ISLAMIC WORLD ACADEMY OF SCIENCES

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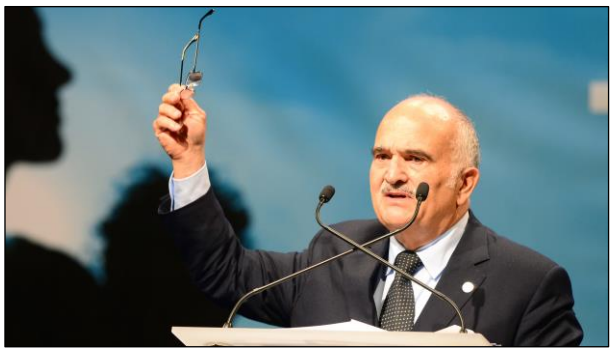
MESSAGE OF HIS ROYAL HIGHNESS PRINCE EL HASSAN BIN TALAL FOUNDING PARTON OF THE ISLAMIC WORLD ACADEMY OF SCIENCES

ON

SCIENCE, TECHNOLOGY AND INNOVATION FOR GLOBAL PEACE AND PROSPERITY

DELIVERED AT THE 21ST IAS CONFERENCE IN KONYA, TURKEY, 2017



Politics rather than policies is clouding the biosphere of most countries in the Islamic world. Science policy in the Arab region is not stable due to the instability of the region. The question is how the 2030 agenda for sustainable development (UN-SDGS), can pave the way for global peace and prosperity with such political instability. Does stability come with policies in science, technology and innovation (STI) to create the "niche" of political stability that the Islamic world has hardly enjoyed?

There are areas where some countries in the Islamic world have succeeded in providing political stability with sound policies and have created a stable democratic governance with change and continuity, and emerged strongly in STI and economy. Malaysia is a country that has succeeded in generating wealth per capita to overcome unemployment and poverty and to compete with OECD countries and has developed a unique democratic system with full participation of all segments of the society based on tolerance, equity and justice. They have created a sustainable political system leaving no one behind with sound policies in economics, science, technology and innovation (STI), generating high-tech exports dependent heavily on R&D and technology transfer. This is a model that could be studied carefully for the prosperity and future progress of the Islamic Umma.

The Islamic world cannot live on the glories of the past, although we have to underline the success stories in our history to give us the impetus to trigger with vigor the development of our present and future quality of life and put human dignity, at the center of development. The Islamic world faces problems in knowledge use more than in knowledge creation. Without translating academic research into policy and public awareness, research will be read by few people who constitute the elites who are disconnected from the masses of the society. There is a gap between scientists and policy/decision-makers.

Universities are the centers of creating knowledge and its transmission and where minds are shaped. The creation of knowledge occurs through research, free-thinking, exploration, and exchange and debate of ideas. The transmission of knowledge is done by teaching and training of the next generation, which not only receives the distilled, confirmed facts and theories in various branches of knowledge but also learns to dissect them, check for any flaws, and construct, more robust framework of knowledge for the world.

In addition to the knowledge production and scholarship and the shaping of critical and creative minds, one of the main goals and *raisons d'être* of universities worldwide is to develop within society a culture of inquiry, intellectual rigor, and promotion of evidence and merit. This spirit is what led to the Islamic '**Golden Age**' of science. Indeed, the Muslim world is widely credited for having established the first universities in the world, going back as far as 859 AD (**al-Qarawiyyin** in Fez, Morocco, **Al-Azhar** in Cairo, Egypt, and others, some of which are still operating today). Indeed, those universities created knowledge, by translating books from scholars of previous civilizations, by hosting scholars and giving them the means and the freedom to explore all ideas that they wished to analyze, and by training students and disciples in intellectual work, from the purely philosophical, theological, or theoretical to the most directly applicable techniques.

However, after a '**golden age**' of knowledge and science that lasted many centuries, the Islamic world went through a long period of decline, which was followed by Western colonization, and by the 20th century, it was trailing all other nations in knowledge production and dissemination. Today, after huge efforts (financial and other), only a few universities from the Arab world can be found in the Top 400 of the major world university rankings, and none in the Top 100 of any of them.

New knowledge, particularly knowledge related to technology, drives the economic systems. Economic agents, including firms and governments, are forced to adapt to technical change in order to survive in a competitive environment. While governments should act as facilitators, technology capabilities must accumulate in enterprises. This will only be possible if we strengthen our universities and R&D organizations and create effective linkages between them and industry. It will be the increasing use of knowledge in the production processes and service industry which will determine the growth of our GDP.

Our ability to compete or survive in the globalization of economic systems depends on our commitment towards the development of our human capital and ensuring a continuous learning process within the government institutions and enterprises to create a culture of innovation. Innovation is concerned with enhancing national productivity and national competitive performance. Dynamic innovation systems involve an inter-play between a number of different parts of the society which include the government, private sector, universities and research institutions. The transition of our economy from an agriculture-based economy to a knowledge-based economy involves a mosaic of complex interactions in which a large number of players would be involved. The universities will need to play a central part in this transition through knowledge creation, its use and diffusion of new knowledge into the society through the establishment of technology parks, business incubators, access to venture capital and other such schemes.

The new world order requires us to prepare our children to face the challenges of the global economy. This involves a substantially different type of education to be imparted, focused not only on the mastery of subject matters but also on the development of the various other skills such as the ability to think critically, innovate, communicate effectively, work effectively in teams, develop entrepreneurship and risk-taking skills, and the ability to face and manage changes in a flexible manner. This would require a massive focused national effort.

ARTIFICIAL INTELLIGENCE (AI) IN HIGHER EDUCATION

Adnan Badran FLAS, FTWAS, FAAS[*],*
Joelle Mesmar[**] *and Elias Baydoun FTW AS, FLAS, FAAS*[***]

I. Introduction

Artificial intelligence (AI) is exhibited by machines, particularly through computer systems. It is based on new knowledge stored in extensive databases and information technology delivered by R & D from research in laboratories in universities, institutions and research centers.

AI is going to lead progress in the current century. It will change our style and quality of life. But also, it may lead to disasters if its delivery is used to manufacture mass destruction and not used wisely in building progress and a culture of peace for all humanity as it happened in mankind's history when scientists discovered fission and fusion of atoms in producing huge energy where politicians and decision-makers utilized it for manufacturing nuclear weapons which may lead to destruction of humanity.

Nowadays, we may estimate the number of atomic bombs piled by many nations of the world which are enough to destroy the life on our planet.

Higher education in the genAI era: OPPORTUNITIES

II. AI for Educators:

- To help in the **preparation of content material** such as lectures, slides, and exams.
- To provide an **interactive and engaging learning environment** through simulations, videos, and multimedia formats.
- To **free educators from administrative tasks**, boosting their productivity, making them more accessible to students, and allowing them to focus more on learning activities and higher-level thinking.
- To facilitates **adaptive learning**, which is a personalized educational approach that analyzes student's learning style, needs, and progress to create personalized learning experiences, making learning more unique, effective, and dynamic.

III. AI for Learners:

- To tailor **customized learning materials** that match their learning styles, pace, and potential.
- To quickly **analyze academic content** and **provide instant feedback**.
- To generate new content, visuals, ideas, etc. that facilitate faster brainstorming, unleashing creativity, and facilitating decision-making.
- To contribute to **educational democratization**, by breaking language barriers, improving access to information and communication, offering greater access to content material and resources, bridging gaps in resources, and opening opportunities, thus making education more inclusive.

IV. AI for Institutions:

- To enhance how they operate and **improve their efficiency** through the automation of administrative tasks such as enrollment processes, timetabling, and scheduling. This relieves the burden on staff by reducing their workload, allowing them to reallocate resources and focus more on the big picture.
- To **inform data-driven strategic decisions** that serve to enhance the student learning experience and achievements.

[*] *Professor& Chancellor of University of Petra, Amman, President of the Arab Academy of Science, Beirut, Chair, Board of Trustees, University of Jordan & President, Islamic World Academy of Sciences (IAS).*
[**] *Research Associate Department of Biology, American University of Beirut, Lebanon.*
[***] *Professor of Biology, Department of Biology, American University of Beirut, Lebanon, Secretary General of the Arab Academy of Sciences (AAS), American University of Beirut, Beirut, Lebanon.*

Higher education in the genAI era: CONCERNS

V. AI for Short-term Implications:

- Generation of **incorrect content.**
- **Deepfake technologies** offer educational benefits by creating **immersive learning experiences**, but they can be particularly dangerous (fake news).
- **Academic integrity:** students can plagiarize and cheat, without essentially understanding the generated content.
- The collection, processing and storage of data, such as personal information, raises concerns on how it is being used and shared.

VI. AI for Long-term Implications:

- Questions on the role of educators, the nature of learners, the quality of academic practices, and the purpose of higher education institutions.
- The **overreliance on AI tools** can harm the cognitive abilities of students such as reasoning, critical thinking, developing independent thoughts, and problem-solving.

NOW WHAT?

The Role of the Educator:

- Whereas the role of educators may seem less important today and maybe insignificant in the future, it is **more vital and critical** than ever before.
- Education is a transformative experience, and the role of the educator should be to:
  1. facilitate critical thinking.
  2. foster an environment that encourages inquiry and exploration.
  3. raise awareness on the dangers of over-relying on AI and being passive recipients of information.
  4. promote the responsible use of AI and raise critical awareness on the ethical implications of AI such as issues related to copyright, data privacy, and bias.

Therefore, the role of the educator needs to be re-emphasized, re-defined, and maybe re-invented.

