocks, sustainable meals to feed aquaculture production are on demand (FAO, 2024). An emergent alternative has been the production of insect meal (IM) with high protein value (Hua, 2021). Musca domestica (housefly) larvae meal can be an interesting source of essential amino acids (EAA) and essential fatty acids (EFA) and a competitive replacement for fishmeal due to its EAA composition which is rich in lysine (Oliva-Teles et al., 2022). Waste by-products from shrimp and fish are available in Qatar, upcycling them as IM ingredients for animal consumption could also help in waste reduction and become a cheap source of animal feed. With this aim, waste from fish and shrimp was collected from local markets, processed by drying in the oven for 48h at 60°C and used for insect meal (IM) production. The experimental design consisted of triplicate containers with a control treatment (C) fed with wheat bran only and two treatments replacing 33% of wheat bran for fishmeal waste (FMW) and shrimp meal waste (SMW). The temperature and humidity were monitored during the 7 experimental days. At the end of the growth period, the IM was produced by drying the larvae at 60°C for 24h. Proximal analysis of all the experimental treatments was carried out. Also, amino acids (AA) and fatty acids (FA) of all samples were measured. Results showed that the addition of protein sources in the insect diets diminishes the protein value in the IM, at the same time the addition of lipidic sources increases the lipid content in the IM. The AA results showed an increase in the Taurine concentration as the SMW increased. The FA analysis proved that the housefly larvae have an accumulation of EFA with an inclusion of fish and shrimp meal in the diet, especially for arachidonic acid (ARA) and Palmiteoic acid (16:1 n-7). Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA), which are naturally absent from the larvae nutritional composition (Barroso et al., 2014) have the potential to increase their value by recycling fish and shrimp waste products in Qatar.

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<sup>&</sup>lt;sup>1</sup> Environmental Science Center, Qatar University, P.O. Box: 2713, Doha, Qatar.

<sup>&</sup>lt;sup>2</sup> Departament of Marine Bioscience, Tokyo University of Marine Science and Technology (TUMSAT), Tokyo, Japan.

# The influence of the rhizosphere on the abundance, growth, and activity of hydrocarbon degrading bacteria isolated from Simaisma mangroves in Qatar

Siddique, Afrah<sup>1\*</sup>, Al Disi, Zulfa<sup>1,2</sup>, Al-Ghouti, Mohammad<sup>1</sup> and Zouari, Nabil<sup>1</sup>

<sup>1</sup>Environmental Sciences Program, Department of Biological and Environmental Sciences, College of Arts and Sciences, Qatar University, P.O.B 2713, Doha Qatar

<sup>2</sup> Environmental Science Centre, Qatar University, P.O. Box 2713, Doha, Qatar

Email: as2211139@qu.edu.qa\*, zaldisi@qu.edu.qa, mohammad.alghouti@qu.edu.qa, nabil.zouari@qu.edu.qa

Mangroves are highly sensitive ecosystems, naturally found in the Middle East. They are climate regulators as they play an important role in carbon sequestration. To mitigate climate change impacts, the protection of mangroves is crucial. Studying mangrove ecological parameters and the association between mangrove forests and rhizosphere microorganisms is necessary to protect and conserve mangroves (Siddique et al., 2024). In this study, aerobic bacterial strains were isolated from the rhizosphere and non-rhizosphere regions of mangrove trees to investigate the effect of plant roots on the growth and hydrocarbon degrading capability of bacteria. Sediment samples were taken from the four different sites of the Simaisma mangrove forest of Qatar. A total of 25 bacterial strains were isolated from 16 samples based on their capability to degrade hydrocarbons by following the procedure as previously reported by Al Disi et al., (2017). The growth potential of these bacterial strains on 5% Diesel-MSM media was evaluated through colony forming unit count (CFU). Among the isolates, SD110 exhibited the highest growth of 2.45±1.5 10<sup>7</sup> CFU/ml after 1 week of incubation in minimal salt media supplemented with 5% diesel as a sole carbon source. Bacterial isolates were further tested for diesel emulsification and solubilization activities. Two isolates SD200c and SD210 demonstrated the highest diesel solubilization activity. The highest emulsification activity 100 AU/mL was recorded for SD200a. Based on the experimental data, it is observed that the bacterial strains isolated from the rhizosphere region of the trees exhibited the highest diesel degradation potential. However, the bacterial strains isolated from the non-rhizosphere region exhibited less growth. Based on these results, it is evident that there is a symbiotic relationship between mangrove plant roots and hydrocarbon degrading bacteria. This association can be harnessed as a natural tool for bioremediation of hydrocarbon pollution in the mangroves of Qatar.

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Siddique, A., Disi, Z. A., AlGhouti, M., & Zouari, N. (2024). Diversity of hydrocarbon-degrading bacteria in mangroves rhizosphere as an indicator of oil-pollution bioremediation in mangrove forests. *Marine Pollution Bulletin*, 205, 116620. https://doi.org/10.1016/j.marpolbul.2024.116620

#### Growth pattern and polyhydroxyalkanoates (PHA) production of Purple Non-Sulphur bacteria enriched cultures under varying nutrient concentrations for fuel-synthesis process water treatment

Siddique, Afrah<sup>1\*</sup>; Rashid, Naim<sup>2</sup>; Vincent, Annette S.<sup>3</sup> and Mackey, Hamish R.<sup>1,2</sup>

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#### **Abstract**

Biodegradable plastics sourced from waste biomass are required to minimize the harmful environmental impacts of petroleum plastics. This study investigates the production of polyhydroxyalkanoates (PHA), one type of bioplastic, using purple non-sulfur bacteria (PNSB) from fuel synthesis wastewater PNSB, an anoxygenic phototrophic group of bacteria, to avoid aeration and allow an easily enriched mixed culture production method (George et al., 2020). Purple non-sulfur bacteria provide effective anaerobic treatment of a wide variety of compounds. This study's objective is to evaluate their ability to treat fuel synthesis process water (FSPW) which is nutrient deficient. The effect of nitrogen (N) and phosphorus (P) on the growth and treatment performance of mixed purple non-sulfur bacterial communities (PNSB) was investigated. PNSB were grown in FSPW containing 3150 and 4010 mg/L of chemical oxygen demand (COD) for the P and N tests respectively, with an additional supplement of trace elements and vitamins. Growth was measured as optical density at 420 nm (OD<sub>420nm</sub>). P was tested under P-high (P<sup>+</sup>, 65.2 mg/L), P-low (P<sup>-</sup>, 32.6 mg/L) and P-depleted (P<sup>0</sup>, 0 mg/L) conditions. Growth was similar for P<sup>+</sup> and P<sup>-</sup> conditions over the first seven days of incubation but diverged as  $P^-$  consumed available P. The final OD<sub>420</sub> and COD removed were  $P^+ = 4.534$ and 2746 mg/L, P = 3.328 and 1978 mg/L and  $P^0 = 3.125$  and 1890 mg/L. N was tested under N-high (N<sup>+</sup>, 100 mg/L), N-low (N<sup>-</sup>, 60 mg/L) and N-depleted (N<sup>0</sup>, 0 mg/L+10 mg/L of Na<sub>2</sub>SO<sub>4</sub>) treatments. The final OD<sub>420</sub> and COD removed were  $N^+ = 2.448$  and 2830 mg/L,  $N^- = 1.377$ and 1986 mg/L and  $N^0 = 2.073$  and 2318 mg/L. N was depleted or almost depleted by the end of each test ( $N^+ = 2.6 \text{ mg/L}$ ). Growth in  $N^0$  was constant throughout the test while  $N^+$  and  $N^$ plateaued, with N<sup>+</sup> picking up again at 7 days. This indicates a dependency on nitrogenase for N supply could be a favorable nutrient supply strategy. pH behavior was similar between the N and P tests. It was concluded that PNSB has more tendency to tolerate P-deficient conditions better than N-deficient conditions, possibly due to P-storage mechanisms.

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## Investigation of the effect of heavy metals on biomineralization of the mineral forming bacteria

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#### **Abstract**

Heavy metal pollution is a serious environmental issue around the world due to its high toxicity, non-biodegradability, and long biological half-life. Many microorganisms, especially bacteria, have the ability to survive in the presence of these toxic metals by employing diverse pathways. Biomineralization is the process by which bacteria can mediate the formation of minerals and interact with heavy metals, mitigating the contact between the cells and toxic metals. The aim of this study is to investigate the potential of local bacterial strains isolated from sediments of Simaisma mangrove area to tolerate the toxicity of the impact of heavy metals such as chromium chloride, copper sulfate, nickel chloride, zinc chloride, and cadmium chloride. Moreover, the impact of the studied heavy metals on biomineralization by the mineral-forming strains is investigated. Interestingly, the *Halomonas spp.*, *Virgibacillus spp.*, and *Shewanella spp*. Exhibited tolerance to Cu and Ni up to 5 mM. The presence of Cd, Zn and Cr inhibited the formation of minerals. These results indicate the ability of bacteria to develop certain mechanisms to tolerate different concentrations of heavy metals in order to survive, which can be applied to this process to tolerate heavy metals and reduce their toxic effects on the environment and life.

#### By-product fishmeal replacement by insect meal in diets for Penaeus vannamei: effects in growth and health

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#### **Abstract**

High pressure on the use of fishmeal (FM) in aquaculture farming has led to the search for alternative sources to replace FM. By-product FM and insect meal (IM) are two proteic sources that could serve as alternatives to FM in shrimp diets. In the present study, five isoproteic (38% protein) and isolipidic (9%) diets were formulated for *Penaeus vannamei*, in which by-product FM was gradually replaced (0%, 25%, 50%, 75%, and 100%) by a mix of black soldier fly (BSF) larvae meal and soybean concentrate. The diets were tested in triplicate for 56 days at a density of 250 shrimps/m<sup>2</sup>. Each experimental diet was offered three times a day according to the feeding rate recommended by Jory et al., (2001). At the end of the experimental period, growth parameters and hepatopancreas status were evaluated. The counting of hepatopancreas tubule cells was performed for all treatments. Results indicate that neither by-product FM nor BSF meal alone supported acceptable growth. However, a mixture with up to 50% replacement showed improved growth parameters, especially final weight and total biomass. This effect is related to nutritional deficiencies in the IM and FM, which can be compensated when combined. Additionally, the hepatopancreas cell analysis revealed that 50% replacement led to larger blister cells (B-cells) and more reserve cells (R-cells), while complete FM replacement resulted in a higher count of embryonic cells (E-cells) in the tubular midgut. The results indicate that both by-products FM and IM can be alternative sources to fishmeal, and it is possible to produce it in Qatar, which will lead to reduced waste production as well, and can become interesting ingredients for aquaculture farming.