The Relationship With AI:
a collaborative dynamic:

- Students have been widely using generative AI tools to support their self-directed learning by giving them access to a wide range of personalized resources as well as feedback on their progress.
- Educators have also been experimenting with AI tools, serving them not only as assistants that carry out administrative tasks, but also to enhance their teaching methods and facilitate an engaging learning environment.
- The educator serves as a mentor to the student, offering guidance, support, and help in their personal development.
- The human interaction is essential in motivating students, instigating curiosity, promoting critical thinking, and nurturing creativity.
- It is imperative to look at generative AI as a mediator between the educator and the student and not a threat or a replacement for human interactions.
- In order to establish a successful educational experience, the educator, student, and AI should engage in a collaborative relationship, where each party complements the other and supports the other, for the purpose of maximizing the learning benefits.

Measuring learning success:

- Student success needs to be re-defined to reflect the evolving nature of learning.
- Assessment practices may need to change correspondingly, bearing in mind that a cure-all approach is not an option given the rapid pace at which AI is evolving.

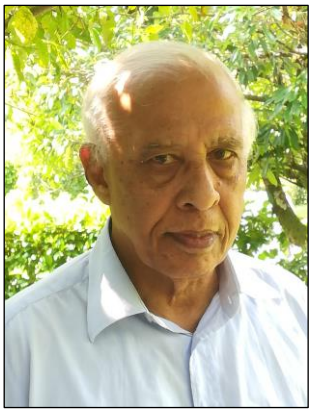
Conclusion:

- Should we fear AI?
- Should we block it?
- Should we ignore it?
- Is it going to replace human intelligence?
- Or should we embrace the wave, understand it, and accept it?
- Artificial intelligence and human intelligence are not the same thing.
- We are being compelled into believing that AI can replace human intelligence, when in fact the human brain can't be fully automated.
- We should shift our focus on what we can automate through AI tools for our benefit so that we can work on enhancing our human intelligence through an effective educational system.

PHENOMENON OF SUPERCONDUCTIVITY

Mohammed Asghar[^] *FIAS*

Abstract:
This text treats the physics of the phenomenon of superconductivity and some of its consequences.



1. Introduction.

Superconductivity, complete disappearance of electrical resistance in various solids, when they are cooled below a critical temperature T_C. This T_C called the transition temperature Figure 1 varies for different materials but generally is below 20 K (-253° C).

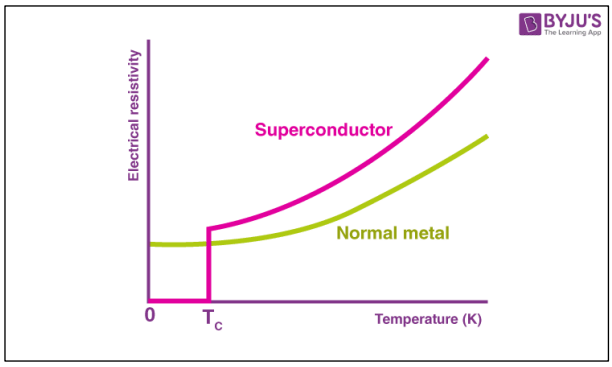


Figure 1. for a normal metal, the electrical resistance continues to decrease down to absolute zero temperature (0° Kelvin), but for a superconductor, the electrical resistance decreases down to T_C, but at T_C, it suddenly falls to zero, and the once induced electric current continues to flow in it without any hinderance **(1).**

In a metal, where the atoms as positively charged ions, are arranged in lattices, and their electrons flow freely, how does it become a superconductor?

2. Cooper pairing.

When an electron moves in the metal of positively charged-ions-based lattices, it couples with their vibrational phonons, distorts them, Figure 2 creating positive charge around the electron. This positively charged electron pairs with another negatively charged electron forming what is called the bosonic "Cooper pair" of total spin S = (+1/2) + (-1/2) = 0.

This thesis was confirmed by the work on Hg isotopes, Figure 3. This Cooper pairing of electrons in a metal plays a central role in the electron-based Bardeen, Cooper, and Schrieffer (BCS) theory of superconductivity.

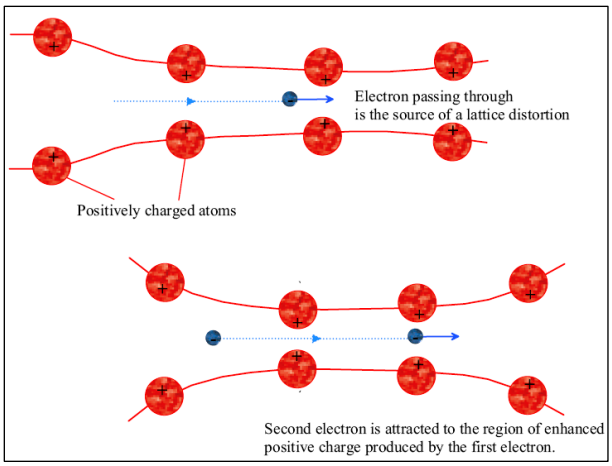


Figure 2. The positive-ions-based lattices in a metal, where the presence of an electrons distorts them leading to a positively charged electron that pairs with a normal electron to form the bosonic Cooper pair **(1).**

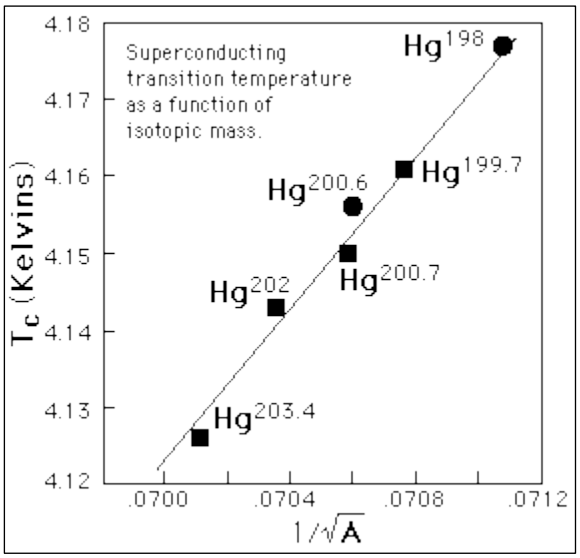


Figure 3. The dependence of the critical temperature T_C for superconductivity, on the isotopic mass of Hg isotopes is the direct evidence of interaction between electrons and lattices of the metal **(1).**

[^] *12 rue des abeilles, 38240, Meylan, France*

3. Meissner effect.
The Meissner effect is the repulsion of an external magnetic field from the interior of a material that is in the process of becoming superconductor, (Figure 4).

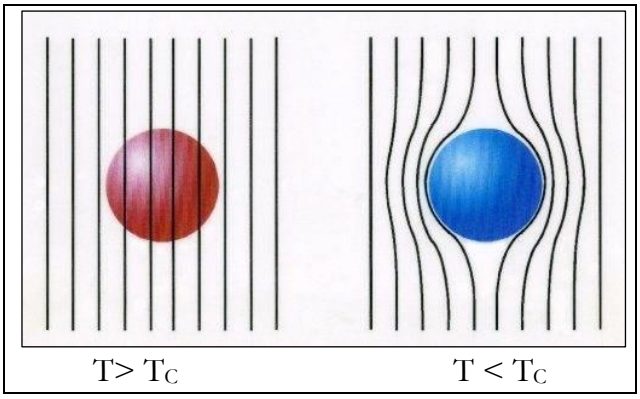


Figure 4. The external magnetic enters the material, when its temperature $T > T_C$, implying the absence of superconductivity, it is expelled, when $T < T_C$, indicating the presence of superconductivity; here, the field of the magnet induces currents in the superconductor that generates an equal and opposite field, exactly balancing out the applied magnetic field, **(1).**

4. Superconductivity gap Δ.
The superconductivity gap Δ as the increased binding energy caused by the process of Cooper pairing:

$$\Delta (T = 0) = 1.764\, k_B\, T_C,$$

is independent of material.
Near the critical temperature, the relation asymptotes to:

$$\Delta (T \text{ to } T_C) = 3.06\, k_B\, T_C\, (1 - (T / T_C)^{1/2}),$$

where k_B is the Boltzmann constant. Here, the value of Δ goes to zero for $T = T_C$, indicating the disappearance of superconductivity.

References
1. Courtesy Google.

PROF. TASAWAR HAYAT FIAS AWARDED THE 2024 QIN-JIU-SHAO PRIZE

Prof. Tasawar Hayat was awarded the 2024 Qin-Jiu-Shao Prize for his contributions to the mathematical models in fluid mechanics with ATTS, HARK and KHA models.

Tasawar Hayat is a professor of Quaid-i-Azam University, Pakistan. In 1999, Tasawar Hayat completed his doctorate in the scattering of waves from the Department of Mathematics of Quaid-i-Azam University in Pakistan.

Professor Hayat is recognized for his significant contributions in the fields of mathematical models in fluid mechanics. He and his coauthors developed the widely-known ATTS, HARK, and KHA models in fluid mechanics. Professor Guoqian Chen of Peking University said that Tasawar Hayat is a world-leading and a highly cited researcher in Fluid Mechanics.

Professor Tasawar Hayat, a distinguished scientist award by Pakistan Academy of Sciences (PAS) in 2010, was elected as a fellow of Pakistan Academy of Sciences (PAS) in 2006. After four years, he was selected as a Third World Academy of Sciences fellow. After one year, he was elected a fellow of the Islamic World Academy of Sciences (IAS). He was elected as a foreign fellow of the African Academy of Sciences in 2022. He is a recipient of the Young Scientist of the South Award of the Third World Academy of Sciences in 2000 and Alexander Von Humboldt fellowship in 2000. He has received multiple local and international awards. These include the Earned Abdus Salam Prize in Mathematics in 1999, Khwarizmi International Award in 2004, PAS Gold Medal by the Pakistan Academy of Sciences (PAS) in 2006, Obada Prize in 2021, among others.

He became a member of the Pakistan Mathematical Association. Professor O. D. Makinde of Stellenbosch University said that Professor Hayat is a well-known authority in mathematical sciences globally in Fluid Mechanics. He is the convener of International Conferences on "Recent Developments in Fluid Mechanics" organized by Fluid Mechanics Group UC3M in Pakistan.
https://www.linkedin.com/company/313unit/posts/

UNESCO CHAIR ON INTERDISCIPLINARY RESEARCH IN DIABETES (UCIRD): A GLOBAL HUB FOR SCIENTIFIC INNOVATION AND COLLABORATION

Mohammad H. Khodabandehloo, Freshteh Taghavi and Ali A. Moosavi-Movahedi
Institute of Biochemistry and Biophysics (IBB), University of Tehran, Tehran, Iran

The UNESCO Chair on Interdisciplinary Research in Diabetes (UCIRD), hosted by the Institute of Biochemistry and Biophysics (ibb.ut.ac.ir), University of Tehran, is a pivotal force in the fight against the stress rising global health crisis caused by diabetes. UCIRD was established in 2014 and forms part of the UNESCO program entitled UNITWIN/UNESCO Chairs nurturing international cooperation and knowledge sharing. The UCIRD tries to draw upon interdisciplinary research in trying to unravel the complexities at a molecular level and lays emphasis on innovative solutions toward the prevention, and management of this pervasive disease. The research it conducts not only furthers academic knowledge but also massively contributes to the global health agenda via popularization of science in the society.

Vision and Mission

The vision of UCIRD further emanates from UNESCO's general mission concerning promotion through international cooperation for sustainable development in education, science, and culture. Diabetes as a pandemic spread across every part of the world, with particular alarmingly high prevalence in the Middle East. UCIRD bucks this trend through the interdisciplinary combining of biophysics, biochemistry, molecular biology, bioinformatics, and medical sciences. The Chair addresses the molecular and biophysical mechanisms of diabetes with the intent to explore how changes in protein structure and function contribute to disease progression and complications.

UCIRD was built to foster international collaboration and knowledge exchange in support of the fight against stress and diabetes. This will promote inter-university collaboration and the transfer of competencies by researchers, professors, and institutions from all over the world. The interdisciplinary research the Chair aims at should bring about new knowledge regarding diabetes at the molecular level so fundamental for more effective early diagnosis, prevention strategies. Such a mission certainly falls squarely within the priorities of UCIRD at the global level, namely the implementation of inclusive knowledge societies and finding molecular solutions to urgent health problems by means of scientific innovation and cooperation.

Addressing the Molecular Basis of Diabetes

Diabetes is a very complicated metabolic disorder with devastating effects at the molecular level, especially on proteins and other biomolecules. UCIRD focuses its work on the understanding of these molecular changes that often lead to severe complications like the formation of AGEs and amyloid fibrils, which cause proteins to misfold, lose their natural functions, and often become toxic, contributing toward a degenerative disease such as Alzheimer's or Parkinson's.

The Chair has a particular interest in the biophysical aspects of diabetes, studying the ways in which the disease changes the physicochemical properties of proteins, which result in aggregation and structural deformities. By applying advanced biophysical techniques, UCIRD researchers are able to monitor these kinds of changes at the molecular level and thus provide important insights into the early stages of the disease. By this approach, it would enable the identification of possible thermal calorimetry techniques of biomarkers for early diagnosis, which would allow timely intervention that may prevent the progress of the disease and its complications.

Promotion of Interdisciplinary Research and Innovation

At UCIRD, major strengths are found in an interdisciplinary approach by a wide range of scientific disciplines to tackle the molecular complexities of diabetes. The discipline of the Chair now integrates the field of biophysics, molecular biology, bioinformatics, and cell

biology in developing the techniques to understand how diabetes impacts the molecular processes of the body. It also enables improved quality of research and innovation because the scientists from different disciplines work together on common challenges.

UCIRD gives equal prominence to translational research, which is aimed at applying the findings of basic research to clinical practice (translational medicine). By the main focus on molecular and biophysical mechanisms of diabetes, UCIRD strives to develop new diagnostic tools for diabetes recognition. This commitment to translation ensures that UCIRD's findings will have a real-world impact in helping improve quality of life for people living with diabetes.

Global Collaboration and Capacity Building

Within this framework, UCIRD has promoted a set of agreements with several higher education and research institutions all over the world. Such networks enable the Chair to expand its research influence beyond the boundaries of the country itself and turn it into a contributor for the rest of the world in the fight against stress and diabetes. This entity coordinates with other entities such as Iran National Science Foundation-INSF, together with international universities and research centers with a view to sharing knowledge, resources, and expertise.

In addition to research activities, UCIRD is very concerned about capacity building. A great deal of importance is attached to the role of the Chair in training the coming generation of scientists and researchers in the field of molecular diabetes. The educational programs at UCIRD ensure PhD training, postdoctoral opportunities, and seminars and workshops which provide young researchers with the skills and knowledge required for contributing to goal of this Chair. By developing scientific literacy in providing a catalyst for interdisciplinary collaboration, UCIRD marshals the scientific capacity necessary to address the rapidly emerging diabetes epidemic facing the world today.

This capacity-building by UCIRD reaches out in various ways, including public outreach and education. The Chair has facilitated many public workshops and forums that further awareness about diabetes and elicit healthy lifestyle choices that help prevent the disease. Such efforts are more pertinent for the Middle East as there is a growing incidence of diabetes related to changes in diet, lifestyle, and environment.

Diabetes and Sustainable Development

UCIRD work is aligned with UN SDGs specifically Good Health and Well-being, Reduction of Inequalities, and Partnerships for the Goals. The molecular mechanisms of addressing diabetes enable UCIRD to contribute to the reduction of the global burden of non-communicable diseases as one of the major causes of premature death and disability around the world.

The Contribution of Biophysics and Biochemistry to Diabetes Research

The main idea in the research that UCIRD does is based on a philosophy: the key to new insights into diabetes lies at the heart of biophysics and biochemistry. These disciplines give tools and methodologies for studying molecular mechanisms of the disease and hence afford a deeper view of how diabetes affects the body at a cellular level. Researchers at UCIRD apply high-resolution imaging techniques, calorimetry, spectroscopy, and bioinformatics to investigate the structure and function of biomolecules involved in diabetes, focusing mainly on proteins.

Among the central problems researchers of diabetes face is how the disease contributes to the formation of toxic protein aggregates, responsible for many of the disease's complications. By understanding these molecular changes, UCIRD hopes to develop new strategies that might prevent or reverse diabetes-induced damage. Results from this study can also translate into the development of more effective consulting for diabetes and other degenerative diseases like Alzheimer's and Parkinson's.

Conclusion: A Global Hub for Diabetes Research and Collaboration

UNESCO Chair on Interdisciplinary Research in Diabetes is not just a place of research; it is a meeting point for collaboration, innovation, and education throughout the world. UCIRD seeks to garner scientists from across numerous fields to address one of the most serious health concerns of our times through its interdisciplinary approach. With an emphasis on molecular research, early detection, and translational medicine, these indeed are

scientifically valid findings that may help in improving the lot of millions of sufferers due to this disease.

UCIRD clearly shapes the future of diabetes care in its quest to foster international cooperation and build global research capacity. Its multifaceted contributions-from scientific knowledge to health care policy to public education-are actually making a critical difference in the fight against diabetes in Iran and worldwide. As the global burden of diabetes continues to rise, the work of UCIRD will remain crucial in this ongoing effort to understand this devastating disease.

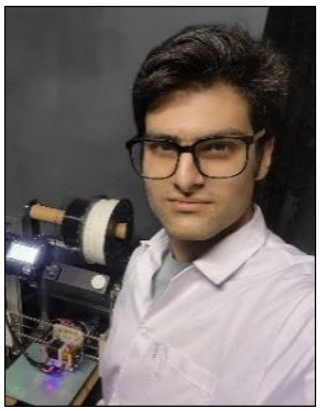
About the authors:

Ali A. Moosavi-Movahedi

Ali A. Moosavi-Movahedi is the Chair-holder of UCIRD http://ucird.ut.ac.ir He is Professor of Biophysics and Head of Institute of Biochemistry and Biophysics, University of Tehran (UT). Born in Shiraz, Iran, in 1953; BSc in Chemistry, National University of Iran,1975; MSc in Chemistry, Eastern Michigan University, USA, 1979; PhD in Biophysical Chemistry, University of Manchester, UK, 1986. His research career has been mostly marked on Biothermodynamics and protein structure function relationship. He is already the Fellow of Iran Academy of Sciences, Fellow of Islamic World Academy of Sciences, Fellow of The World Academy of Sciences (TWAS), and the Chairholder of UNESCO Chair on Interdisciplinary Research in Diabetes, at UT. Web: https://ibb.ut.ac.ir/fa/-moosavi

Fereshteh Taghavi

Fereshteh Taghavi is a researcher and executive director of UNESCO Chair on Interdisciplinary Research in Diabetes, University of Tehran (UT). Born in Tehran, Iran, in 1968; BSc in Biology, Faculty of Biology, University of Tehran (UT), Iran,1991; MSc in Biophysics, Institute of Biochemistry and Biophysics, University of Tehran (UT), 1999; PhD in Biophysics, Institute of Biochemistry and Biophysics, University of Tehran (UT), 2013. Her research career has been mostly marked on Oxidative Stress, Diabetes and protein's structure. She is already a member of the Iranian Society of Biophysical Chemistry.
Web: https://scholar.google.com/citations?user=hO2qp7AAAAAJ&hl=en
Email: taghavif@ut.ac.ir