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#### Alcoholic extract of *Teucrium polium* exhibits remarkable antiinflammatory activity: *In vivo* study

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#### **Abstract**

**Context:** *Teucrium polium* (Family: *Lamiaceae*) is one of the local plants (flora) in Qatar that has been used in folk medicine to treat many illnesses. *Teucrium polium* is known for its antioxidant, analgesic, anticancer, and antibacterial activities in herbal medicine.

**Objective:** This study aimed to evaluate the anti-inflammatory activity through the  $\alpha$ -carrageenan-induced rat paw edema method.

Materials and methods: The anti-inflammatory effect of *Teucrium polium* ethanolic extracts is evaluated by of α-carrageen induced paw edema in adult *Sprague Dawley rat model*. The acute inflammation was induced by a sub-plantar injection of 100 μL of 1% α-carrageenan to the rat right hind paw. Three different doses (50,100,150 mg/kg B.wt) of the ethanolic extract of *T. Polium* were tested in different interval points (1, 3, 5 hours). Parameters such as, paw size, percentage inhibition of inflammation, level of cytokines (TNF-α and IL-1 β) were measured and analysed.

**Results:** The results demonstrated that all tested doses showed significant inhibition of  $\alpha$ -carrageenan-induced rat paw edema in a dose-dependent manner in the early and late phases of edema formation. the size of  $\alpha$ -carrageen induced paw edema was reduced significantly after one, three, and five hours of TP extract injection compared to the acute inflammation group. The maximum dose (150mg/kg B.wt) of extract resulted in the inhibition of inflammation in paw edema in contrast to the middle dose (100mg/kg B.wt) and the lower dose (50mg/kg B.wt).

**Discussion and Conclusion:** These results indicated that the ethanolic extract of *T. polium* plant possesses significant anti-inflammatory effects in *vivo* acute inflammation model.

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# Nanotechnology-Enhanced Delivery of Omega-3 Fatty Acids: A Biotechnological Solution

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#### Abstract

Introduction: Omega-3 polyunsaturated fatty acids (ω-3 PUFAs), including eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are primarily sourced from marine sources such as fatty fish, krill, and algae. They offer numerous health benefits, including cardiovascular protection, enhanced cognitive function, muscle mass maintenance, Improved bone density, and anti-inflammatory effects. Despite evidence supporting ω-3 PUFAs benefits, there are still challenges in achieving effective supplementation. Poor oral bioavailability and susceptibility to oxidative degradation reduce shelf life and impact consumer acceptability, functionality, nutritional value, and safety of fish oil supplements. Utilizing nanoparticles (NPs) for ω-3 PUFA delivery is an innovative Nano biotechnology approach that enhances bioavailability and stability while protecting against oxidative damage. Nano encapsulation technology enhances ω-3 PUFAs by forming a micelle network and minimizing interactions with other substances. This method prevents colour changes, masks undesirable flavours, allows controlled release of nutrients, improves product stability, and increases the biological availability. Innovative Nano biotechnology delivery systems for ω-3 PUFAs include liposomes, LDL nanoparticles, PEG liposomes, silver nanoparticles, resveratrol-based solid lipid nanoparticles, Nano emulsions with lactoferrin, and superparamagnetic nanoparticles like Nanotex, enhancing the efficacy and bioavailability of these supplements. Overall, these advancements in Nano biotechnology not only improve the effectiveness of ω-3 PUFAs but also pave the way for innovative health solutions.

**Methods:** A comprehensive literature review was conducted to explore the advancements in nanoparticle delivery systems for  $\omega$ -3 PUFAs. Databases including PubMed, Scopus, and Web of Science were systematically searched using key terms such as "nanoparticles," "omega-3 fatty acids," and "Nano encapsulation,". Inclusion criteria encompassed peer-reviewed articles published in the last 10 years, focusing on the bioavailability, stability, and health benefits of  $\omega$ -3 PUFAs delivered through nanoparticle systems.

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**Results and Discussion:** This review highlights advancements in nanoparticle delivery systems for  $\omega$ -3 PUFAs, showing that Nano encapsulation improves bioavailability and stability, addressing issues like oxidative degradation and poor absorption. Recent studies confirm that nanoparticles enhance the efficiency of  $\omega$ -3 PUFAs, emphasizing their potential to improve health outcomes.

Conclusion: This review underscores the critical role of nanoparticle encapsulation in enhancing the clinical efficacy of  $\omega$ -3 PUFAs for improved health outcomes.

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### Flow Cytometry Core Facility

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#### **Abstract**

**Introduction:** Flow cytometry is a laser-based technology that is used to measure physical and chemical differences of a cell or particles in a suspension. It is based on scattering of light, excitation and emission of fluorescence. Flow cytometry has three main parts: fluidics, optic system and electronic system. The fluidics system is responsible for transporting cells/particles in a fluid stream to the laser beam. The optic system uses lasers for excitation and collection optics, which are the photomultiplier tubes and photodiodes that generate the visible and fluorescent light signals used to analyze the sample. The electronic system converts the light signals to electronic signals processed by computer to be digitized for data analysis.

**Methodology:** The Flow Cytometry Core Facility offers access to high-end Flow Cytometers such as BD LSR Fortessa, BD Symphony A5, Cytek Aurora and FACS Aria III cell sorter, actively providing researchers with adaptive setups and dedicated support. We are performing wide range of assays from invitro, ex-vivo experiments and with the specimen collected from human subject's such as blood, peripheral mononuclear cells (PBMCs), serum/ plasma, single cell suspension from tissues, bone marrow sample and body fluids (BALB, Synovial etc.).

**Results:** We are performing apoptosis assays, cell cycle, caspase 3, parp, pH2AX, cellrox, mitoSOX, mitochondrial membrane potential (MMP), intracellular GSH assay, autophagy assays to screen the natural compound against cancer cell lines. From blood, PBMCs and single cell suspension from tissues, we are performing a deep phenotypic and functional profiling of immune cell populations including the rare one such as  $\gamma\delta T$ , iNKT, MAIT cells, innate lymphoid cells (ILCs), plasmablast, inflammatory epidermal dendritic cells (IDECs), iNOS DCs etc. From serum and plasma samples, we are performing exosome detection, quantification of cytokines and chemokines and detection of inflammasomes. Currently, we are deep immunophenotyping PBMCs from colorectal cancer patients and comparing the immune cell composition between responder and non-responder patients to chemotherapy treatment. We are also phenotypically and functionally characterizing the immune cell population in the peripheral blood of atopic dermatitis, prurigo and alopecia patients before and after therapy.

**Conclusion:** These methods can be used to screen the anti-cancerous property of a natural compound, to analyze the role of different immune cell population in driving disease progression in different patients' cohorts, such as treated, untreated, responder and non-responder.

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## Insights into the Physical and Chemical Dynamics of Qatar's Agricultural Soils

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#### **Abstract**

The exponential population growth and massive inflation in Qatar's agricultural activities to become self-sufficient has possibly led to the entry of numerous pollutants into the environment, that become threat to living beings and the ecosystem. The unregulated use of wastewater and animal manure on agricultural soil has led to the entry of contaminants, like trace elements (TEs), drugs, etc. into the food chain, causing negative impacts on soil health and crop quality. TEs can cause long-term effects such as soil degradation and chronic exposure to humans through food consumption, resulting in serious health problems like neurotoxicity, reproductive disorders, and cancer. The physical properties of soil like pH, salinity, conductivity, corrected specific conductivity (SpC), temperature, total dissolved salts, metal content and pH also play a crucial role in determining contaminant behaviour and mobility. Understanding these parameters is thus crucial for further downstream analysis and ensuring the health of the soil. Soil samples were collected from 6 different sites (site-1, site-2, site-3, site-4, site-5, and site-6) and their soil physical characteristics were assessed such as soil type, soil temperature, SpC, total dissolved solids (TDS), and soil pH) and TEs levels, i.e., boron, (B), copper (Cu), calcium (Ca), magnesium (Mg), iron (Fe), potassium (K), zinc (Zn), sodium (Na), manganese (Mn), and phosphorous (P). The granulometry of the soil revealed that the soil dominated mostly as silt sand. A high proportion of clay and silt was found for site-6 (45.28%) followed by site-4 (41.04%). The elements Cu, Mn, P, Zn concentrations were higher for site-4 and lower for site-2 among all. The correlation showed that soil physical properties are positively and negatively correlated with TEs. These results reflect the influence of agricultural management practices and natural geochemical factors at the different sites. This work highlights the importance of understanding the relationship between soil characteristics and TEs. By examining TE content and soil properties across various agricultural soils in Qatar, the study underscores the need for sustainable soil management practices. The findings provide critical insights into preserving soil health, which is essential for safe food production and longterm environmental sustainability.

**Keywords:** Trace elements, physical characteristics, agricultural soil, soil health

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### Enhancing Scientific Research through Histology and Imaging (H&I) Core Services at the Translational Research Institute, HMC, Doha, Qatar.