Mohammad H. Khodabandehloo

Mohammad H. Khodabandehloo is currently pursuing his Master's in Biophysics at Institute of Biochemistry and Biophysics (IBB), University of Tehran. Born in Tehran in 2000, he earned his B.Sc. in Cellular and Molecular Biology from the University of Mazandaran in 2022. Mohammad has been involved in Biomolecular research, including a thesis on the interaction between insulin and different ligands under a static magnetic field using both experimental and computational methods which involved in developing a 3D bioprinter for studying biomolecules in molecular levels. This work is recognized for its potential impact on understanding diabetes at a molecular level. Concurrently, he manages public relations of UNESCO Chair on Interdisciplinary Research in Diabetes (UCIRD), hosted by University of Tehran. Email: khodabandehloo.m@ut.ac.ir
LinkedIn: www.linkedin.com/in/mohammadhossein-khodabandehloo-faaaf0920

THE ANTIOXIDANT POTENTIAL AND ANTICANCER ACTIVITY OF *HALODULE UNINERVIS* ETHANOLIC EXTRACT AGAINST TRIPLE-NEGATIVE BREAST CANCER CELLS[**]

Nadine Wehbe [1], **Adnan Badran [2]**, Serine Baydoun [3], Ali Al-Sawalmih [4], Marc Maresca [5,*], Elias Baydoun [1] and Joelle Edward Mesmar [1,*]

1 Department of Biology, Faculty of Arts and Sciences, American University of Beirut, Riad El Solh, Beirut 1107 2020, Lebanon; nww04@mail.aub.edu (N.W.); eliasbay@aub.edu.lb (E.B.)
2 Department of Nutrition, Faculty of Pharmacy and Medical Sciences, University of Petra, Amman11196, Jordan; abadran@uop.edu.jo
3 Breast Imaging Section, Imaging Institute, Cleveland Clinic Foundation, Cleveland, OH 44195, USA ;baydous@ccf.org
4 Marine Science Station, University of Jordan, Aqaba 11942, Jordan; a.sawalmih@ju.edu.jo
5 Aix-Marseille Univ, CNRS, Centrale Marseille, iSM2, 13013 Marseille, France
* Correspondence: m.maresca@univ-amu.fr (M.M.); jm104@aub.edu.lb (J.E.M.)

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Abstract: Natural remedies have been indispensable to traditional medicine practices for generations, offering therapeutic solutions for various ailments. In modern times, these natural products continue to play a pivotal role in the discovery of new drugs, especially for cancer treatment. The marine ecosystem offers a wide range of plants with potential anticancer activities due to their distinct biochemical diversity and adaptation to extreme situations. The seagrass *Halodule uninervis* is rich in diverse bioactive metabolites that bestow the plant with various pharmacological properties. However, its anticancer activity against invasive triple-negative breast cancer (TNBC) is still poorly investigated. In the present study, the phytochemical composition of an ethanolic extract of *H.uninervis* (HUE) was screened, and its antioxidant potential was evaluated. Moreover, the anticancer potential of HUE against MDA-MB-231 cells was investigated along with the possible underlying mechanisms of action. Our results showed that HUE is rich in diverse phytochemicals that are known for their antioxidant and anticancer effects. In MDA-MB-231 cells, HUE targeted the hallmarks of cancer, including cell proliferation, adhesion, migration, invasion, and angiogenesis. The HUE-mediated anti-proliferative and anti-metastatic effects were associated with the downregulation of the proto-oncogenic STAT3 signaling pathway. Taken together, *H. uninervis* could serve as a valuable source for developing novel drugs targeting TNBC.

Keywords: *Halodule uninervis*; breast cancer; herbal medicine; antioxidant; malignant phenotype

Citation: Wehbe, N.; Badran, A.; Baydoun, S.; Al-Sawalmih, A.; Maresca, M.; Baydoun, E.; Mesmar, J.E. The Antioxidant Potential and Anticancer Activity of *Halodule uninervis* Ethanolic Extract against Triple-Negative Breast Cancer Cells. *Antioxidants* **2024**, *13*, 726. https //: doi.org/10.3390/antiox13060726

[**] *Link to the whole publication: https://www.mdpi.com/2076-3921/13/6/726*

COMPREHENSIVE REVIEW OF *CYCLAMEN*: DEVELOPMENT, BIOACTIVE PROPERTIES, AND THERAPEUTIC APPLICATIONS *

Aya Sharara [1] , **Adnan Badran [2]** , Akram Hijazi [1] , Ghosoon Albahri [1] , Mikhael Bechelany [3,4,*] , Joelle Edward Mesmar [5,*] and Elias Baydoun [5]

1 Plateforme de Recherche et D'Analyse en Sciences de L'Environnement (EDST-PRASE), Beirut P.O. Box 6573/14, Lebanon; aya.sharara.1@st.ul.edu.lb (A.S.); akram.hijazi@ul.edu.lb (A.H.); g.albahri@st.ul.edu.lb (G.A.)

2 Department of Nutrition, University of Petra, Amman P.O Box 961343, Jordan; abadran@uop.edu.jo

3 Institut Européen des Membranes, IEM, UMR-5635, University Montpellier, ENSCM, CNRS, Place Eugene Bataillon, 34095 Montpellier, France

4 Functional Materials Group, Gulf University for Science and Technology (GUST), Mubarak Al-Abdullah 32093, Kuwait

5 Department of Biology, American University of Beirut, Beirut P.O. Box 110236, Lebanon; eliasbay@aub.edu.lb

* Correspondence: mikhael.bechelany@umontpellier.fr (M.B.); jm104@aub.edu.lb (J.E.M.)

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Abstract: Plants are being researched as potential sources of novel drugs, which has led to a recent acceleration in the discovery of new bioactive compounds. Research on tissue culture technology for the synthesis and processing of plant compounds has skyrocketed, surpassing all expectations. These plants can be bought either raw or as extracts, where some of the chemicals are extracted by mashing the plant in water, alcohol, or another solvent. The use of herbal medicine may open new chances for reducing the onset of infections and treating different diseases including cancer. A perennial plant that blooms in the winter, *Cyclamen*, is one of the most widely used potted flowers in many nations. Alkaloids, flavonoids, phenols, tannins, saponins, sterols, and glycosides are the main active components of *Cyclamen*. Analgesic, cytotoxic, antioxidant, antimicrobial, and anti-inflammatory properties have all been demonstrated as potential effects of various extracts of *Cyclamen* tubers. However, the use of this medicinal plant in official medicine will require further research in the areas of pharmacology. Furthermore, it is necessary to create standard operating procedures for a crude herbal medication. In this regard, this review aims to highlight the key characteristics of the *Cyclamen* plant, such as its various parts, species, stages of development, and geographic range; pinpoint its intriguing bioactivities, its antioxidant, anti-inflammatory, and its anti-cancerous effects; and ascertain its potential medicinal uses and the main future perspectives.

Keywords: *Cyclamen*; characteristics; bioactivities; antioxidant; anti-inflammatory; anti-cancerous effects; therapeutic applications; future perspectives.

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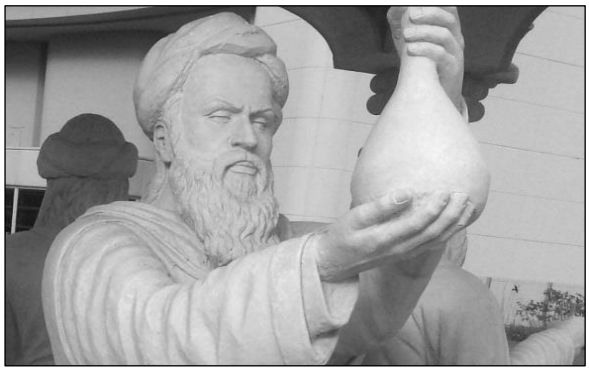
* *Link to the whole publication: https://www.mdpi.com/1424-8247/17/7/848*

ABU BAKR MUHAMMAD IBN ZAKARIYA RAZI

A LUMINARY OF ISLAMIC SCIENCE

Prepared by: International Relations Office of the Iran Academy of Sciences



Abu Bakr Muhammad Ibn Zakariya Razi, commonly known as Razi (865–925 CE), stands as one of the most eminent figures in the history of science and medicine, representing the golden age of Islamic scholarship. Born in the city of Ray, near modern-day Tehran, Razi was not only a physician but also a philosopher, chemist, and prolific writer. His contributions have left a lasting impact on medicine, alchemy, and philosophy. He is celebrated as one of the earliest proponents of experimental medicine and is regarded as a pioneer in hospital practice and clinical diagnostics.

Razi's educational background was diverse. Initially trained as a musician, he later turned towards the study of medicine and philosophy, eventually becoming a highly respected physician and teacher. His medical career flourished in Baghdad, where he served as chief physician at a major hospital. Razi's commitment to empirical observation and clinical practice was groundbreaking for his time; he advocated that medical practitioners should rely on firsthand observations and experiments rather than solely on ancient texts.

One of Razi's most significant contributions to medicine is his comprehensive medical encyclopedia, *Kitab al-Hawi* (*The Comprehensive Book of Medicine*). This work, spanning over 20 volumes, compiles medical knowledge from various sources, including his own observations and experiences. Razi's approach to medicine emphasized symptoms and differential diagnosis, a methodology that would not gain prominence in the Western medical tradition until centuries later. His insistence on careful observation and the recording of clinical data established a foundation for future generations of physicians.