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#### **Abstract**

Histology and advanced imaging techniques are pivotal in modern biological research, offering insights into cellular and tissue structure, function, and pathology. The Histology and Imaging core (H&I) at the Translational Research Institute (TRI), Hamad Bin Khalifa Medical City, offers a range of histological techniques which includes chromogenic staining for structural and morphological assessment, immunohistochemistry, immunofluorescence for protein level analyses and in-situ hybridization for mRNA analyses. Complementary imaging modalities, such as light, confocal and fluorescence microscopy are utilized to obtain high-resolution images, enabling detailed morphological and quantitative assessments. Here we highlight the variety of services provided at the H&I Core for advancing research, showcasing the methodologies, technologies, and collaborative opportunities we offer to empower researchers to produce impactful and reproducible scientific findings

# Exploring PRMT5 and PRC2 Crosstalk in Triple-Negative Breast Cancer and Unveiling Mechanisms of Apoptosis

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#### **Abstract**

Histone modification is a crucial mechanism in epigenetic regulation, significantly affecting gene expression. Histone arginine methylation has become a focus of attention, particularly in cancer, where PRMT5 plays a key role. PRMT5 symmetrically methylates histones at gene promoters, suppressing anti-cancer genes and promoting tumor cell proliferation. Furthermore, PRMT5 disrupts growth control networks, contributing to tumorigenesis. Our research showed that when we blocked PRMT5, we observed significant alterations in the profiles of gene expression. In MDA-MB-231, RBL2 expression increased 3-fold, while EZH2 expression decreased 2-fold. Notably, EZH2 target genes CASP10 and DAP1 exhibited differential responses; CASP10 increased 2-fold, while DAP1 remained unchanged. Additionally, c-MYC expression rose 1.5-fold, concurrent with a 4-fold increase in P53 expression. Interestingly, in this context, BAX and BCL2 expressions remained stable. Similarly, in MDA-MB-468, RBL2 expression increased 3-fold, accompanied by a 2-fold reduction in EZH2 expression. The EZH2 target genes CASP10 and DAP1 also showed consistent two-fold upregulation, with DAP1 exhibiting a 1.5-fold increase. c-MYC expression mirrored that of MDA-MB-231, increasing by 1.5 folds. However, the fold increase in P53 expression was slightly lower at threefold. In contrast, BAX expression increased 4-fold, while BCL2 expression decreased 2fold, as determined by real-time PCR analysis, indicating a prominent shift toward activating apoptosis. PRMT5 indirectly increases EZH2 protein levels, which enhances tumor cell survival by silencing pro-apoptotic genes in TNBC cells. Inhibition of PRMT5 induces TP53 and c-MYC transcription, triggering apoptosis and inhibiting proliferation. PRMT5 inhibition induces growth arrest and cell death in MDA-MB-231 and MDA-MB-468 cells. Moreover, our results demonstrate a significant halt in proliferation, while in migration assays, it markedly reduces migration in MDA-MB-231 and completely halts migration in MDA-MB-468, highlighting its potential therapeutic importance.

### The Proteomics Core Facility - An Overview

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#### Abstract

**Background**: Proteomics is the large-scale study of proteins, including their structures, functions, abundances, modifications, sub-cellular localization and interacting partners and networks, to understand cellular processes. It involves several techniques to analyze the complete set of proteins (the proteome) expressed by an organism, tissue, or cell type at a specific time. The Proteomics Core Facility (PCF) at TRI provides a full service from sample preparation to data analysis and visualization for identification and quantification of proteins from biological samples/specimens of varying origin (clinical/non-clinical) using mass spectrometry. We employ shotgun, label free, non-targeted approach to deliver high-quality proteomic data through advanced mass spectrometry based quantitative proteomics. Moreover, we offer a full suite of including project design, customized protocol optimization, project execution, troubleshooting, data analysis and visualization to support projects for collaborators. Our facility is equipped with the latest high-resolution mass spectrometer (tims-TOF Pro-Bruker).

**Methods:** Sample preparation involves protein extraction from cell/tissues/skin tape strips using a lysis buffer followed by protein quantification. Samples such as plasma/serum/saliva must undergo depletion to remove several high abundant proteins that mask the identification of low abundant proteins in the sample, and the protein quantification is done post depletion and concentration. The proteins then undergo reduction and alkylation followed by digestion and we employ both in-gel and in-solution digestion techniques, wherein the proteins are digested overnight using Trypsin/Lys-C enzyme. The peptides are then purified, and mass spectrometry analysis and data acquisition are done using a timsTOF Pro mass spectrometer that generates spectra which represent the peptide profiles in the sample.

**Results and Discussion:** A comprehensive whole proteome analysis as per the requirements of the investigator is performed. In our core facility, we employ advanced bioinformatics tools to analyze the identified proteins and deliver necessary data providing insights to biological pathways, protein interactions and functional annotations (including diagrams, heat maps, plots and graphs). Our facility's contributions to some significant discoveries and a plethora of publications highlight our significance in advancing scientific advancement.

**Conclusion**: This abstract highlight the key steps in PCF, from sample preparation to data analysis. Each step can be tailored based on specific research objectives and the nature of the samples being analyzed. Proteomics technique is an add on to enhance research in fields such as cancer biology, drug discovery, therapy monitoring and biomarker development. To satisfy the changing demands of the research community, we are dedicated to expanding our services and strengthening collaborations.

### Role of Molecular pathophysiology core for translational research

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#### **Abstract**

**Objective:** The main objective of the Molecular pathophysiology core is to provide molecular biology/Biochemical assays investigational support /services to the research investigators of Hamad Medical Corporation research community. It is our goal to offer the highest quality Biochemical & Molecular assays and services possible in the most cost-effective and timely manner. In addition, we also carry out our own basic and clinical projects approved by Medical Research Center, Hamad Medical Corporation.

**Methodology & Assays:** We used various assays at our core including Cell proliferation, Apoptotic assays, Western blotting analysis for protein expression, Gene silencing techniques, Apoptotic markers, Immunoprecipitation, co- immunoprecipitation assays and cytokine quantitative analysis.

**Results/finding:** In collaboration with various clinician as well our own research generated many publications:

Systemic and cerebro-cardiac biomarkers following traumatic brain injury: an interim analysis of randomized controlled clinical trial of early administration of beta blockers. Sci Rep. 2024 Aug 23;14(1):19574

Plasma neurological biomarkers as a measure of neurotoxicity in pediatric dental general anesthesia: a prospective observational feasibility study. <u>Eur Arch Paediatr Dent. 2024</u>
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Targeting of S-phase kinase associated protein 2 stabilized tumor suppressors leading to apoptotic cell death in squamous skin cancer cells. <u>Biochim Biophys Acta Mol Basis</u>

<u>Dis.2024 Oct;1870(7):167286.</u>

In vitro evaluation of Neosetophomone B inducing apoptosis in cutaneous T cell lymphoma by targeting the FOXM1 signaling pathway. <u>J Dermatol Sci. 2023 Nov;112(2):83-91</u>.

### Diversity of heterotrophic bacteria involved in mineral formation in Qatari Sabkhas and Mangrove forest in Qatar: A comparative study of adaptation and biomineralization

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#### **Abstract**

Mangroves and Sabkhas in Qatar are considered sites of adaptation and biodiversity. Mangroves have special roots, especially "aerial" roots. The sediments surrounding "aerial" roots are inhabited by various microbial communities existing in symbiotic relationships within the mangroves' rhizosphere. In contrast, Sabkhas are predominantly colonized by microbial mats, encompassing green macroalgae, microalgae and cyanobacteria, alongside populations of both heterotrophic and autotrophic microorganisms. However, saline sedimentary carbonate minerals typically accumulate below the surface of Sabkhas and mangroves. Consequently, these specific Qatari ecosystems, can serve as sink for CO<sub>2</sub> capturing and fixation. This study is the first comparative study of the diversity of mineral-forming bacteria in Khor Al-Adaid and Dohat Faishakh Sabkhas and Simaisma mangroves forest. The identification, categorization and assessment of bacterial biodiversity was performed using MALDI TOF MS and PCA analysis. In addition, the bacterial mineral formation potential, the minerals diversity were elucidated using SEM/EDS and XRD analyses. Our findings demonstrated the potential of these two ecosystems to develop different mechanisms of CO<sub>2</sub> capturing and fixation. Our research revealed that several local dominating bacterial strains, mainly, Virgibacillus and Vibrio are the main contributors to diverse mineral formation arising from various adaptation routes. These findings confirm the hypothesis that these ecosystems are actively engaged in biological fixation of CO2 into minerals.

**Keywords:** Sabkha, Mangrove forests, MALDI-TOF, PCA, Biomineralization.

### Nature-Based Biostimulants for Mangrove Resilience in the Extreme Environments of the Arabian Gulf

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#### **Abstract**

Mangroves are salt-tolerant woody plants predominantly found in the intertidal zones of tropical and subtropical regions, where they are regularly subject to tidal inundation and salinity. In the Arabian Gulf ("the Gulf"), mangroves are primarily limited to single species Avicennia marina (A. marina) and thrive in one of the world's most extreme marine environments, characterized by high temperatures, elevated salinity, nutrient-poor sediments with low organic matter, and limited freshwater. The conservation of mangroves in the region is essential, as their loss threatens marine biodiversity, disrupts carbon sequestration, and jeopardizes the resilience and stability of the mangrove ecosystem. Hence, biotechnologybased interventions are gaining recognition as promising eco-friendly solutions for enhancing the resilience of mangrove ecosystems. Recent advancements in marine biotechnology focus on utilizing biostimulants to enhance mangrove growth and support sustainable friendly ecosystem restoration efforts in the Gulf's extreme environmental conditions. This short review elucidates recent approaches and the potential advantages of using biostimulants in the Gulf, namely plant growth-promoting bacteria, seaweed extracts, fish emulsions, and treated sewage sludge in enhancing the resilience and growth of mangrove ecosystems in nutrient-deficient and high-saline environments. For instance, Streptomyces sp., a plant growth-promoting bacterium isolated from the sediments of mangrove rhizosphere, has been shown to enhance A. marina growth along the UAE coast by improving nutrient availability, synthesizing growth regulators, and modulating stress responses, leading to increased root and shoot biomass as well as higher photosynthetic pigment levels [1]. Kelp-derived seaweed extracts have proven to be potent biostimulants, enhancing soil nutrients and improving the uptake of essential micronutrients such as phosphorus and magnesium, thereby reducing stress and increasing biomass and leaf area [2]. Fish emulsions, rich in amino acids and nutrients, effectively promote nutrient absorption in mangrove seedlings as an eco-friendly approach [3]. Another study [4] demonstrated the efficacy of nutrient-rich sludge from an offshore treatment facility in enhancing the growth and survival of mangrove seedlings. However, utilizing biostimulants in the Gulf faces significant challenges, primarily due to the extreme environmental conditions and operational difficulties related to large-scale use in harsh coastal settings. Hence, this review explores the potential benefits and practical limitations, offering perspectives on their contribution to sustainable mangrove restoration in the region.

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### Metabolomics: A cutting-edge technology in human health and disease

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#### **Abstract**

**Introduction:** Metabolomics is the branch of omics that deals with the identification and quantification of small molecules. The basic mission of the metabolomics core is the identification and quantification of small molecules in a diverse range of sample matrices to explore and understand and provide meaningful insights into the biological system.

**Methods**: Metabolomics (MET) core at Translational research institute (TRI) in Hamad medical city, Hamad medical corporation is equipped with cutting-edge technologies (Triple Quad 5500+ LCMS system) and automation that can perform up to 78 samples at one run with considering quality control aspects, enabling the most suitable place for metabolomics analysis done by high-experienced and well-trained mass spectrometry scientists.

**Results:** Currently, our workflow is predominantly using a targeted metabolomics approach using Biocrates technology and is suitable for biological fluids, culture and tissue-based studies, nutritional or environmental samples. Interestingly, we provide accurate and highly reproducible data of more than 1000 metabolites (Lipids, Fatty Acids, Amino Acids, Organic acids. Biogenic amines. vitamins and cofactors. hormones. Acylcarnitines, Phosphatidylcholines, LysoPCs, Sphingomyelins, Sugars, neurotransmitters, Triglycerides, Cholesterol esters, Diglycerides, Microbial metabolites etc.) apply to more than a hundred metabolomic pathways and assisting in data analysis. The Investigators can get their study data in the form of tables. Moreover, we also perform data analysis on a case-to-case basis.

**Discussion:** Investigators need to first contact the core manager and set up a meeting to discuss the potential use of the MET core facility to perform the metabolic profiling of their approved study samples.

**Conclusion:** MET core at TRI provides services and help the investigators in deciphering the role of metabolites in disease and health.

**Key words:** Metabolomics, Small molecules, Biocrates, data analysis.

# Comparative analysis of two types of microalgae and insect meal inclusion in nursery *Machrobrachium rosenbergii* culture

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#### **Abstract**

The aquaculture of *Macrobrachium rosenbergii* is a significant part of global shrimp farming due to its high economic value and adaptability to diverse farming systems (Zarantoniello et al., 2023). Optimizing the nutrition of this species, especially during the critical nursery phase, is essential for improving growth rates and survival. Recent research has focused on enhancing traditional diets with microalgae such as Haematococcus pluvialis and Spirulina sp., known for their rich content of essential nutrients and bioactive compounds, to support better health and performance in shrimp aquaculture (Radhakrishnan et al., 2014). In this study, two microalgae species were included: Spirluina and Heamatococcus puluvalis, with different inclusions (2.5% and 5% each) along with by-product fish meal and insect meal as protein sources; all experimental diets were isoproteic (38% crude protein) and isolipidic (9% lipids); the carotenoid content of the experimental diets were measured by HPLC. The experimental treatments were tested in triplicate for 60 days at a density of 240 shrimps/m<sup>3</sup>. At the end of the experimental period, the zootechnic performance, overall color, and hepatopancreas status were evaluated. It was found that the inclusion of microalgae had no negative effects on growth parameters in shrimp compared to the control. The inclusion of 5% of *Heamatococcus* had a significant effect on shrimp redness (P<0.05) when the shrimps were cooked, and Spirulina 5% treatment had the highest values of blue color intensity in raw shrimps. Histological analysis showed that there was a significant difference between the amount of B-cells and Rcells between treatments, and the B-cell area between the treatments (P<0.05). The overall analysis indicates that microalgae have an effect in M. rosenbergii coloration and hepatopancreas status, and that can improve the quality of the final product making it more attractive for the human market.

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### Ex- situ Sexual Propagation of Native Corals: A Restoration Approach for Qatar's Reefs

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#### **Abstract**

Coral reefs are considered as one of the most productive, diverse and economically important ecosystems providing shelter, food and habitat to about 25% of the marine species. However, coral reefs face tremendous challenges in various ways such as climate change, pollution, and overfishing that have caused massive coral bleaching, illness, and mortality and are being threatened with regional extinction, highlighting the critical need for comprehensive conservation and restoration efforts in Qatar. Most corals in the Arabian Gulf are broadcast spawners, with only one annual spawning event, which constitutes a critical bottleneck for any restoration strategy relying only on natural reproductive cycles. Understanding their reproductive cycles and developing the ability to control and manipulate these cycles with the goal of producing sexual off springs multiple times per year is thus critical for accelerating the innovation of coral reef restoration technologies in Qatar. Qatar University's Coral Research Lab is focused on developing locally adapted and innovative technologies for inducing the sexual reproduction of native coral species in land-based hatchery systems and enhancing natural coral populations with the hatchery produced offspring. Two mesocosm spawning system systems were setup with 4 species of corals (Acropora downingi, Platygyra daedalea, Coscinarea monile and Dipsastrea pallida) which are observed in the reefs of Oatar. In season spawning was observed for the coral species in programmed spawning systems. Also, out of season spawning were induced and observed in the corals by manipulating the natural spawning cycles. Individual reproduction behavior and spawning cycles, settlement rates, survival and growth of the coral spat are monitored at regular intervals. The natural spawning periods of 4 local coral species (Acropora downingi, Platygyra daedalea, Coscinarea monile and Dipsastraea pallida), were determined and multiple out-of-season spawning events were induced for these 4 coral species. Several trials are currently underway, to improve our husbandry techniques at the post settlement stage (e.g., co-culture with herbivorous snails, manual removal of algae, optimization of light levels and feeding regime, etc). The finding of this project will contribute to accelerate and strengthen the implementation of coral reef restoration initiatives in the Arabian Gulf region.

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# Morphological changes induced by the antifungal properties of Brown macroalgae *Hormophysa triquetra* in plant pathogenic fungi

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#### **Abstract**

Recently, there has been increasing interest in macroalgal extracts due to their rich content of valuable compounds and biologically active metabolites, particularly for their antimicrobial properties. This study investigated the antifungal effects of aqueous, ethanolic, and methanol: chloroform extracts from the brown macroalga Hormophysa triquetra, collected from Ad-Dukhan, Qatar. The extracts were tested for antifungal activity against Fusarium species, Alternaria alternata, and Colletotrichum gloeosporioides using the agar disc diffusion method, while the pour plate method was used to evaluate activity against *Penicillium citrinum*. The results showed that the aqueous extract had no effect on the phytopathogens, but the ethanolic (ET) and methanol-chloroform (MCF) extracts exhibited antifungal properties against Fusarium species, A. alternata, and P. citrinum. Although the extracts did not inhibit fungal radial growth, they caused notable morphological changes, such as hyphal deformation, thickening, vacuolization, and the appearance of pseudo-hyphal forms. These effects resemble those of fungicides, indicating the antifungal potential of the extracts. For P. citrinum, no inhibition was observed at the lowest concentration of 1 mg/mL. However, ET at concentrations of 5 mg/mL and 20 mg/mL inhibited growth by 41% and 63%, respectively, while MCF at the same concentrations reduced growth by 38% and 50%. Gas chromatographymass spectrometry (GC/MS) analysis identified various bioactive compounds in both ET and MCF extracts, with fatty acids being the predominant components.

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# **Exploring Desalination Brine as a Sustainable Growth Medium for Microalgae Cultivation and valorization of obtained biomass**

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#### **Abstract**

**Introduction:** Access to clean, safe water is becoming more difficult as a result of the depletion of freshwater supplies brought on by expanding worldwide demand. The rising demand for water is also greatly influenced by the fast-paced industrialization and changing environment in highly populated places. Roughly half of all seawater desalination projects worldwide are located in the Middle East and North Africa (MENA) area, which includes Qatar (Al-Saidi et al., 2024). This highlights the critical role that desalination plays in meeting water demands. The desalination process yields two separate streams: concentrated brine that is usually released back into the sea and drinkable water for human use. The conventional approach of discharging brine without further utilization neglects a valuable resource (Gilani et al., 2024). This research explores the potential of desalination brine as a growth medium for microalgae cultivation, presenting a promising avenue for sustainable and resource-efficient practices. Microalgae, essential contributors to marine ecosystems, possess the remarkable ability to convert sunlight, carbon dioxide, and nutrients into biomass through photosynthesis.

**Methodology:** This study conducted at Qatar University presents a comprehensive analysis of the physicochemical characteristics and microbial impact on desalination brine, specifically focusing on its potential as a growth medium for microalgae cultivation.

**Results and discussion:** The chemical composition of discharge brine from seawater desalination plant encompasses various microelements essential for microalgal growth. The physicochemical characterization revealed varying properties of different brine brine samples (RO brine, MSF brine and the output brine (brine discharged back to sea)). The growth rate of *Chlorocystis* and *Halospira* strains was investigated under different conditions, emphasizing

the positive impact of nitrate supplementation on biomass productivity. The output brine enriched with nitrates, exhibited the highest biomass productivity for both microalgae strains, demonstrating improved lipid productivity and protein content. this comprehensive analysis highlights the impact of brine discharge on growth, productivity, and biochemical characteristics of both local isolates *Chlorocystis sp.* and *Halospira sp.* Furthermore, the study investigates the phycocyanin production in *Spirulina*, in various brines. Gas Chromatography-Mass Spectrometry (GC-MS) analysis revealed shifts in chemical compositions when microalgae were introduced to brine with nitrates, indicating biotransformation capabilities.

**Conclusion:** The findings suggest that discharged Brine can serve as a viable growth medium for algae cultivation, offering a nutrient-rich environment that positively influences biomass, lipid, and protein production. Utilizing desalination wastewater helps reduce the costs associated with conventional culture media for producing valuable biomass (Matos et al., 2024).

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# Tailoring Cu-MOFs for Enhanced Antimicrobial Activity: A Synthesis and Characterization Study

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#### Abstract

Bacterial infection poses a significant concern and represents a global threat. Antibacterial drugs are common agents used to treat bacterial infections. However, their misuse causes resistance of bacteria to different antibiotics. On the other hand, copper-based metal-organic frameworks (Cu-MOFs) showed extraordinary antibacterial effectiveness against both Gramnegative and Gram-positive strains. This study focuses on investigating the specific chemical and physical characteristics of Cu-MOFs, investigating their antibacterial capabilities on three representative bacteria, and linking their structure to their function. Analysis through Fourier Transform Infrared Spectroscopy (FTIR) of untreated and Cu-MOF-treated bacterial cells revealed distinct features indicating surface modifications of bacterial cells due to Cu-MOF interaction. The crystalline structure of synthesized Cu-MOFs was validated using X-ray diffraction (XRD) analysis, exhibiting peaks at 14.7° and 24.3°. X-ray photoelectron spectroscopy (XPS) was used for the analysis of the Cu-MOFs showing characteristic peaks confirming their elemental composition (Cu, C, N, O, S). Transmission Electron Microscopy (TEM) analysis verified the significant biocidal activity of Cu-MOFs against both the Gramnegative and Gram-positive bacteria. The findings demonstrated the role and mechanisms of synthesized Cu-MOFs as antibacterial agents in both categories of bacteria. However, their structure is shown more potent against the Gram-positive bacteria (Bacillus subtilis and S. aureus), although accumulating the Cu-MOFs intracellularly. The Cu-MOFs nanoparticles entered the cell of the Gram-negative strains including E. coli and caused a clear change of the form, from rod to swollen-circular. Overall, the study highlights the broad-spectrum potential of Cu-MOFs, making them strong candidates for developing antimicrobial agents in the future, for instance, antibiotics.