In *Kitab al-Hawi*, Razi introduced an array of treatments and medicinal substances that were innovative for his time. He distinguished between different types of illnesses, discussing their causes and symptoms in detail. His work delved into numerous diseases, including smallpox and measles, distinguishing them based on clinical presentation-a method still relevant in contemporary discussions on infectious diseases.

Moreover, Razi played a crucial role in the development of pharmacology, authoring texts that systematically categorized and described various drugs. His work with elements such as sulfur and mercury laid early foundations for chemistry, linking it closely with medicine. Razi's contributions bridged the realms of science and art, blending empirical investigation with philosophical inquiry into human health and disease.

Razi was also an outspoken critic of prevailing medical theories, particularly those attributed to Galen, whose work dominated the field for centuries. He expressed skepticism toward the authority of ancient scholars, arguing that reliance on their theories without critical examination hindered scientific progress. This attitude exemplified Razi's commitment to

intellectual independence, encouraging future scholars to question established norms and pursue knowledge through observation and experimentation.

Beyond medicine, Razi made notable contributions to philosophy. He engaged with themes of ethics, metaphysics, and the natural sciences, displaying a profound understanding of various philosophical traditions. His work in astrology and alchemy reflects his holistic approach, seeking to understand the universe and humanity's place within it.

Despite his substantial contributions, Razi's legacy was somewhat obscured in history, particularly in the West, where the works of physicians like Avicenna (Ibn Sina) outshone those of Razi. However, contemporary scholars recognize Razi as a vital figure whose emphasis on empirical methods and rationality laid the groundwork for modern scientific inquiry. His commitment to questioning dogma and advocating for evidence-based practices resonates with the principles of contemporary science, making his work relevant even today.

In conclusion, Abu Bakr Muhammad Ibn Zakariya Razi embodies the spirit of inquiry that characterized the Islamic Golden Age. His innovations in chemistry, medicine, philosophy, and the natural sciences established him as a pivotal figure whose influence transcended his era and continues to inspire scholars and practitioners worldwide. As we highlight the contributions of Islamic thinkers, Razi's life and work remind us of the profound legacy of scholarship rooted in observation, critical thinking, and the pursuit of knowledge for humanity's betterment. According to Biruni, Razi passed away in Ray in 925 CE at the age of sixty. A statue of Razi is located at the United Nations Office in Vienna.

TWAS LAUNCHES PROF ATTA-UR-RAHMAN AWARD FOR CHEMISTRY

Italy has announced the World Award for Chemistry attributed to Prof Atta-ur-Rahman.

The World Academy of Sciences in Italy has established an annual award in the name of Prof. Atta-ur-Rahman for scientists under 40 years of age from developing countries. The award has been named the Atta-ur-Rahman Award in Chemistry and will continue to be awarded annually to the best scientist in developing countries.

So far, the award has been given to twelve brilliant scientists from Bangladesh, Cameroon, Egypt, Nepal, Sri Lanka and its worth is $5,000. It is currently considered the world's most prestigious award in chemistry for outstanding scientists.

Prof. Atta-ur-Rahman said in a special interview that Italy's World Award is a great honor for him and Pakistan and the award has been established by PWAS.

In recognition of his services to the development of science and technology, Malaysia's largest University of Technology (UIT) established an institute named Atta-ur-Rahman Institute of Natural Product Discovery in 2013. He is the first Muslim scientist to be included in the famous "Wall of Scientists" of the world. No other Pakistani has been inducted into the Wall of Scientists before. Swiss Federal Institute of Technology, one of Switzerland's top universities in the world, has announced the inclusion of Prof. Dr. Attaur Rahman of the International Center for Chemistry and Biological Sciences in the famous "Wall of Scientists."

Source: *https://www.thenews.com.pk/print/1232743-italy-launches-prof-atta-ur-rahman-award-for-chemistry*

PROF. SHAZIA ANJUM FIAS APPOINTED VICE CHANCELLOR OF GOVERNMENT SADIQ COLLEGE WOMEN UNIVERSITY

Government of Punjab has appointed Dean Faculty of Chemical and Biological Sciences at the Islamia University of Bahawalpur **Prof. Dr. Shazia Anjum** as Vice Chancellor Government Sadiq College Women University Bahawalpur in Pakistan.

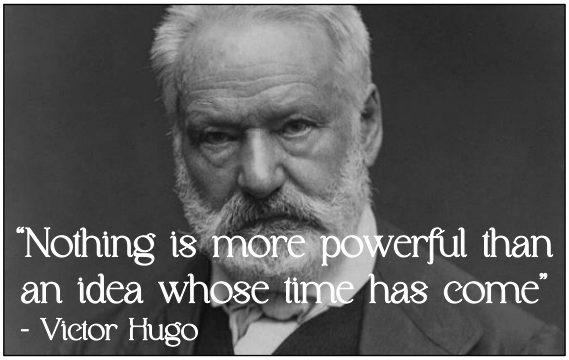
Prof. Dr. Shazia Anjum has been serving as a professor at the Islamia University of Bahawalpur for the past 11 years. She is nationally recognized as an expert teacher of medicinal and natural product chemists. She has authored over 140 research papers and co-authored over 13 books in addition to one US patent. She has supervised dozens of MS and PhD theses so far. She conceptualized and implemented Pakistan's first Inter-University Consortium on Climate Change, which includes more than eighty universities and institutions, overseeing the Cholistan Ancient Architecture Project as the Director of the Culture and Heritage Center.

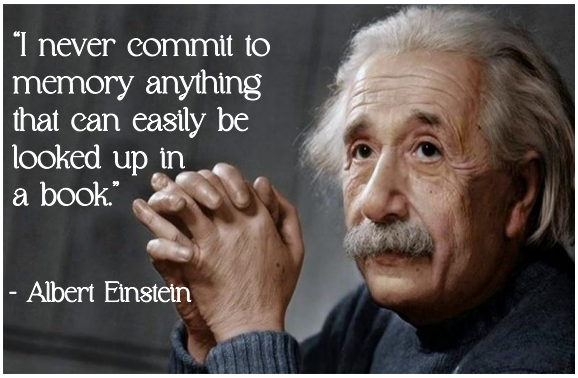
Prof. Dr. Shazia Anjum was awarded the 25 Women 2022 honor by the University of Michigan, USA. She has been a Fellow of the Islamic World Academy of Sciences since 2016. The Third World of Sciences Italy awarded her the Youngest Chemistry Award. The Government of Pakistan awarded her Aizaz Kamal, Presidential Award and Ms. Fatima Jinnah Medal.

Source: https://www.iub.edu.pk/another-honor-of-iub-prof-dr-shazia-anjum-became-vc-of-government-sadiq-college-women-university-bahawalpur

PROF. AMEENAH GURIB-FAKIM FIAS INDUCTED INTO "THE NEW AFRICAN LEADERS HALL OF FAME"

H. E. Prof. Ameenah Gurib Fakim, the 6th President of the Republic of Mauritius (2015 - 2018), has been included in the list of "The New African Leaders Hall of Fame" for the year 2024. The ceremony for 'The New Africa Global Economic Summit and Honours' was held in Livingstone, Zambia on 15th November 2024.





THE PRESIDENT OF PAKISTAN REAPPOINTS PROF. DR. M. IQBAL CHOUDHARY FIAS AS COORDINATOR GENERAL, COMSTECH

The President of Pakistan, Chairman COMSTECH, H. E. Asif Ali Zardari has reappointed Prof. Dr. M. Iqbal Choudhary for second term of four years as the Coordinator General of COMSTECH. Prof. Choudhary has been serving COMSTECH as Coordinator General since April 2020.

The appointment of Prof. Choudhary for second term has been welcomed by the diplomats of the OIC member states, vice chancellors, and concerned circles. Prof. Choudhary started a number of projects supporting the capacity building and socio-economic development of OIC member states during his first term.

COMSTECH is the only OIC institution chaired by Pakistan. COMSTECH is the Ministerial Standing Committee on Scientific and Technological Cooperation of the OIC (Organization of Islamic Cooperation) which was established by the Third Islamic Summit of OIC held at Makkah, Saudi Arabia in January 1981. COMSTECH is composed of all the member states of the organization represented by their ministers of science and technology or nominated representatives. The President of Pakistan is the chairman, Prime Minister of Pakistan is the co-chairman and the Coordinator General is the Chief Executive of COMSTECH.

Prof. Dr. M. Iqbal Choudhary is a distinguished national meritorious professor. He is among the most prominent scientists of Pakistan, recognized for his contributions in the fields of natural products and bioorganic chemistry. He has written and edited 94 books, most of which have been published in USA and Europe. He has published 1,443 research papers in the fields of organic and bioorganic chemistry in top international science journals. He has secured 65 US patents so far. Dr. Choudhary's work has been cited by the researchers from around the world by 44,351 times and his h-index is 87. By now over 100 national and international scholars have completed their PhD degrees under his supervision.

Dr. Choudhary is D.Sc., Ph.D., and C. Chem. He has been awarded by different governments of Pakistan with Hilal-e-Imtiaz, Sitara-e-Imtiaz, and Tamgha-e-Imtiaz. He has received Mustafa(pbuh) Prize (2021), ECO Award (2005), Khawarzimi Award (2006), COMSTECH Award (2011), TWAS Young Scientist Award (1994), and Prof. Abdus Salam Prize (1989). He is a fellow of world renowned science academies: Academy of Sciences for the Developing World, Islamic World academy of Sciences, Pakistan Academy of Sciences, Royal Society of Chemistry, and Chemical Society of Pakistan. He is also the Vice President of TWAS for South and Central Asia.

Recently, Hunan University of Medicine (HNUM), named a newly constructed research building after Prof. Dr. M. Iqbal Choudhary. Prof. Choudhary's contributions to various scientific endeavors, particularly his strategic role in establishing Sino-Pak research centers, have been instrumental in fostering collaborative projects between Chinese and Pakistani scientists.

Source: https://www.facebook.com/OIC.Comstech

HIGH INTERNATIONAL HONOUR FOR PROFESSOR SYED M. QAIM FIAS

Professor Dr. Dr. h. c. mult. Syed Muhammad Qaim of Forschungszentrum Jülich (FZJ) and University of Cologne, Germany, was recently elected a **Fellow of the International CORE Academy of Sciences and Humanities** with the Headquarters in Hong Kong. The citation reads: **"For outstanding contributions to chemical sciences and applied sciences, particularly to nuclear chemistry, and for commitment to advancing knowledge, research and sciences for the benefit of humanity".**


The International Core Academy of Sciences and Humanities
certifies that
Syed Muhammad Qaim
was duly elected a
Fellow
for outstanding contributions to chemical sciences and applied sciences, particularly to nuclear chemistry, and for commitment to advancing knowledge, research and sciences for the benefit of humanity
Class of 2024
Head of Membership
Executive Director, Academic Council

This singular honour thus recognizes not only the research contributions of Prof. Qaim but also his great services to the cause of science in the Third World.

Professor Qaim is a Fellow of the Islamic World Academy of Sciences, a Foreign Fellow of the Pakistan Academy of Sciences and a Fellow of the World Academy of Sciences (TWAS) from the North. Furthermore, he received various kinds of honours and awards in more than 10 countries of the world. He actively participates in the scientific affairs of IAS.

PROF. IQBAL CHOUDHARY AWARDED HONORARY PROFESSOR TITLE BY EURASIAN NATIONAL UNIVERSITY

Prof. Dr. M. Iqbal Choudhary, a renowned scientist and researcher, has been awarded the prestigious title of Honorary Professor by the Rector of L.N. Gumilyov Eurasian National University (ENU) in Astana, Kazakhstan. This recognition honours his significant contributions to research and training Kazakh students over the past three decades. During the award ceremony, Prof. Choudhary's impact on the scientific community was highlighted, underscoring his ongoing dedication to fostering academic collaboration.

Prof. Choudhary is also a distinguished recipient of the Doctor of Science degree from Al-Farabi Kazakh National University, further cementing his strong academic ties with Kazakhstan.

During his recent visit to ENU, Prof. Choudhary engaged in productive discussions with the Dean of the Faculty of Natural Sciences, along with the heads of the Departments of Chemistry, General Biology, Genomics, Biotechnology, and Microbiology. These meetings focused on advancing research collaborations between the university and international institutions.

Prof. Choudhary also delivered two highly impactful lectures on the discovery of new drugs, drawing on his extensive research in the areas of neglected diseases and neurodegenerative conditions. His lectures were well received by both faculty members and students, further enhancing the exchange of knowledge between ENU and global scientific communities.

Source: https://www.facebook.com/OIC.Comstech

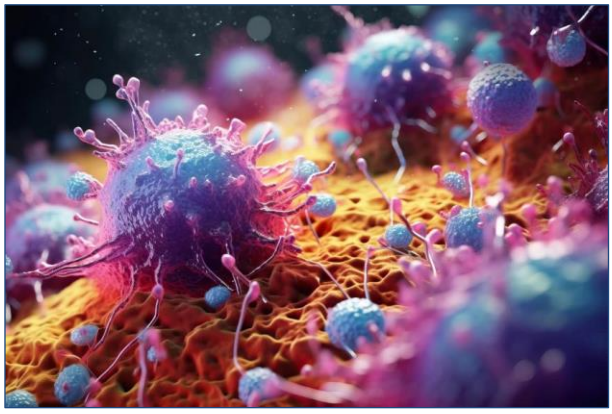
TOP INNOVATIONS FOR 2024 IDENTIFIED BY THE GLOBAL R&D COMMUNITY♦

This top innovations list for 2024 is unique. Firstly, it focuses on scientific innovation - technical advances and discoveries made by academic teams working in laboratories around the world. Second, they have been identified by industry R&D leads searching for their next academic partner - the most promising candidates being taken forward into R&D pipelines for validation and co-development. One day they could form part of a medicine that will save a life, or infrastructure helping take carbon out of the atmosphere.

WHAT ARE THE TOP SCIENTIFIC INNOVATIONS FOR 2024?

The top scientific innovations for 2024 come from academic teams around the world working on agriculture and food sustainability, biopharmaceutical research, healthcare and medical technologies, and innovations in chemistry, materials and energy. These topics were identified by the global R&D community to have significant potential for the future.

I. TOP BIOPHARMA INNOVATIONS



1. A NEW METHOD TO MORE QUICKLY DIAGNOSE PARKINSON'S DISEASE

Diagnosing Parkinson's disease can be difficult and wait-times for a definitive and clear diagnosisis often long and costly. This is primarily due to the requirement of using electronic imaging tools (PET, MRI, SPECT, etc.) and the assessment of clinical symptoms only. This presents an unmet need in medicine for a direct test that can substantially speed up diagnosis in combination with existing method.

Scientists at the **University of Galway** have developed a new diagnostic method for Parkinsons' disease, aiming to mitigate long wait times. The technology uses four blood-based protein biomarkers that can be detected in serum. Using these biomarkers in combination with existing strategies will allow diagnosis and subsequent treatment of Parkinsons' to be improved. The scientists have also detailed the potential for the biomarker panel to determine the extent of neurodegeneration and disease stage.

2. USING NON-CODING RNAS TO IDENTIFY NEW APPROACHES TO CANCER

Non-coding RNAs (IncRNA) are often overlooked in the search for new cancer drugs, as many are yet to be characterized. IncRNAs have regulatory functions, which in cancer cells are mutated or expressed differently, thus there is a pressing need to characterize them to reveal their true potential for cancer treatments.

Using this knowledge, a team of researchers working at **ETH Zurich** has found a novel IncRNA that activates an evolutionary conserved tumor suppression mechanism. Additionally, through laboratory experiments, they found that let-A RNA has included cell death in many human cancers, but not non-tumor cells. As such, this IncRNA can prove to be a promising candidate for cancer treatment, with less production cost than for proteins or polypeptides.

3. A NEW FIRST-IN-CLASS THERAPY FOR HEART FAILURE

Diastolic heart failure, also known as heart failure with preserved ejection fraction, is estimated to affect at least 85-million people worldwide.

♦ *Source: https://www.inpart.io/blog/24-top-innovations-for-2024*

Because of its complicated pathophysiology and a lack of effective therapies, this condition is associated with a lower quality of life, highlighting the unmet medical needs of those affected.

To reduce inflammation and cardiac fibrosis from heart failure, **Baker Institute** researchers have developed a soluble small molecule with potent anti-inflammatory and anti-fibrotic action at low doses. In preclinical mouse models of heart failure, the compound demonstrated the ability to enhance cardiac function and reduce inflammation and fibrosis compared with the current standard care of treatment. This suggests promise for a new and effective treatment for diastolic heart failure patients.

4. A NEW CAR-T THERAPY TARGET HALTING TUMOR METASTASIS

There are around 55,900 new cases of breast cancer in the UK every year, the fourth most common cause of cancer death in the UK. The majority of breast cancer deaths are due to metastatic evolution of the disease. Novel clinical targets can be identified by characterizing interactions between the tumor cell and tumor microenvironment that contribute to metastasis.

Scientists at the **Institute of Cancer Research** have identified endosialin as a target. Endosialin is a transmembrane receptor with limited expression in healthy tissues but strongly promotes spontaneous metastasis of tumors. The researchers tested endosialin-directed CAR-T cells in a breast cancer mouse model, resulting in significant growth inhibition and necrosis of the primary tumor, without affecting normal tissue. This shows promise that endosialin CAR-T therapy could be a viable option to treat not only breast cancer but also other solid tumors and metastatic cancers.

5. A HUMANIZED ANTIBODY STOPPING FIBROTIC DISEASE IN ITS TRACKS

Collagen is the most abundant protein in the human body. It combines with minerals to form our bones and teeth, gives strength and elasticity to our tendons, and is also a major component of our corneas, blood vessels, gut, and skin. However, when collagen production goes wrong, tough fibrotic scar tissue is formed that if left unchecked can quickly lead to organ failure.

Although fibrotic diseases are highly progressive and can occur throughout the body, no fully effective intervention exists to treat them. To meet this clinical need, researchers at **Thomas Jefferson University** have developed a patented humanized collagen-specific antibody that binds to collagen molecules, preventing their aggregation into insoluble fibers, and thereby blocking pathological fibrosis. Extensive testing by the researchers has shown effective treatment of fibrotic disease in model systems without alteration of healthy structural collagen. The team at Thomas Jefferson University are now looking for licensing partners help take this next-generation antibody treatment into the clinic.

6. A NOVEL COMBINATION THERAPY IMPROVING THE PROSPECTS FROM PROSTATE CANCER

of cancer deaths worldwide, with 1.3 million new cases each year and 360,000 associated deaths. Advancement to castrate-resistant prostate cancer (CRPC) is seen in 50% of these patients as they become resistant to androgen deprivation therapy and eventually succumb to the illness.

To combat this, a team of academics at **Stony Brook University** have pioneered a therapeutic platform that elicits a long-term adaptive immune response to CRPC. This therapy facilitates the generation of tumor-specific cytotoxic T-cells that kill cancer cells expressing tumor-associated antigens, preventing a major resistance pathway for prostate cancer. This combination of cytotoxic and immunostimulant treatments provides enhanced clinical outcomes, and is likely to save non-responding patients, potentially resulting in long-term remission and immunity to prostate cancer.