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### Investigation of toxigenic mycobiota and mycotoxins in dry fruits and edible nuts marketed in Qatar

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#### **Abstract**

This study investigates fungal contamination and mycotoxin presence in dry fruits and edible nuts available in Qatar, addressing food safety concerns linked to the country's reliance on imported products. A total of 88 samples, including 40 dry fruits and 48 edible nuts, were analyzed to assess potential health risks associated with toxigenic fungi, particularly Aspergillus and Penicillium species, known for producing harmful mycotoxins like aflatoxins (AF), zearalenone (ZEN), and ochratoxin A (OTA). Findings revealed that all samples showed contamination, with peanuts exhibiting elevated aflatoxin levels and walnuts containing high ochratoxin A levels, both exceeding safe limits. All dry fruit and nut samples were found to contain toxigenic fungi, including A. niger, A. carbonarius, and A. flavus. The presence of these fungi led to the detection of various mycotoxins, notably zearalenone in nuts and ochratoxinA in dry fruits, with aflatoxins detected across multiple samples, raising public health concerns. To mitigate contamination, the study also explored the potential of camel gut microbiota as a natural biocontrol method. Bacterial strains isolated from the camel gut exhibited significant antifungal properties, inhibiting the growth of A. flavus, A. carbonarius, and P. citrinum in vitro.

Additionally, in vivo tests showed that bacterial volatiles from these microbes effectively reduced fungal growth and mycotoxin production in contaminated dry fruits and nuts. GC-MS/MS analysis identified four anti-fungal compounds from these bacteria, indicating the promise of camel gut microbiota as an eco-friendly approach for managing contamination risks. These findings underscore the need for stricter regulation on imported foods in Qatar and highlight the potential of innovative biological controls to enhance food safety, ultimately safeguarding public health in Qatar.

## Linking mRNA translation to cell cycle progression: a lesson from WARS-1

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#### **Abstract**

The dysregulation of mRNA translation is a common occurrence in tumors, attributed to the heightened protein synthesis demands and rapid proliferation of cancer cells (Weaver, 2011). Genetic mutations in key genes associated with protein synthesis, such as mTOR, are frequently observed in cancer patients (Averous & Proud, 2006). Despite ongoing efforts, the exact connection between mRNA translation defects and cancer progression remains uncertain.

A crucial aspect of protein translation involves the binding of amino acids to their corresponding tRNA, a process facilitated by a set of proteins known as Aminoacyl tRNA synthetases (AARS) (Kofman et al., 2021). In cancer patients, mutations in the tryptophanyl tRNA synthetase (WARS1), a member of the AARS family, is frequently detected and strongly linked to metastasis (Sung et al., 2022). Studies involving the knockdown of *wars-1* in *C. elegans* have demonstrated disruptions in germ cell mitosis and cell cycle arrest at the G2/M phase transition, regulated by the cyclin-dependent kinase 1 (CDK1) (Izadi et al., 2024).

Further exploration in our lab has revealed that depletion of WARS1 disrupts protein translation, resulting in CDK1 phosphorylation, subsequent cell cycle arrest at the G2/M checkpoint in addition to chromatin bridges formation. Using a high-throughput RNAi screen, coupled with RNA sequencing, we identified crucial key players in the aforementioned process including *cdc-25*, *ruvb-1* and *ruvb-2* to be significantly downregulated following *wars-1* knockdown.

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# Genotypic Selection and Deployment of Heat Tolerant Tomato (Solanum lycopersicum L.) Varieties Using QTL Markers for Enhanced Productivity and Quality in Qatar Greenhouses

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#### Abstract

High temperature stress significantly impacts tomato production in tropical and subtropical regions worldwide. This study evaluated 329 tomato varieties in Qatar under net greenhouse conditions for 4 years to identify heat-tolerant genotypes. After initial screening, 71 diverse hybrid and pure line varieties were selected for detailed analysis under greenhouse conditions, where mid-day temperatures frequently exceeded 40 °C. The varieties were assessed for key traits including fruit size, weight, hardness, locules, fruit set percentage, total soluble solids (TSS), and yield. Using 104 SNP markers previously linked to heat tolerance, genotyping revealed 19 markers that reliably identified heat-tolerant varieties based on improved fruit yield, fruit set, and TSS. These markers are located on chromosomes 1, 5, 6, 8, 9, and 12, with two particularly important marker clusters on chromosome 6 showing significant effects on all three traits. Notably, 18 of the 19 SNP markers were mapped within gene bodies, including genes encoding ABC transporters, protein kinases, and phospholipase C. Phenotypic analysis revealed significant differences among genotypes for all assessed traits, with fruit set and yield showing no significant variation among fruit types (globe, plum, cherry, oxheart, and beefsteak), making them reliable indicators of heat tolerance. Several of these markers aligned with heat tolerance QTLs reported in other studies.

Based on combined phenotypic and genotypic analysis, five elite varieties were identified as suitable for heat-stressed environments in Qatar, with some varieties showing up to 100% favorable alleles for yield-related traits. These selections demonstrated consistent performance across multiple growing seasons. The findings have broader implications beyond Qatar, as the identified markers can be used by breeders worldwide for marker-assisted selection of heat-

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tolerant tomato varieties. This work provides valuable tools for developing climate-resilient tomato varieties adapted to high temperature conditions.

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**Keywords:** heat tolerance; QTL mapping; tomato genotypic; SNP markers

### From Field to Genome: Biotechnological Characterization of Spore-Forming Bacteria in Qatari Soil Using Metagenomic

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#### **Abstract**

Arid regions, presented by the soils of Qatar, host distinctive ecosystems where microbial life has evolved to survive adverse conditions, including hot temperatures, limited water supply, and nutrient deficiency. Spore-forming bacteria, especially those in the *Bacillus* genus, have attracted interest because of their resilience and potential biotechnological uses in agriculture, environmental management, and industrial processes. This research investigates the diversity, metabolic capabilities, and industrial uses of spore-forming bacteria extracted from Qatari soils, utilizing a blend of field sampling, microbial cultivation, and metagenomic analysis.

Soil samples were obtained from selected ecological zones around Qatar to document microbial diversity under varying environmental circumstances. After collecting samples, researchers used traditional methods to cultivate spore-forming bacteria and then recovered DNA from bulk soil samples. High-throughput metagenomic sequencing elucidated these microbial communities' taxonomic makeup and functional capabilities, providing a genome-level perspective on spore-forming bacteria in dry soils.

The metagenomic study revealed a rich array of spore-forming bacteria, especially among the *Betaproteobacteria*, *Actinobacteria*, and *Alphaproteobacteria*, which had many biotechnologically significant characteristics. The functional annotation of metagenomic data identified genetic markers linked to stress tolerance, nutrient cycle, and enzyme activity pertinent to agricultural and environmental sustainability applications. I also identified pathways related to cell growth, transcription, translation, and nutrient-transforming activities, indicating potential benefits for soil health and crop yield in arid agricultural environments.

This comprehensive investigation illustrates the biotechnological potential of spore-forming bacteria in Qatari soils. Characterizing these bacteria at the genetic level enhances our understanding of their adaptation to extreme settings and enables us to utilize their capabilities for practical purposes. The research enhances our comprehension of microbial diversity in arid habitats and underscores the significance of metagenomic methodologies in identifying novel microorganisms and genetic characteristics applicable to sustainable biotechnological solutions. Global challenges require innovative approaches to enhance agricultural output and environmental sustainability; the unique microbial resources in Qatar's soils provide promising avenues for future research and application.

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### In Silico-Engineered Antimicrobial Peptides: Protecting Against Botrytis cinerea and Preventing Food Spoilage

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#### **Abstract**

*Botrytis cinerea*, a fungal pathogen responsible for grey mold in various post-harvested plant products, poses a significant global threat due to its implications for food safety and economic security. This pathogen's ability to persistently infect a wide range of crops leads to considerable losses in food quality and supply, impacting both local and global markets. To mitigate this issue, research has increasingly focused on developing safe and efficient fungicides to prevent fungal growth associated with food spoilage.

In the present study, antimicrobial peptides (AMPs), designed through computational (in silico) methods, were evaluated for their antifungal activity specifically against *Botrytis cinerea*. These AMPs, engineered for targeted effectiveness, displayed remarkable antifungal activity, completely inhibiting fungal growth at the highest concentrations tested (2500, 1250, and 625  $\mu$ g/ml). This complete inhibition suggests a potent mechanism by which the AMPs disrupt fungal cell integrity or metabolic processes, effectively halting the growth and spread of the pathogen.

To assess the safety profile of these AMPs, we also conducted cytotoxicity tests using Alamar Blue assays, which measure cell viability based on metabolic activity. Neonatal fibroblast cells treated with these peptides were evaluated to ensure that the AMPs did not exhibit harmful effects on non-target cells. The results indicated that the peptides were effective at concentrations as low as 312  $\mu$ g/ml without compromising the health of fibroblast cells, underscoring their selective antifungal properties.

These findings highlight the potential of in silico-designed AMPs as promising alternatives to traditional fungicides in the fight against food spoilage fungi. Unlike some conventional chemical treatments, which may carry risks of toxicity or environmental damage, AMPs offer a targeted approach that could minimize adverse effects on non-target organisms and reduce chemical residues in food products. This study emphasizes the potential of bioengineered AMPs to support a safer, more sustainable agricultural practice and address the rising demand for effective biocontrol agents in food preservation.

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# Diversity and Conservation of Plant Genetic Resources at Qatar National Gene Bank: A Decade of Collection and Documentation (2012-2024)

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#### **Abstract**

Qatar National Gene Bank, Agriculture Research Department, Ministry of Municipality, has been actively collecting and preserving plant genetic resources for food and agriculture (PGRFA), with a significant focus on native and naturalized species. From 2012 to 2024, the gene bank has accumulated 1,132 accessions representing over 150 genera and approximately 200 unique species from various locations across Qatar.