7. OVERCOMING LIMITATIONS IN GENE EDITING TO IMPROVE THERAPIES AND DIAGNOSTICS

Targeted genome modification is a powerful therapeutic tool for human genetic diseases, but current methods using CRISPR face limitations. HyEdit, a breakthrough technology developed by researchers at the **European Molecular Biology Laboratory**, aims to address these challenges. Their artificial system utilizes RNA-guided nucleases for more precise genome editing in therapeutic and diagnostic applications.

The European Molecular Biology Laboratory overcomes limitations in genome editing by being fully independent of sequence motifs and having high specificity even for highly repetitive genomic regions. The protein component the technology allows for adenovirus packaging and localization into organelles, enabling mitochondrial or chloroplast DNA editing. Available for out-licensing and co-development, HyEdit presents a novel opportunity in the advancement of genome editing.

II. Top Agriculture and Food Sustainability innovations

1. A dual-solution biobased packaging with embedded antibacterials

Natural biopolymer development and application are critical for reducing the environmental impact of plastics. However, significant progress is needed, particularly in the food packaging sector, to decouple a reliance on fossil-fuel derived plastics. What's more, to feed growing global populations, developments are needed to preserve the freshness and nutrient-value of food.

With these goals in mind, researchers based at **Ca' Foscari University of Venice** have developed an active and intelligent bio-based packaging - the world's first active material containing an antibacterial compound that is irreversibly anchored to the packaging itself. By reducing bacterial growth and extending product shelf life without introducing any additives into the food, this technology improves both the sustainability and safety of food and packaging.

2. Making crops more sensitive to their own growth factors

As the human population grows so does our need for crop productivity. With limited space for farming and fresh pressures arising from climate change, increasing crop yield is more important than ever. In recent history, this has been addressed by the application of chemical fertilizers. However this can cause non-specific promotion of plant growth and significant pollution as fertilizers leach from fields into the environment.

To tackle this global challenge, **University of Durham** scientists have developed a series of easy-to-manufacture compounds that promote plant growth by increasing sensitivity to their own naturally occurring growth hormones. Their small molecule growth promoters can be added to crops in the field or as a seed treatment, boosting both root and shoot development. Application of this technology has been demonstrated for both monocot and dicot plants and represents a vital step towards a future of more sustainable agriculture.

3. Identifying harmful microbes wherever they hide

Harmful microbes can be found in water, food, plants, the environment, and can be transmitted through human-to-human contact. Access to rapid and low-cost microbe detection technology is crucial to protecting the health and wellbeing of humans and animals.

With this in mind, researchers at **Michigan State University** have been working with novel magnetic nanoparticles capable of rapidly extracting pathogens from different substances. The nanoparticles bind with microbes, forming complexes that can be selectively separated and identified, providing an inexpensive, fast, and simple method to detect bacteria across multiple domains.

4. Treating complex mixed-infection threats to crops

Due to the complex and varying morphology of different pathogenic fungi and bacteria that affect a number of vital crops, it is becoming increasingly difficult to implement effective and safe disease control measures. Most control measures are unspecific, due to the absence of knowledge around effective molecular targets,

leading to increased resistance from pathogenic microbes. This resistance is a threat to global crop supplies, and if left unchallenged can cause long term food chain issues.

Scientists at the **Max Planck Society for the Advancement of Science** have developed a new treatment approach to mitigate this resistance with unique compounds demonstrated to directly inhibit the aggregation of amyloid-like proteins within these disease-causing structures. Their research has shown that the compounds expel significant effects on the growth and spread of disease and negating the onset of resistance through specific methods of action.

5. Scaling up production of a bio-based sweetener to reduce obesity rates

Sweeteners are often used as a way to reduce calories and lower obesity. Although they aren't favorable with consumers, being reported as having an unpleasant taste or the perception of being addictive. Brazzein, a natural protein found in the fruit of the Oubli shrub, has been used as a sweetener in West Africa for hundreds of years. Its sweet taste, high heat-resistance and stability makes it suitable for the food industry, however the production of this protein has not yet been economically viable.

Researchers at the **University of Oulu** have developed and patented a technology to purify Brazzein on a large scale. Their method is facile, cheap, scalable and only uses chemicals which can be found in a well-stocked kitchen. This provides a zero-calorie sweetener that tastes like sugar, whilst also reducing production costs for the food and beverage industry.

III. Healthcare and medical technology innovations

1. A route to deliver insulin orally that could revolutionize diabetes treatment

Diabetes affects around 10% of the global population and ranks as the 7th leading cause of death. The standard treatment, insulin therapy, faces challenges in patient adherence due to inconvenient subcutaneous injections. To combat this, academics at **New York University** have developed novel organic nanoparticles to allow insulin to be delivered orally.

The nanoparticles exhibit high insulin-loading capacities, resistance to acidic conditions, and the ability to traverse the intestinal barrier without inducing toxicity. The NYU innovation presents an opportunity to revolutionize diabetes care, offering a more convenient and non-invasive method. With applicability to both Type 1 and Type 2 diabetes, the researchers are seeking a strategic partner to help advance the oral insulin technology into the clinic and improve diabetes treatment.

2. Stabilizing the delivery of nucleic acid therapeutics

Nucleic acid therapeutics have shown promise in the treatment of genetic disorders, infectious disease, and cancer. Their delivery, however, poses a challenge because nucleic acids are highly charged and easily degrade. Therefore, they require a delivery system that can improve stability, facilitate uptake, and increase target affinity.

Polymeric nanoparticles have become a focus as a nucleic acid delivery tool due to their relative stability, propensity for functionalization, and tunability. Building on this knowledge, **University of Victoria** scientists have developed a polymeric nanoparticle with a hydrophobic core to enable the stable encapsulation and controlled release of nucleic acids. Applications include gene therapy, vaccine delivery and other drug delivery.

3. Enabling self-administration of glaucoma therapeutics

Glaucoma is a serious eye condition that leads to blindness and affects millions of people worldwide. Existing treatments for glaucoma either require experienced practitioners to give the drug or the administration of self-treatments that are difficult for patients.

A team of scientists working at the **Georgia Institute of Technology** have developed a new device that can deliver therapeutic agents for glaucoma to the subconjunctival space of the eye. Their single-button device revolutionizes the administration of glaucoma therapeutics. Its user-friendly design, requiring only one hand to operate, makes it safer and easier for individuals with glaucoma to self-administer the drug as well as maintain compliance with their prescription.

4. The next step in wearable healthcare diagnostics

In the ever-advancing landscape of healthcare, wearable technologies have emerged as powerful tools to enhance patient outcomes and reduce costs. Researchers at the **University of Hawai'I** are contributing to this landscape with their novel 'sweat sticker' technology. Leveraging stereolithography-based 3D printing, the researchers' flexible, stretchable devices offer real-time, non-invasive analysis of sweat and allowing personalized health assessments. The streamlined prototyping process enables rapid fabrication, ensuring user-friendly, mobile-accessible devices.

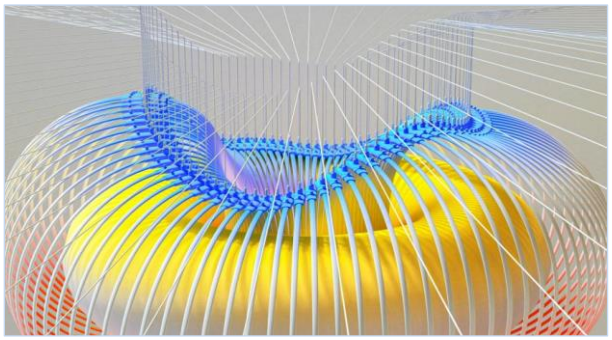
This approach addresses the need for multiple sample collections in a single setting, presenting a cost-effective solution with vast applications in wearable technologies and healthcare diagnostics. The technology has potential to greatly improve personalized health assessments, marking a significant stride toward accessible and efficient healthcare solutions.

5. Moving past injections to improve vaccine delivery

Current vaccine platforms have mixed success at preventing new emerging infectious diseases and present several limitations. With these in mind, researchers at **St George's, University of London** have developed a novel protein-only based vaccine that is delivered via a respiratory route and generates mucosal immunity against COVID-19 and other diseases.

This technology provides many important benefits over injectable vaccinations. Its needle-free delivery allows for easy administration and in the absence of a trained professional, it can be self-administered. Furthermore, this simple, protein-only vaccine is producible in all conventional cell lines, ensuring affordability and safety for human application.

IV. Chemistry, materials, and energy innovations



1. Driving sustainable change through EV lithium battery recycling

New solutions also create new challenges. The rise of electric vehicles has created a need to effectively recycling lithium-ion batteries. To address this, researchers at the **University of Birmingham** have developed a novel technology to separate battery components in an efficient process using low-cost, non-toxic chemicals and water.

The method is highly versatile, rapid, and can be applied to various cathodes, significantly reducing recycling waste, presenting an opportunity to streamline the battery recycling process with increased safety, environmental friendliness and efficiency.

2. A non-toxic, low-cost heat reflective coating for buildings and surfaces

Heat reflective coatings are important for global energy management, but they're often made of toxic and costly materials. To address this, researchers at the **University of California**, Irvine have developed an innovative energy-efficient coating derived from a naturally occurring, inexpensive biomolecule. Their technology can be produced at a very low cost in large quantities and is fully biocompatible, reducing total life cycle costs across production, installation, and removal/replacement stages.