The collection activities began in 2012 with initial collections focusing on important native desert species. Key indigenous species include *Prosopis cineraria* (Ghaf), *Vachellia tortilis* (Samr), *Vachellia ehrenbergiana* (Salam), *Ziziphus nummularia* (Sidr), and *Leptadenia pyrotechnica* (Markh). Important medicinal plants in the collection include *Teucrium polium*, *Anastatica hierochuntica*, *Citrullus colocynthis*, and *Peganum harmala*. The collection has also prioritized native grasses such as *Cenchrus ciliaris*, *Panicum turgidum*, *Pennisetum divisum*, and *Cymbopogon commutatus*, which are crucial for livestock feed and soil stabilization.

A significant portion of the collection comprises crop species and their varieties. The Solanaceae family is particularly well-represented, with extensive collections of *Solanum lycopersicum* (tomato) including over 100 heirloom varieties and breeding lines from F2 to F8 generations. Other important crop genera include *Capsicum*, *Allium*, and *Phoenix* (particularly *P. dactylifera* with multiple local date palm varieties).

The collection sites span diverse ecosystems across Qatar, including: Northern rawdahs (depressions): Rowdat Rashid, Rowdat Al Faras; Coastal areas: Al Khor, Al Dhakhira, Ras Laffan; Southern regions: Al Wakrah, Mesaieed; Western zones: Dukhan, Umm Bab; and Central agricultural areas: Al Shahaniya, Al Jumayliyah

The gene bank maintains detailed documentation of each accession's habitat and ecological data. Desert-adapted species like *Rhanterium epapposum*, *Haloxylon persicum*, and *Salsola imbricata* are particularly valuable for their potential in ecological restoration projects.

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Key plant families in the collection include: Fabaceae (25 genera, 35 species), Poaceae (20 genera, 28 species), Asteraceae (18 genera, 22 species), Chenopodiaceae (8 genera, 12 species), Brassicaceae (12 genera, 15 species) Solanaceae (6 genera, 15 species), Zygophyllaceae (5 genera, 8 species).

The gene bank's systematic approach to documentation includes GPS coordinates, collection dates, local names, and traditional uses. Also Qatar National Gene Bank used Plant Genetic Resources for Food and Agriculture (PGRFA) documentation employs standardized Digital Object Identifiers (DOIs) globally. Qatar National Gene Bank implements the format "10.18730/" followed by unique identifiers (e.g., J5DC5, 13HE5J) for each accession. This system ensures permanent identification, facilitates international tracking, enables database integration, and promotes efficient sharing of germplasm information within the global genetic resources community.

This comprehensive preservation effort supports Qatar's agricultural biodiversity while contributing to food security and sustainable agriculture in arid environments. The collection serves as a valuable resource for research, breeding programs, and conservation efforts, particularly for species adapted to Qatar's challenging desert climate.

**Keywords:** Gene Bank, Qatar Gene Bank, Flora diversity, Ex situ conservation, Native species, Germplasm documentation

### Isolation and Identification of Oil-degrading bacteria from Sediments of Qatari Mangrove forests, as response to oil pollution and symbiosis with mangrove roots

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#### **Abstract**

Mangrove ecosystems are increasingly threatened by oil pollution, posing a risk of species extinction or necessitating biological adaptation. Within the rhizosphere of mangrove roots, a variety of symbiotic bacteria flourish, some capable of breaking down hydrocarbons. Investigating these hydrocarbon-degrading bacteria across varying pollution intensities can reveal their potential to withstand Qatar's environmental conditions, supporting mangrove survival and adaptation. Sediment samples were taken from two sites, Al-Ruwais and Al-Thakhirah, representing high and moderate pollution levels, respectively. Bacteria were isolated, purified, and identified via MALDI TOF MS, with protein profiles analyzed through principal component analysis. At the heavily polluted Al-Ruwais site, Pseudomonas aeruginosa predominated, while Al-Thakhirah showed greater bacterial diversity, including species like Lysinibacillus xylanilyticus, Acinetobacter calcoaceticus, Micrococcus luteus, Brevundimonas diminuta, Kocuria rhizophila, and Bacillus pumilus. Protein profiles of Pseudomonas strains exhibited notable diversity, potentially due to variations in metabolic processes, growth patterns, and diesel degradation capabilities. These results highlight the critical role of rhizosphere bioremediation in aiding mangrove resilience in polluted environments, where bacterial communities at less polluted Al-Thakhirah showed limited diesel degradation and adaptation potential, likely due to lower pollution exposure. This study underscores the significance of rhizosphere bacteria in maintaining mangrove health amid high oil contamination levels.

**Keywords:** Mangrove, oil pollution, hydrocarbon-degrading bacteria, adaptation, biodiversity.

# Insights into the Role of *Virgibacillus* EPS in Heavy Metal Immobilization and Mineral Formation

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#### **Abstract**

Heavy metal pollution presents significant environmental and health hazards due to its toxicity, persistence, and tendency to bioaccumulate and bio-magnify within the food chain. Microbial biomineralization offers a promising solution for heavy metal removal through immobilization, facilitated by extracellular polymeric substances (EPS) that also play an essential role in mineral formation. This study examined the interactions among selected heavy metals (Cd<sup>2+</sup>, Cu<sup>2+</sup>, Ni<sup>2+</sup>, Zn<sup>2+</sup>), EPS, and mineral formation using two mineral-forming Virgibacillus strains isolated from Qatar's sabkhas-ideal environments for biomineral formation-and a nonmineral-forming Virgibacillus strain from the Dukhan oil waste site. It was observed that Cd2+ and Zn<sup>2+</sup> tended to inhibit mineral formation, likely due to their competition with Ca<sup>2+</sup> and Mg<sup>2+</sup> ions in biomineralization. In contrast, Ni<sup>2+</sup> and Cu<sup>2+</sup> exposure led to shifts in the FTIR spectra of the EPS, indicating specific functional group interactions within the EPS matrix. Each strain's EPS also correlated with its heavy metal removal efficiency, with EPS from Virgibacillus halodenitrificans Z4D1 (the non-mineral-forming strain) showing the highest removal rate for Zn<sup>2+</sup> at 31.7%. These results demonstrate that EPS not only influence biomineralization but that specific functional groups in EPS directly impact heavy metal immobilization. Conditions unfavorable for mineral formation may instead be optimal for selective heavy metal removal.

Keywords: Virgibacillus, EPS, Heavy Metals, Bioremediatoin, Biomineralization.

# TiO<sub>2</sub>-Modified Fly Ash Geopolymer as a Nanoparticle-Enhanced Adsorbent for Phenol Removal.

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#### **Abstract**

This study explores the application of titanium dioxide (TiO<sub>2</sub>) nanoparticles embedded within a fly ash-based geopolymer matrix to improve phenol adsorption from wastewater. The incorporation of TiO<sub>2</sub> nanoparticles significantly enhances adsorption efficiency by increasing active surface sites and promoting the formation of functional groups, such as -OH, which facilitate pollutant binding. Characterization techniques, including transmission electron microscopy (TEM), scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and energy-dispersive X-ray spectroscopy (EDX), highlighted the influence of TiO<sub>2</sub> on surface morphology and chemical interactions. Adsorption tests achieved a maximum phenol removal efficiency of 92% under optimal conditions of pH 6 and 25°C, with an adsorption capacity of 166.7 mg/g. The adsorption performance, modeled by the Langmuir isotherm, supports a monolayer adsorption process primarily driven by the TiO<sub>2</sub>-modified surface properties. TiO<sub>2</sub> nanoparticles are increasingly recognized in environmental remediation for their ability to enhance pollutant removal efficiency in water treatment applications.

Keywords: TiO<sub>2</sub> Nanoparticles, Geopolymer, Phenol Adsorption, Wastewater Treatment

# Application of *Bacillus thuringiensis* for the production of insecticidal proteins active against dipteran insects and antimicrobial peptides

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#### **Abstract**

The reliance on chemical pesticides has increased the search for more eco-friendly alternatives, with Bacillus thuringiensis (Bt), the star of biopesticide, due to its insecticidal proteins and antimicrobial peptides. The study aimed to evaluate the capability of local Bt strains isolated from Oatar (in our Lab) to produce these biopesticides. The tested strains produce spherical parasporal crystals. Among the four local Bt strains, two displayed plasmid profiles identical to the reference strain H14, whereas the remaining two exhibited distinct plasmid patterns. These findings were further corroborated by the cyt and cry genes content, where the presence of cyt1A and cry4B genes was confirmed in strains QBT758, QBT862, and H14 but was absent in strains QBT550 and QBT605. Furthermore, QBT550 and QBT605 showed high antimicrobial activity against Staphylococcus aureus. The strains QBT550 and QBT605 produced the highest levels of crystal insecticidal proteins with 11.1±1.3×10<sup>-7</sup> and 9.64±0.8×10<sup>-7</sup> µg/cell, respectively. Insecticidal activity evaluated against *Culex pipiens* larvae revealed that QBT758 exhibited the most potent insecticidal activity, achieving a larval mortality rate of 70±11.3%. These results collectively suggest differential capabilities among the strains in terms of gene presence, bacteriocin production, crystal protein production, and insecticidal activity, highlighting the diverse potential applications of these Qatari Bt isolates in biotechnological and biocontrol sectors.

### Toxicity Assessment of Produced Water from Gas Fields Using Qatari Native Animal Species and Zebrafish Embryo Assay

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#### **Abstract**

Produced water (PW) is the largest effluent discharge from oil and gas production facilities. There is a concern that the contaminants originating from the reservoir and the chemicals used in the production process may affect marine organisms and potentially human health once the effluent is discharged into the environment. This study evaluated the toxicity level of untreated PW and treated water effluent on the indigenous organisms in Qatar (marine copepod and killifish) and the zebrafish embryos (*Danio rerio*) (used as a model). Representative samples of untreated PW effluent were collected from the bulk header within the terminal before the deep well injection. Following chemical and physical composition analysis, three reference compounds were identified accordingly: phenol, zinc sulfate, and sodium dodecyl sulfate (SDS), in addition to heavy fuel oil (HFO). Acute toxicity tests were carried out using a series of static, acute 24h, 48h, 72h, 96h, and 120h toxicity tests. Furthermore, secondary and tertiary treatments were performed on the PW, and acute toxicity and composition analysis were performed similarly to evaluate the efficiency of treatment methods. Exposure to untreated PW increased the mortality rate in all animal models. While Treatments showed effective reduction rates of toxicants present in PW. The results of this study demonstrate the possible risks to the environment that PW discharge from Qatari gas fields may pose if not properly treated. The combination of native animal species and zebrafish embryo models provides a more thorough evaluation of the toxicity effects of PW.