The novel coating is effective for reducing energy expenditures for consumers and corporations. The UCI researcher's achievement opens doors for improved energy efficiency, offering a cost-effective, biocompatible alternative for surfaces like windows, sports gear, clothing, and camping equipment.

3. SUPERCHARGING ELECTRIC VEHICLE BATTERIES WITH SOLID-STATE CATHODES

The rapid growth of the electric vehicle market requires the development of lithium-ion batteries with higher energy and power densities, better safety, and longer lifespan. Solid-state batteries employing an inorganic solid-state electrolyte have been promoted as a breakthrough technology but development is still in an early stage.

Researchers working at **Lawrence Berkeley National Laboratory** have tackled this issue, developing solid-state cathodes for safe solid-state batteries with high energy/power densities and long lifecycles. Featuring halide solid electrolytes and single-crystal cathode active materials, their design reduces capacity loss, ensuring better cycling stability and improved safety compared to current lithium-ion batteries. The technology, at a proven principle stage, holds promise for scalable fabrication processes, making it a game-changer for energy storage in electric vehicles.

4. UPCYCLING HIGH-VOLUME PLASTIC WASTE ON THE ROAD TO A CIRCULAR ECONOMY

The three synthetic polymers produced on the largest scale are polyethylene (PE), polypropylene (PP), and polyvinyl chloride (PVC). Tens of millions of tons of each is produced annually, and recycling or reusing these materials is a critical step in our transition to a sustainable circular economy. Unfortunately, mechanical and chemical PVC recycling is commercially challenging due to the resource-intensive grinding, washing and melting steps required, and the production of harmful chlorinated byproducts.

Oregan State University researchers have developed a low temperature chemical upcycling process that can transform PVC waste into high-density PE for manufacturing, and PE waxes for the adhesives market. Their method strips the chlorine from PVC, trapping dangerous chlorinated compounds as salts, transforming this problematic polymer into a valuable replacement for virgin PE. Early-stage results have been validated and the inventors seek development partners to take their technology to market.

5. CORNCRETE - AN ALTERNATIVE AND MORE SUSTAINABLE SOURCE OF CEMENTS

Cement production is energy and carbon-intensive, contributing to approximately 7% of global industrial energy consumption and 6-8% of global greenhouse gas emissions. It is made from finely ground materials such as fly ash (a byproduct of coal mining), slag, and silica fume. And as coal use declines so too do the inputs to traditional concrete supply. Substituting the cement in concrete with more abundant cementitious materials can be a potential solution to meet our global sustainability goals.

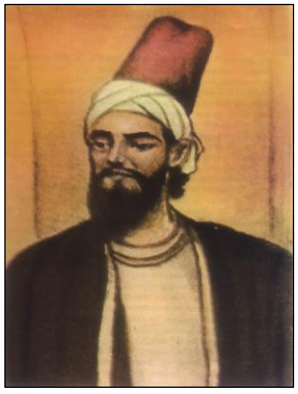
To do this, researchers at **Colorado State University** have looked to corn biomass to create a supplementary cementitious material. In addition to increased sustainability, the blocks produced have improved mechanical and durability properties, and increased resistance to cracking and tensile stress.

6. DERIVING HIGH-VALUE CHEMICALS FROM BIOLOGICAL SOURCES

As we work towards a circular economy, the demand for bio-based and derived chemicals to replace traditional petrochemicals increases. One key player in the transition Is 5-hydroxymethylfurfural (5-HMF), which can be derived from sugars and carbohydrates and transformed into a variety of high-value green chemical products. However, large-scale, cost-effective production of 5-HMF remains an industrial challenge.

Researchers at **Western University** have pioneered a breakthrough continuous-flow biphasic reactor process to produce 5-HMF cost-effectively. Their new green approach, utilizing aqueous media and innovative catalysts, not only enhances yield and selectivity but also achieves scalability. Their technology has the potential to revolutionize green biofuel production and advance the development of bio-based polymers, contributing significantly to the global shift toward sustainable chemical manufacturing.

OMAR AL-KHAYYAM* (1044-1123 AD)



Ghayath al-Din Abul Fateh Omar Ibn Ibrahim al-Khayyam was born at Nishapur, the provincial capital of Khurasan around 1044 AD (c. 1038 to 1048). A Persian mathematician, astronomer, philosopher, physician and poet, he is commonly known as Omar Khayyam- Khayyam means the tent-maker. Although generally considered as Persian, it has also been suggested that he could have belonged to the Khayyami tribe of Arab origin who might have settled in Persia. Little is known about his early life, except for the fact that he was educated at Nishapur and lived there and at Samarqand for most of his life. He was a contemporary of Nizam al-Mulk Tusi. Contrary to the available opportunities, he did not like to be employed at the King's court and led a calm life devoted to search for knowledge. He travelled to the great centres of learning, Samarqand, Bukhara, Balkh and Isfahan in order to study further and exchange views with the scholars there. While at Samarqand, he was patronised by a dignitary, Abu Tahir. He died at Nishapur in 1123-24.

Algebra would seem to rank first among the fields to which he contributed. He made an attempt to classify most algebraic equation, including the third degree equations and, in fact, offered solution for a number of them. This includes geometric solutions of cubic equation and partial geometric solutions of most other equations. His book *Maqalat fi al-Jabr wa al-Muqabila* is a master-piece on algebra and had great importance in the development of algebra. His remarkable classification of equations is based on the complexity of the equations, as the higher the degree of an equation, the more terms, or combinations of terms, it will contain. Thus, Khayyam recognized 13 different forms of cubic equation. His method of solving equations is largely geometrical and depends upon an ingenious selection of proper conics. He also developed the binomial expansion when the exponent is a positive integer. In fact, he has been considered to be the first to find the binomial theorem and determine binomial coefficients. In geometry, he studied generalities of Euclid and contributed to the theory of parallel lines.

The Saljuq Sultan, Malik-shah Jalal al-Din, called him to the new observatory at Ray around 1074 and assigned him the task of determining a correct solar calendar. This had become necessary in view of the revenue collections and other administrative matters that were to be performed at different times of the year. Khayyam introduced a calendar that was remarkably accurate, and was named as Al-Tarikhal-Jalali. It had an error of one day in 3770 years and was thus even superior to the Georgian calendar (error of 1 day in 3330 years).

His contributions to other fields of science include a study of generalities of Euclid, development of methods for the accurate determination of specific gravity, etc. In metaphysics, he wrote three books Risala, Dar Wujud and the recently discovered *Nauruznamah*. He was also a renowned astronomer and physician.

Apart from being a scientist, Khayyam was also a well-known poet. In this capacity, he has become more popularly known in the Western world since 1839, when Edward Fitzgerald published an English translation of his *Rubaiyat* (quatrains). This has since become one of the most popular classics of the world literature. It should be appreciated that it is practically impossible to exactly translate any literary work into another language, let alone poetry, especially when it involves mystical and philosophical messages of deep complexity. Despite this, the popularity of the translation of Rubaiyat would indicate the worth of his rich thought.

Khayyam wrote a large number of books and monographs in the above areas. Out of these, ten books and thirty monographs have been identified. Of these, four concern mathematics, three physics, three metaphysics, one algebra and one geometry.

His influence on the development of mathematics in general and analytical geometry, in particular, has been immense. His work remained ahead of others for centuries until the times of Descartes, who applied the same geometrical approach in solving cubics. His frame as a mathematician has been partially eclipsed by his popularity as a poet. Nonetheless, his contribution as a philosopher and scientist has been of significant value in furthering the frontiers of human knowledge.

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EDITORIAL BOARD

PO Box 830036 Zahran
Amman 11183 Jordan

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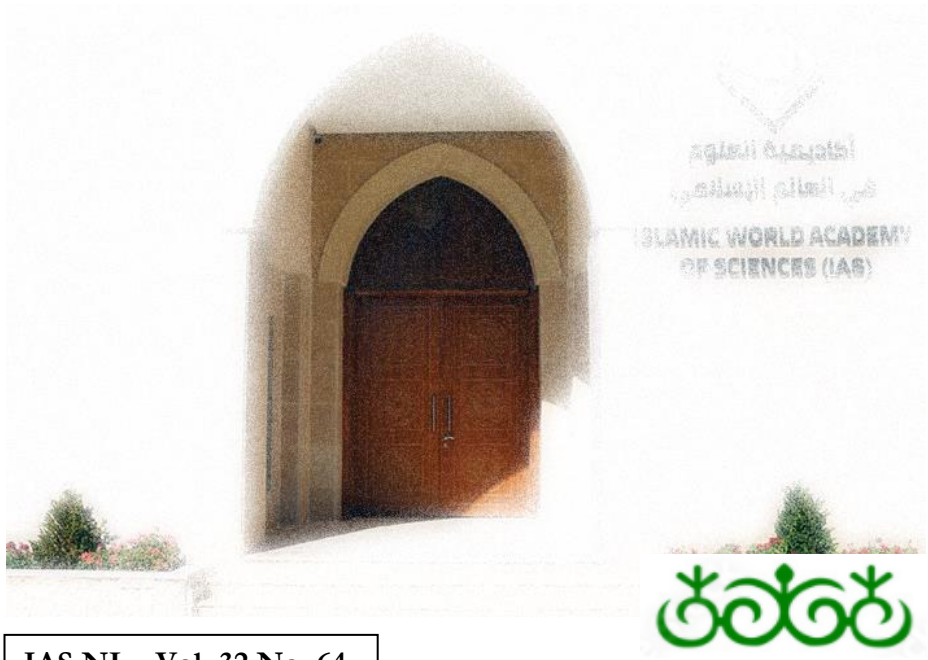

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