**Keywords:** Toxicity, produced water, zebrafish, killifish, copepod.

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### Catalytic Oxidation of Aldehydes Over Transition Metal Oxide Nanoparticles

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#### Abstract

Oxidation reaction represents a significant stage in pharmaceutical and organic synthesis with considerable interest. The carboxylic acid is common in a variety of organic compounds and symbolized as a versatile functional group in organic synthesis. Carboxylic acid can be synthesized from different substrates including aldehyde. Recently, several protocols have been disclosed in reference to the high demand for mild, selective, sustainable and nature-friendly processes. In this piece of work, manganese ferrite nanoparticles were synthesized from the thermolysis of iron and manganese octanoate in Dowtherm A, an eutectic mixture of diphenyl ether and biphenyl, at elevated temperature. Subsequently, the magnetic particles were deposited on the surface of alumina, affording alumina-supported manganese and cobalt ferrite nanocatalyst. The materials were characterized by IR, SEM, and EDX and tested in the oxidation reaction of benzaldehyde at high temperature.

Manganese and cobalt ferrite nanoparticles were used in this research as a catalyst for the oxidation of benzaldehyde as a model substrate. It symbolizes as a Lewis acid that activates the decomposition of hydrogen peroxide giving the atomic oxygen and water. In this research we hope that the nanoparticles could energize the carbonyl group of the aldehyde to react with the generated oxygen to yield carboxylic acid (benzoic acid). In 9 different vials the powder of manganese and cobalt ferrite nanoparticles (5 mg) was added with 2 mL of solvent (water, ethanol, ethanol-water, acetone, acetonitrile, THF, ethayl acetate, chloroform, and toluene), benzaldehyde and hydrogen peroxide, the vials were closed and left stirring for two days at around 80 °C.

The synthesized manganese and cobalt ferrite nanoparticles were support on the surface of aluminum oxide particles, believing that alumina surface activates the carbonyl group in aldehyde according to the literature which will enhance the catalytic oxidation reaction. Thus, the supported nanoparticles were synthesized by reacting MnFe<sub>2</sub>O<sub>4</sub> and CoFe<sub>2</sub>O<sub>4</sub> with Al<sub>2</sub>O<sub>3</sub> in ethanol and NaOH. The mixture was left stirring for a week at room temperature, producing a brown-colored material.

### Eggshell membrane as a novel bio-sorbent for remediation of boron from desalinated water

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#### Abstract

This study explores the potential of nanoparticles derived from eggshell membrane (ESM) for boron adsorption and the influence of various parameters on adsorption efficiency, including temperature, pH, and initial boron concentration. To enhance adsorption capacity, modified ESM nanoparticles (MESM) were synthesized by altering the chemical composition of ESM. Results indicated optimal adsorption of boron at pH 6 and 35 °C. Thermodynamic analysis revealed a positive enthalpy ( $\Delta$ H), indicating an endothermic process, while a negative Gibbs free energy ( $\Delta$ G) suggested spontaneity. The unmodified ESM nanoparticles achieved a 97% boron adsorption rate, compared to 95% for MESM. Fourier Transform Infrared (FTIR) spectroscopy showed distinct functional groups on the surfaces of ESM and MESM nanoparticles, essential in the boron adsorption mechanisms. The experimental data aligned well with the Freundlich model, with a 99.4% correlation coefficient, underscoring the potential of ESM-derived nanoparticles as efficient boron adsorbents.

### **Genomics Core Facility at iTRI**

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#### **Abstract**

The Genomics Core Facility at iTRI is dedicated to advancing medical research in Qatar by providing accessible, high-quality genomic services to support both academic and clinical investigations. Located within the thriving research ecosystem of the Hamad Medical Corporation (HMC), the Core offers cutting-edge technologies and expertise in a variety of genomic applications, including whole transcriptome analysis, whole exome sequencing, DNA/RNA sequencing, and genotyping. The facility is equipped with state-of-the-art platforms such as Next-Generation Sequencing (NGS), the GeneChip System 3000, 3500 Series Genetic Analyzer, and the QuantStudio™ 12K Flex Real-Time PCR System. These tools enable high-throughput sequencing, precise genetic analysis, and in-depth gene expression profiling. The Genomics Core is uniquely positioned to support multi-omics projects, collaborating closely with other core facilities within iTRI to drive comprehensive research initiatives. Serving as a key resource for partners such as Hamad General Hospital, Sidra Medicine, Qatar University, and the National Center for Cancer Care, the Core contributes to advancing the understanding of various diseases, with multiple research publications in leading journals like the European Journal of Medical Genetics, Seminars in Cancer Biology, and Seminars in Cell & Developmental Biology. Through its services, the Genomics Core at iTRI plays a pivotal role in enabling groundbreaking discoveries and supporting personalized medicine research in Qatar.

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# Assessing the Effectiveness of Improved Nanocomposite PAN Membrane in Forward Osmosis for Mitigating Ecological Risks of Brine Discharge in the Marine Environment

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#### Abstract

Desalination of seawater is a practical and effective solution for providing reliable freshwater supply, especially in regions with limited resources. However, the desalination of seawater using reverse osmosis (RO) produces brine, which can potentially harm marine ecology and biodiversity due to its high salinity. The aim of this research was to assess the effectiveness of an improved nanocomposite PAN membrane used in forward osmosis (FO) on mitigating ecological risks of brine in the marine environment.

To examine the ecological risks on the aquatic environment, an ecological risk assessment (ERA) was conducted before and after mitigation of brine produced from RO by FO using two different membranes (commercial and the modified one). In the first phase, assessment endpoints were selected based on different trophic levels, and the impacts of salinity on these species as well as the safe exposure levels were determined through a comprehensive literature review. Synthetic brine included the principal ions found in RO brine based on the literature and was composed of four salts: sodium chloride, magnesium chloride, calcium chloride, and sodium sulphate. Furthermore, RO brine was collected from desalination facilities in Qatar and utilized a membrane system for reverse osmosis and prior to use was filtered to eliminate suspended solids. The salinity of brine obtained from each sample and from different membranes in FO was determined by the YSI EXO1 multiparameter probe by converting the electrical conductivity into salinity. The risks were assessed by the risk quotient (RQ) for each of the brine samples. The assumption of a simplistic model was adopted, and the deterministic approach was used.

#### **Results**

The initial, commercial and modified membranes salinity and RQ was calculated and analysed for each synthetic and real RO brine sample. The salinity of synthetic brines was initially 60.13ppt, then 30.69ppt using a commercial membrane, and finally 24.77ppt with the modified membrane. Whereas RO brines salinity was 70.99ppt, initially, and then reduced to 37.26ppt, and 26.83ppt for the commercial and modified membrane respectively. Statistical analysis using the t-test showed that both commercial and modified membranes using synthetic and RO brine had a significant difference in the initial and final salinity as p-values were all less than 0.05. However, the p-value (one tail) comparing the final salinity of synthetic brine using the commercial and modified membrane was 0.09429, and not significant. However, the real RO brine p-value (one tail), comparing the final salinity obtained from the commercial and

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modified membrane was 0.001153, and significantly different. The RQ for the synthetic brine initially for all the assessment endpoints was between 0.8830 and 1.425. Whereas the RQ for the synthetic brine using the commercial membrane for all the species was between 0.4507 and 0.7273. Furthermore, the final RQ was lowered for the synthetic brine using the modified membrane and for Skeletonema costatum, Chllorella vulgaris, Tetraselmis suecica, Isochrysis galbana, Ulva pertusa, Brachinonus plicatilis, Tigriopus japonicas and Paralichthys olivaceus was 0.4495,0.4015,0.4353,0.5870,0.4647,0.367,0.3895 and 0.5097 respectively. However, for the real RO brine the RO initially was above 1 for all the species. Although, the RO for the RO brine using the commercial membrane decreased and was between 0.5471 and 0.8829. The RQ further reduced for the RO brine using the modified membrane and for the Skeletonema costatum, Chllorella vulgaris, Tetraselmis suecica, Isochrysis galbana, Ulva pertusa, **Brachinonus** plicatilis, **Tigriopus** japonicas and Paralichthys 1 4 1 olivaceus was 0.4869,0.4348,0.4715,0.6358,0.5034,0.3940,0.4219 and 0.5521 respectively.

The results show that, while both membranes reduce the potential species' risk of being affected by the adverse effects of brine, the commercial membranes risk to species remains higher than the modified one even after mitigation measures are implemented. As a result, this depicts how effective the modified membrane is in reducing the potential ecological risks compared to the commercial membrane. Moreover, future recommendations could include ecological studies with long-term monitoring of marine ecosystems and toxicological data obtained from experimental tests conducted in laboratories to enhance the studies results and account for chronic exposure.

# Rhizosphere changes after grey water irrigation: A Circular Approach to Sustainable Urban Agriculture

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#### **Abstract**

The need for resource-efficient, sustainable urban agricultural technologies has grown as a result of the ongoing industrialization of Qatar along with additional drought-prone locations. Novel circular techniques for water management are required due to the limited amount of groundwater and rainfall. This study looks at residential greywater as a circular approach for urban agricultural infrastructure, exploring the possibilities of rhizosphere engineering using greywater irrigation. In the chosen plant species, Alternanthera dentata, Carissa grandiflora, Dianella tasmanica, and Portulaca oleracea, the study investigates the formation, survival, and engineering modification of rhizosphere microbiomes. Three irrigation treatments of simulated greywater (T1), real greywater (T2), and tap water (T3) as a control were applied to the plants to reflect various technical methodologies. Growth measures such as height, biomass, and chlorophyll content were used to evaluate the productivity of the vegetation. Metagenomic DNA extraction and 16S rRNA sequencing have been employed in advanced rhizosphere studies to construct and characterize the makeup of the bacterial population. Heavy metals, total organic carbon, and total nitrogen were all incorporated in the extensive soil investigation to determine the effects of designed irrigation systems. The practicality of constructed greywater systems was demonstrated by the results, which showed that there were few variations in growth characteristics across treatments. In these modified frameworks, environmental stresses and soil chemistry were found to be important determinants of plant survival. Key changes in rhizosphere microbiological diversity and abundance were brought about by the designed greywater irrigation, which also selectively enriched beneficial bacterial groups like Gammaproteobacteria. The soil microbiota successfully adapted to the greywater treatment and nutrient augmentation. In greywater-irrigated agricultural settings, this work demonstrates the possibility of rhizosphere engineering and emphasizes its possibilities for controlling plant-microbe interplay. Further investigation into particular plant-microbe interactions, root exudate operations, and irrigation techniques across a range of soil types and environmental circumstances should be the main goal of future studies in order to optimize these designed systems.

# Phycoerythrin-Rich Extract from *Porphyridium purpureum*: Exploring the Apoptosis Pathways in A549 Lung Cancer Cells

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#### **Abstract**

Microalgae-derived compounds are gaining interest in biotechnology for their potential therapeutic applications. This study investigates the antiproliferative capacity and apoptotic mechanisms induced by a crude extract from *Porphyridium purpureum* in A549 lung cancer cells. The extract rich in phycoerythrin (PE-rich extract) was prepared from *Porphyridium purpureum* strain isolated from the Qatari marine environment and belonging to the Qatar University Culture Collection of Cyanobacteria and Microalgae QUCCCM. The extract was characterized spectroscopically and used to treat A549 cells. Its antiproliferative effects were assessed using cell counting Kit-8 (CCK-8) assay and real-time cell analysis (RTCA), while apoptosis was evaluated using a human apoptosis array and Western blot analyses for key apoptotic markers.

The extract significantly reduced A549 cell viability and proliferation to  $36.18 \pm 3.28\%$  at 20 µg/mL compared to the normal cells after 72 hours of contact time. Molecular experiments revealed the involvement of apoptosis signaling through both intrinsic and extrinsic pathways. Upregulation of BAX, TRAIL R2/DR5, Fas/TNFRSF6/CD95, TNFR1/TNFRSF-1A, FADD, cleaved caspase-3 and PARP was observed, along with phosphorylation of p53 and increased P27/Kip1 levels, indicating a DNA damage response and cell cycle arrest. Downregulation of BCL-X, Livin and Survivin further supported apoptosis progression. These findings highlight the potential of *P. purpureum* extract as a natural, biotechnological agent for targeted cancer therapy.

Keywords: Apoptosis, Microalgae, Phycoerythrin, Porphyridium purpureum.

### Closing the Loop in Aquaculture: Microalgae and Wastewater Utilization for Sustainable Rotifer Cultivation

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#### **Abstract**

Rotifers are microscopic aquatic organisms that are crucial members of the zooplankton community. In aquaculture, more precisely, larviculture, rotifers are used as initial feeds for fish and shrimp larvae. Since they are rich in proteins and fatty acids, rotifers are considered a nutritious food source for larvae. Besides, their tiny size makes them suitable for being ingested by fish and shrimp larvae with small mouths. Also, rotifers have a relatively high reproduction rate, making it easier to cultivate them in high quantities in less time. Despite their advantages, providing appropriate feed to maintain rotifer cultures remains a major challenge in aquaculture. In this research project, we initially fed rotifers with five microalgae species and a commercial rotifer feed to identify the best species for rotifer production. The five microalgae species were Porphyridium sp. (PC), Nannochloropsis sp. (NS), Dunaliella sp. (DS), Tetraselmis sp. (TS), and Phaeodactylum sp. (PT). The results showed DS was the best species, producing 485 rotifer individuals/mL, followed by PC and NS, which produced 420 and 390 individuals/mL, respectively. The commercial feed showed a relatively low production, with a maximum number of rotifers reaching 190 individuals/mL. Regarding reproduction, maximum egg production was seen in DS with 105 eggs/mL, followed by NS and PC producing 98 and 78 eggs/mL. In the next experiment, the best three species were selected and cultivated in rotifer production wastewater to assess whether microalgae species can grow and recover nutrients from wastewater. The results demonstrated that the nitrogen removal of PC was the highest, reaching 86% removal. NS and DS removed nitrogen by 76% and 49%, respectively. For Total Organic Carbon (TOC) content, the species showed no significant changes during the experiment. Regarding biomass production, NS grew up to 0.93 g/L in rotifer wastewater, while PC and DS produced biomasses of 0.83 and 0.72 g/L, respectively. The findings of this study suggest that microalgae species, particularly DS, PC, and NS, are significantly more effective than commercial feed for rotifer cultivation, with DS producing more than 2.5 times the number of rotifers compared to commercial feed. Additionally, these microalgae species demonstrate promising potential for wastewater treatment in aquaculture systems, enabling a more sustainable circular aquaculture system. Future research should investigate feeding rotifers with wastewater-grown microalgae to complete the circularity of rotifer production.

**Keywords:** Rotifer Cultivation, Microalgae, Aquaculture wastewater, Circular Aquaculture, Larviculture

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### Alleviating Salt Stress in Hydroponic Cherry Tomato Cultivation: Exploring the Biofertilizer Potential of Qatari Rhizobacteria Bacillus cabrialesii HB7

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#### **Abstract**

Hydroponic cultivation systems using desalinated groundwater has helped to overcome freshwater scarcity and low soil quality, two major challenges limiting conventional agriculture in the arid and semi-arid regions like Qatar. However, the reliance on desalination remains not sustainable due to the high cost and energy demand in addition to the serious negative environmental impacts caused by its brine byproducts. Employing biofertilizers enhancing plant halotolerance and enabling saline irrigation under hydroponics represents a promising solution towards agricultural sustainability. In the present study, for the first time, a halobacterial-based biofertilizer (HB7B) was introduced, enabling the use of saline groundwater for hydroponic cultivation without the need for desalination process. HB7B was produced based on thermo-halotolerant strain Bacillus cabrialesii HB7, which exhibits interesting plant growth-promoting potential and was isolated from the Qatari rhizosphere. HB7B was developed using Response Surface Methodology and bioreactor fermentation. When applied to hydroponically grown cherry tomato plants irrigated with groundwater (8 ppt) or diluted groundwater (4ppt), HB7B significantly enhances shoot elongation, chlorophyll content, and flower production. It prevents salt infiltration thanks to the effective colonization capability of the bacterial strain HB7 on the rhizoplane and within the different internal plant tissues, as demonstrated by SEM-EDX analysis. HB7B alleviates osmotic stress by boosting catalase production while reducing MDA and H<sub>2</sub>O<sub>2</sub> levels under saline irrigation. Additionally, HB7B enhanced fruit yield, quality, and nutritional value.

These findings qualify the biofertilizer HB7B as a promising alternative to desalination process, paving the way for sustainable agriculture under groundwater irrigation.

*Keywords: Bacillus cabrialesii*; Biofertilizer, RSM, Bioreactor, Groundwater irrigation, Halotolerant bacteria; Hydroponic system; ROS, fruit quality

# Bioplastics production by haloarchaea from Chott El Jerid using renewable feedstocks

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#### Abstract

The large use of non-degradable plastics in our daily lives represents a serious threat to the environment and human health. Polyhydroxyalkanoates (PHAs), one of the most interesting bioplastics, are considered green alternatives to petroleum-based materials, due to their biocompatibility and biodegradability properties. Halophilic archaea are used as cell factories for PHA accumulation using renewable feedstocks. In this regard, our study focused on the screening of novel potential halophilic PHA-producing archaea from Tunisian hypersaline extreme environment « Chott El Jerid ». The screening for PHA accumulation was carried out in PHA production medium using starch as the sole carbon source by staining procedures and amplification of PHA synthase genes. The characterization and the quantification of the polymer from promising isolates were investigated through gas chromatography, fourier transform infrared spectroscopy and UV-visible spectrophotometric analyses. 17 isolates were selected as PHA accumulating strains using phenotypic and genotypic tests and were affiliated with Halorubrum, Natrinema, Haloterrigena and Haloarcula genera. Among them, a powerful PHB hyper-producing archaeon Haloarcula sp. CEJ40-10 was found to be the best one reaching value of 72.8% of cell dry weight (CDW), using starchy substrate as the sole carbon source. Interestingly, two other PHA-producing archaea Natrinema altunense CEJGTEA101 and Haloterrigena jeotgali CEJEA36 produced 35% of poly(3-hydroxybutyrate) (PHB) and 25% of poly(3-hydroxyvalerate) (PHV) using 2% (w/v) glucose, respectively. Our findings highlighted that PHA composition and productivity depend on the substrate used and halophilic PHA producer.

**Keywords:** Polyhydroxyalkanoate; Biodegradable plastics; Tunisian hypersaline extreme environment; halophilic PHA-producing archaea; Feedstocks

# Sustainable Valorization of Date Palm Branch Waste as Growth Media for Tissue-Cultured Date Palm Seedling Acclimatization

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#### **Abstract**

The increasing demand for sustainable agricultural practices has highlighted the need to find alternatives to non-renewable peat-based growing media. This study investigated the potential of date palm branch waste (DPW) as an eco-friendly peat substitute for ex-vitro acclimatization of tissue-cultured date palm (*Phoenix dactylifera* L.) seedlings in Qatar. Five different growing media compositions were evaluated: control (peatmoss + soil + vermiculite), 100% palm waste, 75% palm waste + 25% soil, 50% palm waste + 50% soil, and 25% palm waste + 75% soil. The experiment was conducted in a greenhouse environment at 45.5°C at the Rawdat Al Faras Farm. Physicochemical properties including pH, electrical conductivity, porosity, and bulk density were analyzed according to standard European norms. Plant growth parameters, including plant height, leaf number, leaf surface area, and chlorophyll content, were measured after an eight week growth period. Additionally, micronutrient content (Fe, K, Cu, and Mn) was assessed across treatments. Results demonstrated that DPW-based substrates exhibited suitable physicochemical characteristics for plant growth. The 75% palm waste + 25% soil mixture showed optimal results for plant height and leaf number, while significantly improving leaf surface area compared to the control. Enhanced chlorophyll content was observed in all DPW treatments compared to the control, indicating improved plant health. Micronutrient analysis revealed that the 75% palm waste treatment resulted in higher Fe content, while the 20% palm waste treatment maximized K, Cu, and Mn availability. The study demonstrates that date palm branch waste can effectively replace traditional peat-based growing media while promoting sustainable waste management in Qatar's agricultural sector. This research provides a viable solution for reducing dependence on nonrenewable peat resources while simultaneously addressing the environmental concerns associated with date palm waste disposal.

**Keywords:** *Phoenix dactylifera*; agricultural waste valorization; sustainable horticulture; growing media composition; ex-vitro acclimatization